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GUIDE SPECIFICATIONS
FOR MAINTENANCE
MANAGEMENT SYSTEMS
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<td>MAINTENANCE MANAGEMENT SYSTEM AND THE RECOMMENDED METHOD TO BEST ACCOMPLISH</td>
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<td>UTILIZING SEPARATE COMPUTERS FOR THE PRIMARY WORK.</td>
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REPORT FOR
PREPARATION OF CORPS OF ENGINEERS
GUIDE SPECIFICATION
CEGS 13880
FOR
MAINTENANCE MANAGEMENT SYSTEMS
CONTRACT NO. DACA87-84-C-0012

Prepared For
U.S. Army Engineer Division, Huntsville
P.O. Box 1600
Huntsville, Alabama 35807

By
Verle A. Williams & Associates, Inc.
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7047 Carroll Road, Suite 100
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October 24, 1984
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operating personnel become more familiar with the overall capabilities and benefits of the system; and (3) keep the two systems' main processors and terminals separate, except for the "hook" desired to retrieve certain status information from the EMCS.

The effectiveness and usefulness of the MMS is directly related to the willingness of the system designer, supplier, installer and commissioner to work closely with the facilities operating personnel to integrate the MMS into the facility's operations program. The users must be involved throughout the program for it to quickly attain its maximum benefit.

Keywords: Army Corps of Engineers Standards.
I. AUTHORIZATION

This report has been prepared under authorization from the U.S. Army Corps of Engineers, Contract #DACA87-84-C-0012, issued by the Huntsville Division.

II. SCOPE OF WORK

The work to be performed consists of developing a new Corps of Engineers Guide Specification (CEGS) 13880 for MMS. The work to be performed consists of developing and writing CEGS 13880 to comply with currently available materials, equipment and installation procedures. The CEGS shall describe the materials, equipment, installation, adjustment, documentation and acceptance testing required to provide a complete and operable MMS. The CEGS will be used by design engineers in preparing project specifications for projects for the Army, Air Force and other Federal agency projects for which the Corps of Engineers is, or may be designated as, the design and/or construction agency. (See Appendix H for suggested specification outline.)

The first document of this task is a report, which includes the consultant's recommendations for inclusions in the MMS and the recommended method to best accomplish these within the projects for which the CEGS is being developed. Since the CEGS' contents will result from items included in the report, this report is to be approved by the Huntsville Division prior to developing the CEGS.

Note: This report also includes an analysis of utilizing separate computers for the primary work required for the MMS and the EMCS.
III. ACKNOWLEDGEMENTS

The preparer wishes to acknowledge many individuals for their input and/or assistance in the preparation of this report. (Listed alphabetically):

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In addition to the above personnel, many other individuals contributed by miscellaneous conversations and meetings on the subject.
IV. REQUIREMENTS OF AN EFFECTIVE MAINTENANCE MANAGEMENT SYSTEM

A. GENERAL

An effective MMS will incorporate certain items required by the supervisory and operating personnel.

In addition to maximizing the efficiency of the mechanics by providing reminders and work aids, the system should greatly reduce the clerical, bookkeeping and coordinating efforts previously performed manually by staff personnel. Some examples of these automated efficiency improvements are provided in the Appendix:

1. Sample Preventive Maintenance Task; See Appendix A.
2. Sample Tool Kits Required; See Appendix B.
3. Sample Preventive Maintenance Material Kits; See Appendix C.
4. Sample Belt and Filter Requirements and Location; See Appendix D.

B. REQUIREMENTS FOR AN EFFECTIVE MMS

An effective MMS must have the following features items to be totally effective:

1. **Maintenance Order Printout.** When setting up the system, the maintenance orders can be designated for printing during a "low traffic" time to permit the operator to organize them for distribution to the designated personnel with minimum lost time by the workers and supervisors. Printing should be able to be automatically initiated by the system or manually initiated by operator request.
2. **Flexibility of Input/Output Data Entry and Output Instructions.**
   There is a constant requirement to change the data base. The basic internal methods may be "system specific" (by the manufacturer); however, the manner of handling and displaying the data should be "site specific" and operator changeable through the keyboard.

3. **Password-Controlled Access to Critical Information and Scheduling.**
   To prevent unauthorized revisions to cost control data, including actual hours vs planned hours, and other critical data, access to these areas should be limited to personnel authorized to be in that specific area of the system. A minimum of two-level access should be incorporated.

