DOE/ET/21007--T6

MASTER

10 MWe SOLAR-THERMAL CENTRAL-RECEIVER PILOT PLANT

MARTIN MARIETTA CORPORATION

OPERATING AND MAINTENANCE MANUAL

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P R E L I M I N A R Y

AC03-79ET21007

Approval:

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DISCLAIMER

FOREWORD

This document is submitted in response to the requirements of DOE Contract No. DE-AC03-79ET21007 dated 9/5/78, Collector Subsystem Statement of Work, Item G-1.

Section I describes the operating functions necessary for day to day operation of the field.

Section II identifies the spares and maintenance activities required to keep the system operational.

Section III describes the safety requirements during operation and maintenance of the heliostat field and HAC control system.

This preliminary document prepared in Phase I is submitted to obtain approval for the overall format and general types of information contained herein. During Phase II, the document will be updated and validated to reflect all Phase II software and hardware operating and maintenance activities.

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SECTION I

OPERATIONS

SECTION I OPERATIONS

1.0 INTRODUCTION

1.1 Purpose

This portion of the Operation and Maintenance manual provides the information required to perform the initial program loading and operation of the Heliostat Array Controller (HAC).

1.2 Scope

This manual describes the Operating activities as required for heliostat control. All computer console command steps, from power up to power down will be described. Detailed steps will be provided to wake up the system and direct heliostat beams to standby, on target, standby to stow and power down.

Computer will maintain heliostat beams on target automatically until commanded differently.

2.0 APPLICABLE DOCUMENTS

2.1 The following documents of the latest approved issue from a part of this manual to the extent specified herein.

2.1.1 Martin Marietta Documents

The listed documents will give additional information on the heliostat array controller operational steps as well as the rationale for the sequence of these steps.

- o 40 0 500 16 0 HAC Start Up Procedure
- o 40 0 500 XX 0 HAC Operation Procedure

2.1.2 MODCOMP Documents

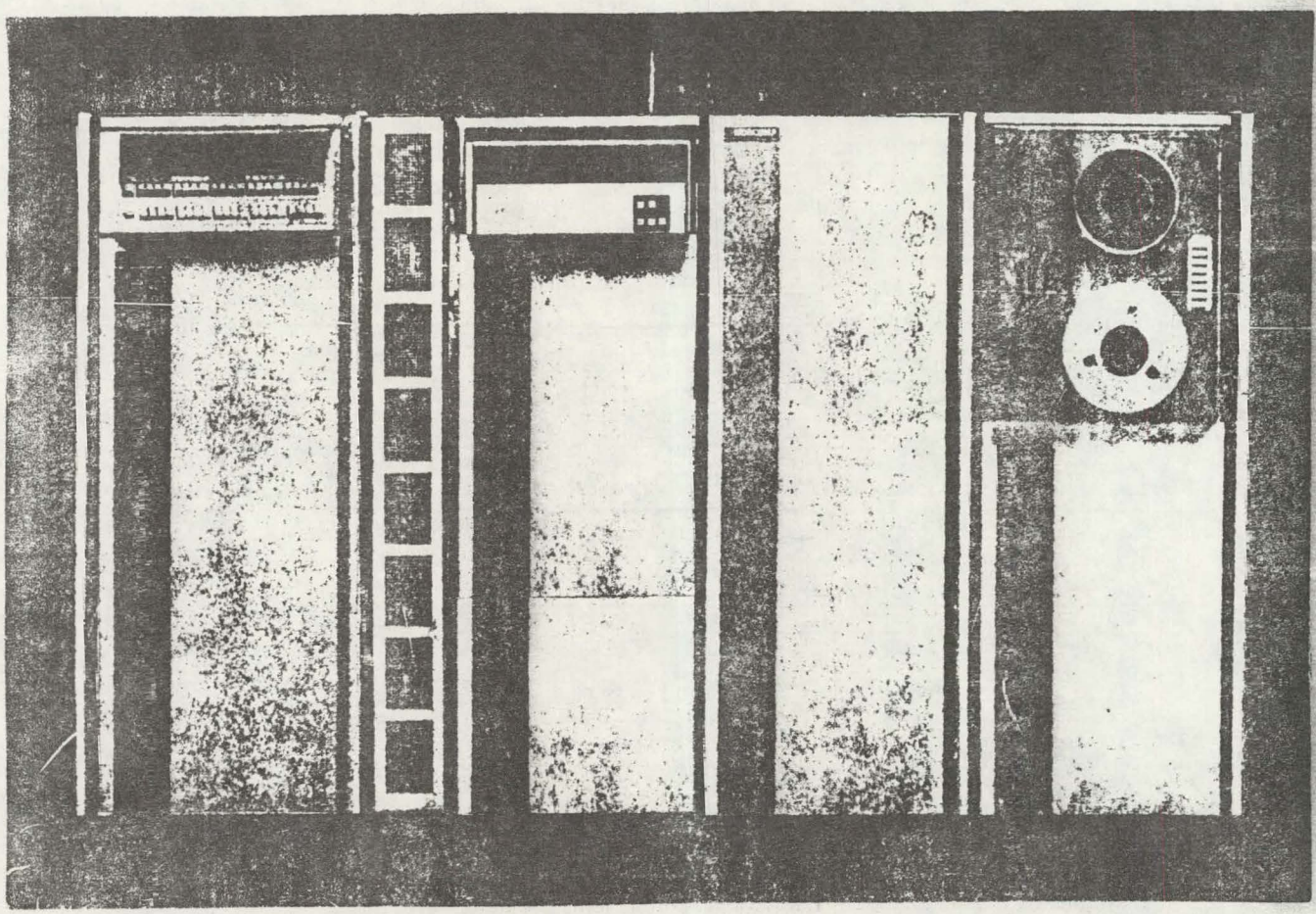
The listed document will expand on theory of operation, start up, shut down, limits of operation and complete breakdown of parts and their identification numbers.

- o MODCOMP - Classic CPU Manual No. 210-140000-000

3.0 HAC POWER UP (REF. FIGURE 3.1)

3.1 Power-On (Cold Start Up)

Power should be turned on starting with the first cabinet on the left and proceeding from left to right in sequence.



Cabinet 1	Cabinet 2	Cabinet 3	Cabinet 4
CPU	Disk	I/O Peripherals	Mag-Tape

Figure 3.1

HAC Computer System (Modcomp Classic)

NOTE

Power should not have been removed from CPU (Cabinet #1). Verify CPU red "POWER" light (located in the upper left corner of the CPU display panel) is illuminated. Proceed to Step 3.1.2.

3.1.1 To apply power to the CPU (Cabinet #1) in the event that power has been turned off:

a. Open the front door of Cabinet #1 and locate switches at bottom left.

b. Place switch marked "CB1" to the on position.

c. Place switch marked "CB2" to the on position.

d. Response - The indicator lamp labeled "POWER" (in the upper left corner of the display panel) will illuminate.

3.1.2 To apply power to the Disk Drive (Cabinet #2):

a. Lift switch cover located at the upper most front edge of the cabinet.

b. Place switch marked "CONTROLLER" to the ON position.

c. Place switch marked "PERI. DEVICE" to the ON position.

d. Place "POWER" switch on the front panel to the ON position.

CAUTION

Verify Cartridge in disk is loaded

e. Response - power and load lights will illuminate.

f. Place $\frac{\text{LOAD}}{\text{RUN}}$ switch on the front panel to the UP position.

g. Response - load light will go out and ready light will illuminate after approximately 1 to 5 minutes.

3.1.3 To apply power to the Peripherals Cabinet (Cabinet #3)

a. Open cabinet door and locate switches at the upper most top edge of Cabinet (Cabinet #3).

b. Place switch marked "CONTROLLERS" to the ON position.

c. Place switch marked "PERI. DEVICE" to the ON position.

d. Response - red lamp marked "DC ON" will illuminate.

3.1.4 To apply power to the Magnetic Tape Drive (Cabinet #4):

a. Lift switch cover located at the upper most front top of the cabinet.

b. Place switch marked "CONTROLLERS" to the ON position.

c. Place switch marked "PERI. DEVICE" to the ON position.

d. Depress push button switch marked "POWER."

e. Response - power switch will illuminate.

3.1.5 To apply power to the WWV receiver:

a. Place toggle switch on right side of receiver to ON.

b. Response - "WWVB" Green "LOCK" light will illuminate. Red numerals displaying time will illuminate in approximately 1 to 5 minutes.

3.1.6 To apply power to the two (2) TI 820 terminals:

a. Place toggle switch, located at the left rear of unit, to the ON position (up).

b. Response - terminals will hum slightly and "BEEP" once.

3.1.7 To apply power to the cathode ray tube (CRT):

a. Depress the rocker type switch, located at the lower left rear of unit.

b. Response - CRT cursor ("=") will appear in upper left corner of screen.

3.1.8 To configure CRT for system boot-up:

a. Depress "CPU RESET" key (upper right-red key).

b. Depress "A-7-ON" key (center keyboard top row center).

c. Depress "ESC" key (center keyboard 2nd top row left end).

d. Depress $\frac{\text{"BAUD}}{\text{RATE}}$ R" key (center keyboard 3rd top row 5th from left).

e. Depress "6" key (center keyboard 2nd top row center).

f. Response - none.