4. **Graphic Printer.** To efficiently and effectively process the maintenance order, both the form and the data should be printed at the same time. This requires a graphic printer with print speed of at least 120 characters per second.

5. **Interconnection to EMCS.** Interconnection to the EMCS to permit automatic transfer of data regarding equipment run time, or event initiated signals (filter differential pressure alarm, water-low level alarm, etc.) that provide indication of the need for preventive maintenance should be included.

6. **Separate Work Scheduling.** Separate scheduling for daily, weekly, quarterly, semi-annual, and annual preventive maintenance requirements permits the preventive maintenance personnel to establish priorities of work from shortest to longest period, (to increase personnel effectiveness). (If an emergency arises, requiring work to be delayed, the annual maintenance order printout can be delayed with less immediate impact than the daily or weekly maintenance order printout.)
The system should automatically segregate maintenance order printouts by building and/or area to minimize inter- and intrabuilding travel time. This separation should be assignable using the MMS keyboard.

C. REPORTS

1. **Maintenance Order.** The most important report of the MMS is the maintenance order, which identifies the maintenance work to be done on a specific item by a designated work crew or skill level. The following items are considered mandatory for a maintenance order. (See Appendix F):

   a. **General:**

      - Facility Number [from existing Integrated Facilities System (IFS)]
      - Area and Building Number
      - Maintenance Order Number
      - Date Generated
      - Date Response Required (Reminder to be generated if no response by this date)
      - Level of Maintenance Required (Daily, Weekly, Monthly, Quarterly, Semi-annually, Annually, Elapsed Time, etc.)
      - Special Instructions (Clearance required to enter the building, special key, escort, etc.)

   b. **Equipment Section:**

      - Description of Equipment
      - Location of Equipment
      - Manufacturer of Equipment
      - Model and Serial Number of Equipment
      - Identification Number, Unique for Each (from IFS)
- Property Control Number, Unique for Each (from IFS)
- Technical Description of Equipment & Reference Manual Number
- Work Requirements Summary, or Reference Manual Containing this Information
- Associated Work, if any, that should be accomplished simultaneously, listed by skill-level code
- Area Served (Computer room, critical, non-critical, base commander, etc.).

c. Work Assignment Section:

- Task Code (from IFS)
- Description of Work (Optional at User's Request)
- Priority of Performance
- Shop to which work is assigned
- Craft (Issue separate maintenance order printout for each craft)
- Related Craft Work? (Yes/No, and if yes, what?)
- Special Skill/Worker Requirements (Electronic Control Expert, 2 workers, etc.)
- Tool Requirements, other than standard hand tools
- Replacement Parts Required
- Special Instructions (Call Ext. 3343 before securing unit, etc.)

d. Response Section:

- Estimated Time to Complete
- Date of Response
- Complete/Incomplete
- Worker's Name/Signature
- Time Required, Worker & Supervisor Separate Work Time and Down Time (in transit, etc.)
- Parts Used (Part No., description & quantity)
2. **Management Reports.** The following reports are to be used by management and supervisory personnel in managing the facility and budgeting future expenditures. (See Appendix E.1-1 through E.5-1.)

   a. **Maintenance Order Summary Report (See Appendix E.1-1):**
      List numerically by outstanding maintenance order number or by date maintenance order was initially issued, at option of operator requesting report. Include maintenance order number, date issued, date response is required, craft and skill level, equipment description, level of preventive maintenance scheduled and estimated performance time. The summary total should indicate total hours of work in progress, listed by trade. Report may be prescheduled to print automatically, at specific calendar dates, etc., or may be manually requested by operator.

   b. **Deferred Maintenance Report (See Appendix E.2-1):**
      A report of all maintenance orders issued but not completed by the required response date. List numerically by outstanding maintenance order number or by date maintenance order was initially issued, at option of operator requesting report. Include maintenance order number, date issued, date response is required, craft and skill level, equipment description, level of preventive maintenance scheduled and estimated performance time. The summary total should indicate total hours of work in progress, listed by trade. Report may be prescheduled to print automatically, at specific calendar dates, etc., or may be manually requested by operator.
c. **Maintenance In-Progress Report (See Appendix E.3-1):**

A report of all maintenance orders issued less the ones included in the Deferred Maintenance Report. List numerically by maintenance order number or by name maintenance order was initially issued, at option of requesting report. Include maintenance order number, date issued, date response is required, craft and skill level, equipment description, level of preventive maintenance scheduled and estimated performance time. The report indicates total hours of maintenance in progress, which is the total scheduled less the total deferred.