3.1.9 To clear the MOS memory and avoid parity errors, toggle in a simple program on the CPU front panel (Cabinet #1).

NOTE

Skip steps "a" through "at" if CPU (Cabinet #1) was not powered down. Proceed to step 3.2.1.

a. "KEY" switch to "ENABLE"
b. "CPU" switch down (bottom row)
c. "MEM" switch down (bottom row)
d. All other switches in bottom row "UP" position.
e. Verify all "DATA/ADDRESS" switches (second row from bottom) are in the center position.
f. Depress "CLEAR" switch.
g. Depress "ENT P/MA" switch
h. Enter F701(HEX) (switches 0-3, 5-7 and 15 up)
i. Depress "ENT MEM" switch
j. Enter BF22(HEX) (switches 0, 2-7, 10 and 14 up)
k. Depress "CLEAR" switch (lights above "UP" switches illuminate)
l. Depress "ENT NXT" switch
m. Enter 602F (switches 0, 3-9 and 11 down) SWS 1,2,10,12-15 up)
n. Depress "CLEAR"
o. Depress "ENT NXT" switch
p. Enter 7E12 (SWS 0,7-10,12,13 & 15 down) (SWS 1-6,11,14 up)
q. Depress "CLEAR" switch
r. Depress "ENT NXT" switch
s. Enter 0000 (all SWS down)
t. Depress "CLEAR" swtich
u. Depress "ENT NXT" switch
v. Enter 6C22 (SWS 0,3,6-9,11-13 & 15 down) (SWS 1,2,4,5,10,14 up)
w. Depress "CLEAR" switch
x. Depress "ENT NXT" switch
y. Enter 703F (SWS 0,4-9 down) (SWS 1-3,10-15 up)
z. Depress "CLEAR" switch
aa. Depress "ENT NXT" switch
ab. Enter 0000 (all switches down)
ac. Depress "CLEAR" switch
ad. Depress "ENT NXT" switch
ae. Depress "EMCR" switch. All other switches in bottom row should be in the up position (this selects register 1).
af. Enter 00FF (SWS 0-7 down) (SWS 8-15 up)
ag. Depress "CLEAR" switch.
ah. Depress "CSL INT-ENT REG" switch (this loads the selected register)

ai. Place "EMCR" switch in UP position

aj. Place "PSW" switch in the DOWN position (this selects register 2)

ak. Enter 0010 (SWS 0-7,12-15 down) (SWS 8-11 up)

al. Depress "CLEAR" switch

am. Depress "CSL INT-ENT REG" switch

an. Place "EMCR" switch in the up position

ao. Place "PSW" switch in the down position (this selects register 3)

ap. Enter 0000 (all SWS down)

aq. Depress "CLEAR" swtich

ar. Depress "CSL INT-ENT REG" switch

as. Depress "ENT P/MA" switch

at. Depress "RUN" switch (this executes the above program).

Response: run light should light briefly. After run light goes off, MERR light should be off.

3.2 Warm Start from Disk

3.2.1 To start up CPU:

a. Verify disk "READY" light is illuminated

b. Key switch to "ENABLE" position

c. Depress "HALT" switch

d. Enter 0001 (SWS 0-14 center) (SW 15 up)

e. Depress "M CLEAR" switch

f. Depress "FILL" switch

g. Depress "RUN" switch

h. Response: TI 820 console (computer operator's console) will respond with: I.4 SAT. @ F6EF

3.2.2 To complete TI 820 start up:

a. Enter MØ6 and depress carriage return.

b. Console will respond with "SATISFIED"

c. Enter GO and depress carriage return

d. Console will respond with: "*DOO 06/17/79 HSTAT PROJECT REALTIME SYSTEM REV. AOO MAX4 (DO.O) HI PAGE IN PRIVATE MEMORY = #01FF IV/OC 1"

NOTE

Next entry "/" must begin within 12 seconds or timer will time out. If time is excceded, depress "CNTL" and "A" keys simultaneously and repeat step e.

e. Enter "/ DATE MM/DD/YY" and carriage return.

f. Console will respond with \over your/ resulting in an X.

NOTE

Next step is also timed. If time is exceeded, depress "CNTL" and "A" keys simultaneously.

g. Enter "/ TIME HH/MM/SS and carriage return

NOTE

While the above steps were in progress, four phases of CRT output take place, the second phase requires operator's answer.