d. **Completed Maintenance Report (See Appendix E.4-1):**

List numerically by maintenance order number. Include maintenance order number, date issued, date response required, date completed, craft and skill level, equipment description, level of preventive maintenance scheduled, estimated hours and actual hours. The report indicates total actual and estimated hours of maintenance completed during the requested report period, which is operator defined by month, quarter or year. The summary of total hours to date will be printed at the bottom of this report indicating total actual hours for month-to-date, quarter-to-date, and year-to-date and total estimated hours for month-to-date, quarter-to-date, and year-to-date.

e. **Actual versus Projected Preventive Maintenance Report (See Appendix E.5-1):**

Report of total time for all preventive maintenance as projected and as actually consumed, listed by month, quarter, and year to date.
V. SYSTEM AVAILABILITY

Many MMSs are available today. Very few are available from companies associated with EMCS in general and even fewer from those who are associated with the CEGS-EMCS projects.

A. EMCS RELATED COMPANIES

Of the companies interviewed, one had a single CPU totally integrated EMCS/MMS; one had a stand-alone interactive, dual CPU EMCS/MMS; and three had totally stand-alone MMS, with no automatic data link with the EMCS host computer. The fully integrated systems are considered limited in the capacity of MMS data management capability when comparing to the needs of military bases throughout the country.

B. NON-EMCS RELATED COMPANIES

There are many companies marketing totally stand-alone MMSs. These systems range in size from a small microprocessor to a full-sized computer network, with the capacity and capability ranging accordingly.

C. CONCLUSION

No system identified to date meets all the requirements of the system outlined herein as recommended for use in DOD projects.

VI. TRENDS IN MAINTENANCE MANAGEMENT SYSTEMS

More development will occur in the field of fully automated MMSs. Each interviewee indicated many items not yet addressed that should be included in an effective and dependable MMS. Larger system capacities are being implemented as computer hardware/software systems expand.
It appears that the MMS field is in the same relative position, i.e., technique and capability, as the computerized EMCS field was approximately 10 years ago. In terms of integrating the MMS and the EMCS, it is believed that the MMS can move ahead with much greater speed, reliability and useability due to the efforts and education in the EMCS "evolution". The MMS issue is much less complex; therefore, there should be no excessive challenge to the contracting and using personnel.

VII. RECOMMENDATIONS

GENERAL

It is recommended that the MMS be configured and function as follows:

The MMS should be a micro-computer system configured for interactive, stand-alone operation, obtaining event-initiated data and equipment run-time data from the EMCS Central Control Unit (CCU):

- This will permit the MMS to perform all functions and provide greater flexibility within the MMS without impacting the EMCS operation. Operator interaction with the MMS will not interrupt any of the EMCS functions.

- This will enable the Government to purchase a stand-alone MMS by competitive bids, as part of a large construction project, with carefully defined interfaces. Many existing EMCS suppliers have not yet developed the first version of MMS; therefore, the cost of integrating the MMS software into the existing EMCS software will expose the purchaser (Government) to a major expense. The MMS suppliers will offer a more complete, more trouble-free system, configured as described, than will result from extending existing EMCS software, which is marginal in many cases, to include all desired MMS features.
The hardware and software interface requirement will be defined as part of the MMS CEGS and will be available to any EMCS manufacturer as a requirement for future interface to the MMS.
APPENDICES

A. Sample Preventive Maintenance Tasks

B. Sample Tool Kits

C. Sample Preventive Maintenance Materials

D. Sample Belt and Filter Requirements and Location

E. Suggested Maintenance Reports
   1. Maintenance Order Summary
   2. Deferred Maintenance Report
   3. Maintenance-in-Progress Report
   4. Completed Maintenance Report
   5. Preventive Maintenance Report

F. Suggested Maintenance Order

G. Sample Work Schedule Report

H. Suggested Specification Outline
APPENDIX A. SAMPLE PREVENTIVE MAINTENANCE TASKS  
(Courtesy Ft. Eustis)

CHILLERS (WATER COOLED):

Bi-Monthly Preventive Maintenance (2000 hrs. run time)

A. Compressor
   1. Check voltage and amperage on each phase.
   2. Check suction, discharge and oil pressure.
   3. Check oil and refrigeration level.
   4. Check crankcase heater.
   5. Check compressor pump cycle.