3.2.3 To power up HAC Operators Console (CRT)

a. Large lettered CRT output (FIRST PHASE)

DATA BASE
INIT

b. CRT output - DO YOU WANT A LISTING OF DATA BASE SOURCE? ("YES, NO")

c. Enter "NO" and depress "RETURN" key.

d. CRT output - UPDATE HC-BIAS VALUES FROM MAG-TAPE? ("YES/NO")

e. Enter "NO" and depress "RETURN" key.

f. CRT output - Protocol monolog, reporting about initialization activities requires approximately 3 minutes. When protocol monolog is finished, real time statusing will begin:

g. Large lettered CRT output:

MMI
ON-LINE

1. A red-bar across the top - stating last non-acknowledged, critical alarms.
2. A yellow-bar just under the red-bar stating most recent alarm.
3. A blue-bar just under the yellow-bar containing status updates and current time.
4. Clear alarms by:
   a) Depress "NULL" key
   b) While holding "SHIFT" key, depress "!" key twice.
   c) Depress "RETURN" key
   d) Repeat steps a-c to remove multiple alarms.

3.3 Heliostat Normal Operational Modes

To configure heliostats to normal operational modes after bringing system up, perform the following.

3.3.1 CRT console (initialization procedure)

a. Depress "NULL" key (to get computer attention)
b. Type in "LOAD" (after prompting characters "->" appear)
c. Depress "RETURN" key
d. Depress "NULL" key
e. Type in "STOW"
f. Depress "RETURN" key
g. Depress "NULL" key
h. Type in "HCMARK X" (see note 1)
i. Depress "RETURN" key

Verify marks have been received by viewing the alarms portion of the CRT console. AZ and EL mark messages should have appeared. To further verify:

j. Depress "NULL" key
k. Type in "STATUS IND X CRT" (see note 1)
l. Depress "RETURN" key

The heliostat status will appear on the CRT console as well as the printer. If the mode on the CRT is "BRKN E064," then the heliostat is marked. If the mode is "BRKN 0064," then the heliostat is still moving towards its mark. Wait a minute and repeat steps "j" thru "l". Once heliostat is marked:

m. Depress "NULL" key
n. Type in "STOW X" (see note 1)
o. Depress "RETURN" key

3.3.2 CRT console (beams to standby from stow)

a. Depress "NULL" key
b. Type in "STAN X" (see note 2)
c. Depress "RETURN" key

It takes approximately 6 minutes for beams to go to standby.

3.3.3 CRT console (beams to track from standby)

a. Depress "NULL" key
b. Type in "TRACK X" (see note 2)

or

Type in "INCR X" (see note 2)

c. Depress "RETURN" key (either of these commands will put beams on target)

3.3.4 CRT console (beams to standby from target)

a. Depress "NULL" key

b. Type in "DECR X" (see note 2)

c. Depress "RETURN" key (this command will return beams to standby)

3.3.5 CRT console (beams to stow from standby)

a. Depress "NULL" key

b. Type in "STOW" (this command takes all beams at standby to stow)

or

Type in "STOW X" (this command takes only 1 beam from standby to stow - see note 1)

It takes approximately 6 minutes for beams to return to stow.

3.4 Additional HAC modes:

3.4.1 CRT console (position a heliostat to absolute azimuth and elevation angles from stow or a previous position command)

a. Depress "NULL" key

b. Type in "POSI X AZ EL" (see note 1 for X, AZ and EL are decimal values e.g. 90.5 or 0.)

c. Depress "RETURN" key

3.4.2 CRT console (position a heliostat to absolute azimuth and elevation angles from standby or track)

a. Depress "NULL" key

b. Type in "OFFLINE X" (see note 1)

c. Depress "RETURN" key

This takes the heliostat offline in order to be able to issue position commands.

d. Depress "NULL" key

e. Type in "POSI X AZ EL" (see 3.4.1 for example)

f. Depress "RETURN" key

3.4.3 CRT console (stow heliostats previously in position modes)

a. Depress "NULL" key

b. Type in "STOW" (this will stow all heliostats in either position, standby or going to HCMARK)

or

Type in "STOW X" (to stow a single heliostat - see note 1)

c. Depress "RETURN" key

3.4.4 CRT console (return a heliostat to operational use after being declared offline)

a. Depress "NULL" key

b. Type in "ONLINE X" (see note 1)

c. Depress "RETURN" key

3.4.5 CRT console (output the status of heliostats to the printer and CRT console).

a. Depress "NULL" key

b. Type in "STAT ALL"

c. Depress "RETURN" key

This will output the status section of the CRT console to the printer device.

d. Depress "NULL" key

e. Type in "STAT MOD N" (N is the mode number 1-9)

f. Depress "RETURN" key

This will output all heliostats in the requested mode to the printer. If the output is desired to be seen on the CRT console also, then the format is "STAT MOD N CRT."

g. Depress "NULL" key

h. Type in "STAT IND X" (see note 1 for X)

i. Depress "RETURN" key

This will output the status of the requested heliostat to the printer. If the output is desired to be seen on the CRT console also, then the format is "STAT IND X CRT."

3.4.6 CRT console (update a heliostat azimuth and elevation biases on the HCB disc file).

a. Depress "NULL" key

b. Type in "UPBIAS X NEWAZ NEWEL" (see note 1)

c. Depress "RETURN" key

The NEWAZ and NEWEL parameters are hex values and both must be preceded by a pound sign "#" e.g. #E000 or #3F3F. After an "UPBIAS" command has been issued, then an initialization procedure must be followed in order to down-load the new values to the heliostat.

Note 1 - The value of "X" stands for the heliostat number and the format is for example:
#1, 1 for HFC 1, HC 1 or #2, 2 for HFC 2, HC 2

Note 2 - The value of "X" can stand for either the heliostat number or the number of heliostats. If a specific heliostat is desired to be moved, then the format of Note 1 is to be followed. If just a number of heliostats want to be commanded, then only the number to be moved has to be entered. (e.g. TRACK 2 to move 2 heliostats from standby to the target).

3.5 Power Down (Refer to Figure 1)

CAUTION

DO NOT REMOVE POWER FROM CPU (CABINET #1).

3.5.1 Reverse power up steps: 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6 and 3.1.7.

SECTION II

COLLECTOR SUBSYSTEM MAINTENANCE AND SPARES REQUIREMENTS

1.0 INTRODUCTION

1.1 Purpose

This section of the maintenance manual for the collector subsystem establishes maintenance requirements (preventive and corrective), reparability (reparable - non-reparable decisions). Spares identification, spares storage location, replacement levels, replacement location and repair location.

1.2 Scope

This manual describes the maintenance activities as required by the design and failure rate determination analysis of the collector subsystem.

Individual system breakdown block diagrams will be provided for each system/assembly/subassembly. "Maintenance and repair description" sheets will be provided for each maintenance significant item. The manual will provide support of the following equipment.

a. Heliostat Assembly
b. Heliostat Control Assembly
c. Maintenance and Installation Equipment

2.0 APPLICABLE DOCUMENTS

2.1 The following documents, of the latest issue, form part of this document to the extent specified herein.

2.1.1 Government Documents

DE-AC03-79ET21007 DOE Contract, "10 MWe Solar Thermal Central Receiver Pilot Plant - Collector Subsystem."

2.1.2 Martin Marietta Documents

Heliostat Drawings

The listed drawings will give visibility to the heliostat's various assemblies as well as defining quantities and description of hardware and component parts.

40M5005132720 Heliostat Assembly
40M5005132730 Reflective Assembly
40M5005132732 Rack Assembly
40M5005132725 Pedestal Assembly
40M5005132721 Drive Mechanism Assembly
40M5005132731 Heliostat Mirror Assembly
40E5005132737 Electrical Harness
40E5005132738 Checkout Diagram
40E5005132740 Heliostat Control - Heliostat Field Control
40E5005132744 HC/HFC Schematic
40E5005132745 HC/HFC Wiring Diagram & Cable Assemblies
40E5005132751 HAC to HFC Interface

Tooling Drawings

The listed drawings will define the design and assembly of those installation and assembly tools that will be used in the repair and maintenance of the pilot plant.

40M5005132761 Assembly Canting Tool
40M5005132764 Rack/Reflective Assembly Fixture
40M5005132767 Mirror Assembly Cart
40M5005132762 Drive Mechanism Assembly Stand
40M5005132763 Drive Mechanism Handling Sling
40M5005132768 Reflective Assembly Handling Sling
40M5005132766 Adapter Plate - Talyvel
40M5005132771 Field Canting Tool
40M5005132772 Protective Cover - Mirror
40M5005132779 Lifting Adapter - Pedestal
40E5005132778 Drive Motor - Direct Drive Control Box
40E50051327XX Drive Mechanism Checkout Console
40E50051327XX Encoder Zero Set Indicator
40E5005132775 Stimulator
40E5005132774 Manual Control Box

Manufacturing Procedures and Instructions

The listed procedures and instructions will provide the necessary information for proper use and sequential operations of the installation and assembly tools.

40M5001I Heliostat Installation Instructions

40M5002M Assembly Canting Procedure

40M5001M Field Canting Tool Procedure

40M500XM Rack Assembly Procedure

40M500XM Reflective Assembly Procedure

40M500XM Mirror Assembly Procedure

40M500XM Drive Mechanism Assembly

40M500XM Reflective Assembly Loading Procedure.