B. Evaporator
   1. Check evaporator chilled water pressure drop and temperature.
   2. Check evaporator low temperature control.
   3. Check evaporator liquid line solenoid valve.

C. Controls
   1. Check sequencer.
   2. Check pump out and anti-cycling timer.

Annual Preventive Maintenance

A. Compressor
   1. Perform continuity test.
   2. Perform ground test (Megohms).
   3. Check electrical connections.
   4. Check starter and overloads.
   5. Calibrate thermometer.
   6. Perform refrigeration leak test.

B. Electrical Interlocks and Controls
   1. Check condenser and chilled water pumps interlocks.
   2. Check flow switches.
   3. Check high pressure cut-in and cut-off pressures.
   4. Check oil pressure cut-in and cut-out pressures.
   5. Check transition timer.

COOLING TOWERS:

Annual Preventive Maintenance

1. Disassemble float valve, clean and reassemble.
2. Drain sump, pans, pumps, pipe lines and flus.
3. Flush interior and tower and check for corrosion.
Appendix A (continued):

4. Inspect fans and motors and repair as necessary.
5. Adjust fan belts.
6. Inspect pump packing.
7. Inspect pump bearings, impeller and casing.
8. Lube motor and pump bearings.
9. Cover system openings.
10. Paint metal welded parts with alkali resistance paint.

CHILLERS (AIR COOLED):

Bi-Monthly Preventive Maintenance (2000 hrs. run time)

A. Compressor
   1. Check voltage and amperage on each phase.
   2. Check suction, discharge and oil pressure.
   3. Check oil and refrigeration level.
   4. Check crankcase heater.
   5. Check pump-down cycle.
   6. Check unusual noise and vibration.

B. Condenser
   1. Check condenser ambient temperature.
   2. Check amperage on motors.
   3. Tighten fan set screws.

C. Evaporators
   1. Check chilled water pressure drop and temperature.
   2. Check low temperature control.
   3. Check heating cable thermostat and amperage.
   4. Check liquid line solenoid valve.

D. Controls
   1. Check sequencer.

Annual Preventive Maintenance

A. Compressor
   1. Perform continuity and ground test.
   2. Check electrical connections.
   3. Check starter and overloads.

B. Condensers
   1. Continuity test fan motors.
   2. Ground test.
   3. Clean as required.
Appendix A (continued):

C. Electrical interlocks and controls.
   1. Check chilled water pump interlocks.
   2. Check high pressure cut-in and cut-out pressure.
   3. Check low pressure cut-in and cut-out pressure.
   4. Check oil pressure cut-in and cut-out pressure.
   5. Check ambient thermostat.
   6. Check transition timer.

BOILERS:

Monthly Preventive Maintenance

A. Perform safety valve test per ASME manual.
B. Inspect operating and limit controls.
C. Inspect floor drains.
D. Inspect water treatment system.
E. Inspect automatic make-up water control.
F. Inspect steam supply and condensate lines for leaks or corrosion.
   Replace insulation as required.

Quarterly Preventive Maintenance

A. Safety and limit controls.
   1. Check safety valves and test.
   2. Check high limit and operating steam pressure control.
   3. Check oil pressure safety switch.
B. Visually inspect operating controls.
   1. Check for leaks.
   2. Check operation.
   3. Check all drain lines of monitoring and operating controls.
C. Remove sludge from mudleg.
D. Inspect fuel supply system.
   1. Check lines for leaks.
   2. Check fuel level controls.
E. Inspect fire side heating surfaces; clean as required.
Appendix A (continued):

F. Inspect exterior of boiler for cracks or corrosion; repair as required.

Annual Preventive Maintenance

A. Boiler drained and opened for inspection and cleaning.
   1. Remove all hand holes and man hole plates and flush boiler thoroughly with high pressure hose to remove loose scale and sludge.
   2. Remove soot and dirt from flues and fire chambers.
   3. Inspect heating surfaces for signs of corrosion, pitting or scale.
   4. Inspect firebrick and refractory; repair as required.
   5. Inspect boiler tube and tube sheets for leaks; repair or replace as required.

B. Dismantle low-water fuel cut-off and inspect for leaks and corrosion; repair as required.
   1. Check floats.
   2. Check switches.
   3. Clean pipes and float chamber.