3.0 MAINTENANCE

3.1 The maintenance policy for the 10 MWe collector system is as follows:

a. Design for long life and minimum maintenance.

b. No scheduled maintenance except periodically washing and inspection.

c. Spare at the assembly/part level that can be readily replaced in the field.

d. Provide spares not commercially available in sufficient quantity for 5 years of operation.

e. Provide support equipment and spares for on-site repairs.

3.2 Spares

All spares shall be completely interchangeable with the items they are intended to replace. Spares are categorized as primary or secondary according to their use.

3.2.1 Primary Spares

Primary spares are used to repair the collector and control systems. Primary spares are the first line of replacement, this can be an assembly, subassembly, or part. Primary spares are the highest replacement level that can be replaced in the field. These items will be stocked at the field site.

3.2.2 Secondary Spares

Secondary spares are used to repair primary replacement items and will be stocked at the site repair facility.

3.3 Maintenance Decisions

Basic maintenance decisions are reached through review and analysis of each end item from the top level down through the lowest maintenance significant item. The Maintenance Decisions Document (Ref. Figure 3.3.1) is prepared by breaking down each end item into an indentured drawing tree, beginning with the top drawing (end item) and waterfalling out the lower indentures that go into that end item. The assemblies are in turn broken down into subassemblies, the subassemblies into assemblies and parts to the lowest maintenance significant item. Each level of indenture is analyzed, decisions are made, and the following codes are entered beside each item:

a. Reparable/non-reparable - R or N
b. Replace location - Supplier, Site, In-place, V, S or P
c. Repair location - Supplier, Site, Government, Non-reparable, V, S, G or N
d. Spared - Affirmative, negative - A or N

3.3.1 Spares Selection

Based upon the maintenance decisions, spares identification, quantities, need dates and need locations are determined. These spares requirements are then used to initiate the spares ordering document.

3.3.2 Maintenance

A more detailed analysis will be performed on maintenance significant equipment identified during maintenance decisions activity. This analysis will identify preventive and corrective maintenance, retest and calibration requirements, required Maintenance Equipment and Bulk Item needs.

The results of maintenance analysis will be recorded on the Maintenance and Repair Description form (see sample, Figure 3.2.2).