C. Inspect and repair hand valves.

D. Perform safety valve test per ASME manual.
   1. Try lever test.
   2. Capacity test.

E. Dismantle and inspect water column.
   1. Clean glass and tubes.
   2. Repair or replace as required.

F. Check all operating controls.
   1. Clean as required.
   2. Check calibration of all gauges and monitoring equipment.
   3. Replace or repair as required.

G. Check exterior of boiler for cracks and leaks; repair as required.

H. Paint surfaces as required.

I. Inspect fuel oil tank and clean.
Appendix A (continued):

J. Treat fuel oil tank with sludge conditioner.

K. Check water treatment system.
   1. Clean as required.
   2. Replace or repair as required.

L. Inspect boiler room ventilation system.
   1. Clean louvers and fans.
   2. Inspect controls and test.

M. Refill boiler, add water treatment and test.

N. Check steam lines for corrosion and leaks; repair or replace as required.

BOILER COMBUSTION SYSTEM:

Monthly Preventive Maintenance

A. Test flame detection controls.

B. Check oil atomization; clean as required.

C. Check pilot gas system.

Semi-Annual Preventive Maintenance

A. Test combustion controls.

B. Test flame detection controls.

C. Check fuel oil lines for corrosion.

D. Test pressure control.

E. Test low gas pressure cut-off.

Annual Preventive Maintenance

A. Burner
   1. Disassemble nozzle assembly and clean; repair or replace as required.
   2. Check gas and oil valves; service as required.
   3. Clean fuel oil filters at burner.
   4. Inspect ignition electrodes; adjust as required or replace.
   5. Check wiring of combustion control system.
Appendix A (continued):

6. Test flame detection controls and combustion system controls per ASME manual
   a. Test pressure control.
   b. Test low gas pressure cut-off.

5. Forced draft fan.
   1. Check bearing and lube.
   2. Clean blades.
   3. Inspect motor and wiring.

C. Electric oil heater.
   1. Disassemble and clean.
   2. Check wiring.

AIR COMPRESSORS - BOILERS:

Monthly

A. Check intake air filter; clean as required.
B. Change oil and clean crankcase 500 hrs.
C. Check belts and pulleys for proper tension.
D. Adjust oil pressure.

Annual Preventive Maintenance

A. Inspect valve assembly.
B. Inspect pressure controls.
C. Inspect motor starter.
D. Lube motor bearings.
# APPENDIX B. SAMPLE TOOL KITS
(Courtesy of Ft. Eustis)

<table>
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<tr>
<th>Kit Title</th>
<th>Contents</th>
<th>Tool Kit Code</th>
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<tr>
<td>Boiler Tool Kit #1 (inspect &amp; adjust)</td>
<td>10&quot; adjustable, 10&quot; pipe wrench, Allen wrench set, wire brush</td>
<td>0001</td>
</tr>
<tr>
<td>Boiler Tool Kit #2 (monthly, quarterly)</td>
<td>Air compressor, 12&quot; adjustable, 14&quot; pipe wrench</td>
<td>0002</td>
</tr>
<tr>
<td>Boiler Tool Kit #3 (semi-annual, annual)</td>
<td>Air compressor, 1/2&quot; socket set, 14 &amp; 18&quot; pipe wrench open end wrench set, Allen wrench set</td>
<td>0003</td>
</tr>
<tr>
<td>Combustion Syst. Kit</td>
<td>10&quot; adjustable, 10&quot; pipe wrench, Allen wrench set, Screwdriver (regular &amp; Phillips)</td>
<td>1001</td>
</tr>
<tr>
<td>Pump Kit #1</td>
<td>1/2&quot; socket set, open end wrench set</td>
<td>2001</td>
</tr>
<tr>
<td>Atomizer Air Compressor Kit</td>
<td>1/2&quot; socket set, 14&quot; pipe wrench, 12&quot; adjustable</td>
<td>1101</td>
</tr>
<tr>
<td>Chiller Preventive Maintenance Kit</td>
<td>Voltage tester, amp clamp, Screwdriver, crescent wrench</td>
<td>5000</td>
</tr>
<tr>
<td>Coil Cleaning Kit</td>
<td>Spray pump, screwdriver, water hose, crescent wrench</td>
<td>2101</td>
</tr>
<tr>
<td>Pump Kit #2</td>
<td>14 &amp; 18&quot; pipe wrench, crescent wrench, scraper, water hose</td>
<td>2002</td>
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<tr>
<td>Cooling Tower Kit #1</td>
<td>12&quot; pipe wrench, 12&quot; crescent wrench, gauge</td>
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<td>Cooling Tower Annual Kit</td>
<td>18&quot; pipe wrench, 12&quot; crescent wrench, hose, Screwdriver</td>
<td>1501</td>
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<tr>
<td>705 Fan Kit</td>
<td>Spray pump, water hose, Adjustable wrench, 24' ladder, extension cord</td>
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<tr>
<td>Compressor Oil Change Kit</td>
<td>Crescent wrench, oil can, Screwdriver</td>
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### APPENDIX C. SAMPLE PREVENTIVE MAINTENANCE MATERIALS
(Courtesy of Ft. Eustis)