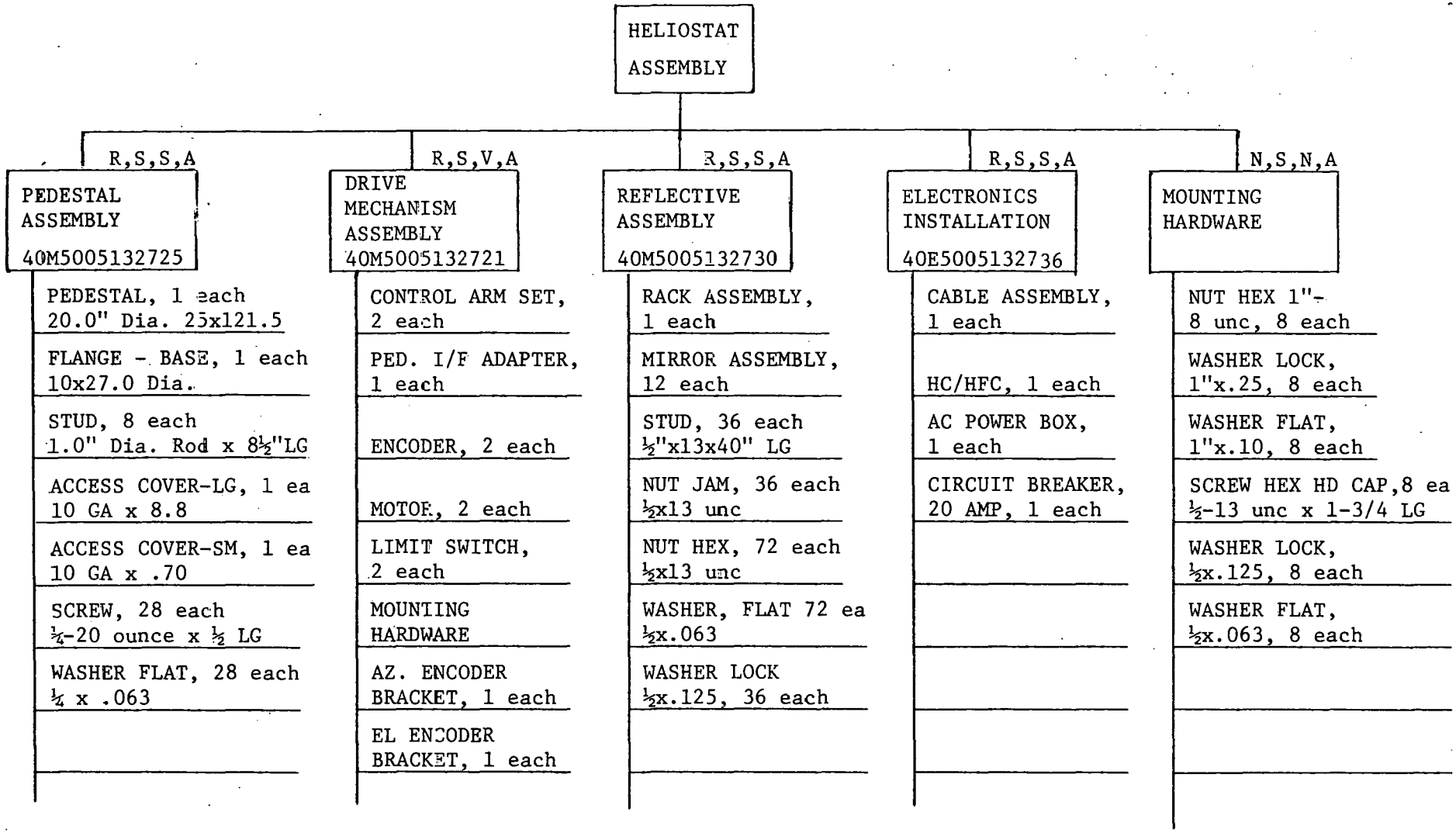


FIGURE 3.3.1 SAMPLE INDENTURED PARTS BREAKDOWN AND MAINTENANCE DECISIONS DOCUMENT

3.3.3 Levels of Maintenance

Three levels of maintenance are planned for the Heliostat equipment, based upon program constraints, and availability of spares, skills and tasks.

a. First level of maintenance will be performed at the installation site.

b. Second level of maintenance will be performed at the maintenance facility.

c. Third level of maintenance will be performed at supplier facilities.

3.4 Preventive Maintenance

Preventive maintenance requirements are established as a part of maintenance decision activities and used in the generation of preventive maintenance procedures. Preventive maintenance will consist of washing mirrors, visual inspection of heliostats, routine servicing of computer and maintenance equipment. Preventive maintenance procedures will be generated for servicing maintenance equipment where required.

3.5 Corrective Maintenance

Corrective maintenance will consist of fault isolation, and replacement of failed components on the heliostat in the field. Repair of failed components will be performed at the site repair facilities, and a computer service contract will be used for computer equipment repair.

NOMENCLATURE Mirror Assembly

IDENTIFICATION NO. 40M5005132731-009

SYSTEM/ITEM DESCRIPTION - The mirror assembly is 120.3 inches long, 43.3 inches wide, and 2.81 inches deep. Assembly weighs 115 lbs. Assembly consists of a steel pan, honeycomb core, glass fiber fabric and 1/8 inch mirror. Assembly components are bonded together and sealed. Three doubler plates are bonded to the exterior of the steel pan at the assembly's mounting points.

MAINTENANCE PLAN -

1. Preventive maintenance will consist of periodic cleaning using cleaning set provided by SFDI.
2. Corrective maintenance will consist of the removal and replacement of the failed mirror assembly.
3. Spare mirror assemblies will be available at the on site storage facility.
4. Mirror assembly is removed by removing three ½ x 13 nuts.
5. Mobile work platform and re-canting tool is required.

FIGURE 3.3.2 SAMPLE MAINTENANCE AND REPAIR DESCRIPTION SHEET

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1.0 INTRODUCTION

1.1 Purpose

This section of the Operation and Maintenance Manual for the collector subsystem establishes the safety requirements for the operating and maintenance functions described in the preceding Sections I and II. These procedures will assist in eliminating or controlling the accident potentials caused by human error, environment, or component malfunctions or interactions that could result in major injury or fatality to operating or visiting personnel, or damage to subsystem components or support equipment.

1.2 Scope

These procedures are for normal and test operating conditions and emergency situations, and apply to all Martin Marietta Corporation, governmental, operating and visitor personnel.

2.0 APPLICABLE DOCUMENTS

The following documents of the latest approved issue have been referred to in the preparation of these safety procedures.

2.1 DOE

a. DOE-SAN 0501, Pattern of Health and Safety Responsibilities.

b. DOE-SAN 0499-6, System Safety Plan (RADL 2-24).