<table>
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<tr>
<th>Kit Title</th>
<th>Contents</th>
<th>Material Kit Code</th>
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<tr>
<td>Boiler Kit #1 (monthly)</td>
<td>Solvent, door sealer, rags</td>
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<tr>
<td>Boiler Kit #2 (quarterly, semi-annual)</td>
<td>Same as above plus: (4) hand hole gaskets, 3x4&quot; manhole gaskets, 11x15&quot; &amp; 12x16&quot; gasket material, 3/8&quot; packing</td>
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<tr>
<td>Boiler Kit #3 (annual)</td>
<td>Same as above plus: graphite, refractory</td>
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<tr>
<td>Combustion Kit #1</td>
<td>Cleaning solvent, contact cleaner, electrode wire</td>
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<tr>
<td>Combustion Kit #2 (semi-annual)</td>
<td>Same as above plus: 3/8&quot; tubing</td>
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<tr>
<td>Combustion Kit #3 (annual)</td>
<td>Same as above</td>
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<tr>
<td>Water Treatment Kit</td>
<td>Tannin, caustic soda, phosphate, morpholine</td>
<td>5004</td>
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<td>Boiler Plant 801 Kit (A)</td>
<td>8 manhole gaskets, 2 hand hole gaskets, solvent, door sealer gasket material, 3/8&quot; packing</td>
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<td>Boiler Plant 801 Kit (B)</td>
<td>Same as above plus: refractory, high temperature compound</td>
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<td>Boiler Plant 195 Kit (A)</td>
<td>3 manhole gaskets, solvent, door sealer, rags, gasket material 3/8&quot; packing</td>
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<td>Boiler Plant 195 Kit (B)</td>
<td>Same as above plus: refractory, high (graphite) temperature compound</td>
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<tr>
<td>Boiler Plant 2406 Kit (A)</td>
<td>Solvent, door sealer, gasket material, 3/8&quot; packing, rags</td>
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<td>Boiler Plant 2406 Kit (B)</td>
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## APPENDIX D. SAMPLE BELT AND FILTER REQUIREMENTS AND LOCATION
(Courtesy of Ft. Eustis)

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<th>Buildings &amp; Units</th>
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<th>Size</th>
<th>Location</th>
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<td>802, 805; AHU 4 &amp; 5, H &amp; V Units</td>
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<td>B-66</td>
<td>Roof-top Unit (AHU-5)</td>
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<td>803, 808, 810, 813, 815, 817, 819; AHU 1 &amp; 2</td>
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<td>(Fresh Air) Basement (AHU-1)</td>
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<td>Roof top, east Bldg. (AHU-2)</td>
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<td>804, 809, 8112, 812, 814; AHU 1 &amp; 2</td>
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<td>H &amp; V Units</td>
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### FILTERS

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<td>Craft</td>
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**Appendix E.2 Deferred Maintenance Report**

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**No.:**

**Date:**

**Issued:**
APPENDIX E.3 MAINTENANCE-IN-PROGRESS REPORT

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<th>Skill Level</th>
<th>Est. Hrs.</th>
<th>Actual Hrs. to Date</th>
<th>Est. Compl. Time (Hrs.)</th>
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TOTAL

E.1.1
APPENDIX E.4 COMPLETED MAINTENANCE REPORT

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<th>Skill Level</th>
<th>Est. Hrs.</th>
<th>Actual Hrs. to Date</th>
<th>Est. Compl. Time (Hrs.)</th>
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Total Actual Hours: Month-to-Date_________ Quarter-to-Date_________ Year-to-Date_________

Total Estimated Hours: Month-to-Date_________ Quarter-to-Date_________ Year-to-Date_________
APPENDIX E.5 PREVENTIVE MAINTENANCE REPORT
Actual vs Projected Labor Costs

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TOTAL FOR PERIOD
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<td>8) Work Req. Summary:</td>
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<td>10) Location of Equipment:</td>
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<td>12) Associated Work:</td>
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<td>13) Special Requirements:</td>
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<td>7) Special Worker Skill Req’d*: If Yes, What?</td>
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<td>8) Description of Work:</td>
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<td>9) Replacement Parts:</td>
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<td>5) Parts Used (Part No., Description &amp; Quantity):</td>
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<td>9) Special Instructions:</td>
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<td>10) Return Response Req’d*: If Yes, What*:</td>
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<td>11) Estimated Time to Complete:</td>
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F-1
## APPENDIX G. SAMPLE WORK SCHEDULE REPORT 1
(As courtesy of F. Cottini)

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1/ PR = Schedule Priority  
SP = Supply Priority  
R&D = Material Due Date  
QC&C = Quality, Deck, Comments  
JUN-SHIP = Job Order Number, which shop involved  
CUR = Coordinator  
FELITY = Building Number or Unit  
PROCDATE = Process Date  
ESTHRS = Estimated Hours  
OTHHRS = Completed Hours  
STARTDATE = Date Project Started  
COMDATE = Date Project Completed  
AMEDATE = Amended Date, if applicable
APPENDIX II. MAINTENANCE MANAGEMENT SYSTEM SPECIFICATION OUTLINE

PART 1 - GENERAL:

1. Applicable Publications and Code. This section will contain those publications and codes applicable to a Maintenance Management System.

2. System Description. Provide an overall general description of the operation and functions of the system:
   a. General
   b. Abbreviations
   c. Environmental conditions
   d. Surge protection

3. Submittals. Description of requirements and procedures for submittals on the system, testing, training, etc.:
   a. General
   b. Drawings
   c. Testing
   d. Training
   e. Operation and Maintenance Manuals
      1) Functional Design Manual
      2) Hardware Manual
      3) Software Manual
      4) Operator's Manual
      5) Maintenance Manual
   f. Forms

4. Reviews. Description of review period and content of each review:
   a. General
   b. First review
   c. Second review

5. Testing. Description of requirements for factory and field testing:
   a. Factory
      1) Hardware
      2) Software
   b. Field
      1) Hardware
      2) Software

6. Training. Provide requirements for frequency and content of factory and field training:
a. General
b. Phase I
c. Phase II
d. Phase III

PART 2 - PRODUCTS

1. Material and Equipment - General. General descriptions and requirements of material and equipment being provided.

2. Field Equipment. Provide reference to CEGS for field hardware requirements:
   a. General

3. System Central Hardware. Detailed description of the central hardware, peripheral equipment and applicable interfaces:
   a. General
   b. Central Computer
      1) Central Processor
      2) Memory
      3) Interfaces
   c. Peripherals
      1) Operator's Console
      2) Printer
      3) MODEM
      4) Disk Storage System
      5) Magnetic Tape Storage System

4. Software. Detailed description of the software requirements for the system, including system and application software:
   a. System software
      1) General
      2) Bootstrap Program
      3) Disk Operating Systems
      4) Assembler
      5) Relocatable Linking Loader
      6) Editor
      7) Compiler
      8) Debugger
      9) Copy Routine
     10) Program Development
     11) Data Base Management
b. Applications Software

1) Operator Commands
2) Graphic and Alphanumeric Displays
3) Printer Formats
4) Point and System Definition Software
5) Report Generation
6) Algorithmic Control Sequences (flow measurement, efficiency calculation, etc.)
7) System Access
8) Data Exchange Requirements with EMCS
9) Preventive Maintenance Scheduling (time, hours)
10) Maintenance Order Generation
11) Management Reports
12) Scheduled Work Reports
13) Maintenance-in-Progress Report
14) Finished Work Report
15) Labor Forecasting Report
16) Material Listing (per job)
17) Project Scheduling
18) Grouping Similar Work and Work Areas

PART 3 - EXECUTION:

1. Installation. Detailed description of the installation of new central and field hardware, etc.:
   a. General
   b. Connection to existing equipment
   c. Central hardware
   d. Field hardware
   e. Software

2. Maintenance and Service. Description of requirements for maintaining the system during first year after acceptance:
   a. General
   b. Personnel
   c. Supervision
   d. Minor inspection
   e. Major inspection
   f. Software update

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