2.2 Other

a. MIL-STD-454, Standard General Requirements for Electronic Equipment.

b. CS-MCS and CS-Plant Interface Requirements, MDC G7852.

3.0 COLLECTOR SUBSYSTEM SAFETY POLICY

3.1 The safety policy for operation and maintenance of the 10 MWe Collector Subsystem is to insure that sound safety practices and precautionary measures become an integral part of the total program effort. Safety concurrent with other disciplines will constitute a mainstream activity in all decision processes. This policy will be enforced and monitored by the Project Safety Engineer who will have full authority from the Program Manager concerning all matters of safety.

3.2 Safety Procedures

3.2.1 Computer System Safety

a. Operating personnel will have received proper instructions in accident prevention and first-aid procedures prior to engaging in electrical work to fully inform them of the hazards involved. This instruction can be informal in nature and will be tailored to the operating characteristics and configuration of the HAC Computer System cabinets. Training documentation will be in accordance with current divisional procedures.

b. Operating personnel will observe all danger, caution, or instructional signs located on computer cabinets or within cabinet recessed areas. Operating personnel who will engage in working inside cabinet recesses should remove finger rings and watches prior to engaging in these operations.

c. Operating personnel will insure that switch covers are placed in the closed position after power switches are placed in the desired position to preclude accidental contact by personnel.

3.2.2 Maintenance Safety

a. A pre-maintenance safety briefing will be given at the beginning of each operating day. This briefing will cover all safety aspects of the preventive maintenance and corrective maintenance activities for first level and second level maintenance. As a minimum, the items addressed in the following sub-paragraphs "b" through "h" will be covered in this briefing.

b. The location of "wire walk" paths, the heliostat positions within the segments, and/or the position of any single or group of failed heliostats will be briefed to the maintenance technicians as required prior to any dispatch to preclude accidental exposure to a possible "unsafe" dose level.

c. Maintenance technicians will wear gloves of such a length as to provide adequate protection to the wrists and forearms during removal and replacement of broken mirror assemblies.

d. Maintenance technicians will wear approved hard hats at all times while operating in the collector field.

e. Maintenance technicians will observe the following safety practices while driving and operating from the FABTEK mobile maintenance vehicle

(1) FABTEK speed will be held within the limit established by the integrator for all special purpose vehicles operating in the collector field.

(2) Parking chocks will be set at all times while the FABTEK is positioned for maintenance on uneven ground.

(3) Safety chain will be secured across the top of the platform above the access steps at any time personnel are on the FABTEK.

(4) All tools and materials used in support of any preventive/corrective maintenance operation will be securely positioned on the FABTEK platform to preclude accidental dropping from the vehicle, and will be so located as to prevent a tripping hazard to personnel.

(5) Prior to raising/lowering the FABTEK in support of any maintenance activity, the technician operating the controls will inform all other personnel on the FABTEK of the operation so that all upward and downward platform movements are anticipated.

(6) A first aid kit will be secured and easily accessible on the FABTEK platform in support of minor injuries such as cuts, gashes and the like.

f. Maintenance technicians/designated project personnel as appropriate, will perform the following actions prior to engaging in any maintenance task requiring the use of certified lifting equipment.

(1) Accomplishment of a current proof load test for the item of lifting equipment will be verified by a metal tag attached to the unit. The maximum load and proof load test date will be permanently stamped on the tag.

(2) Lifting device will be visually inspected for evidence of damage, deterioration, or corrosion prior to each usage.

(3) Lifting device will be given a complete inspection by trained personnel at least once each six months. This inspection will be performed by the designated project Quality/Safety on-site representative.

g. All paints, thinners, solvents, cleaning fluids, and similar materials which support combustion or give off toxic fumes or vapors will be secured in a well-ventilated storage locker or shed outside the assembly building. This storage facility will be clearly marked on the exterior in red lettering" "FLAMMABLES-NO FLAME OR SPARK-PRODUCING DEVICES ALLOWED." At least one fire extinguisher, suitable for the type of materials involved, will be readily available for use.

h. All personnel injuries and/or accidents involving collector subsystem components or support equipment will be promptly reported and investigated in accordance with the provisions of the contract and the applicable Martin Marietta Corporation off-site accident/incident investigation procedure.

i. In the event of any of the following conditions, the heliostat(s) will return to the emergency stow position, and emergency procedures as applicable will be initiated.

   (1) Wind - including gusts in excess of 35 mph.
   (2) Rain
   (3) Lightning
   (4) Hail
   (5) Earthquake

Emergency action procedures for collector subsystem operations and maintenance personnel will be formulated prior to plant activation and start up and integrated into the overall pilot plant emergency response plan.