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Test, Control and Monitor System Maintenance Plan

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FREEDOM

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John F. Kennedy Space Center

TCMS MAINTENANCE PLAN

Prepared by:

D. P. Buehler, F468
TCMS Operations & Maintenance

M. J. Lougheed, CS-GSD-22
TCMS Operations & Maintenance

Concurrence:

D. F. McMillan, F258
TCMS Technical Integrator - Ops.

J. R. Schofield, F200
Director, Payload Projects

P. F. Houston, F324
Senior Project Manager - TCMS

E. G. Spilger, F300
Director, Space Station Project

R. E. Griffin, F404
Manager, TCMS O & M

A. P. Tully, F400
Director, Technical Support

F. D. Hall, F626
Quality Assurance

P. J. Seccuro, F626
Director, SR & QA

Concurrence:

G. G. Johnson, F816
Senior Logistics Engineer

J. O. Holcombe, F820
Director, Production Support

J. R. Rogers, CS-GSD-22
Chief, Checkout Systems Section

H. D. Rice, CS-EED-1
Chief, Project Engineering Staff

W. E. Roy, CS-PSD-4
Logistics Management

J. C. Mack, CP-SSO
Manager, Systems Engineering & Integration

Approved by:

F. B. Stump, CS-PSD
Chief, Payload Support Div.

B. G. Bruckner, CS-GSD
Chief, Ground Systems Division

D. L. Webb, CS-EED
Chief, Systems Eng. & Exp. Div.

J. H. Straiton, CP-SSO
Chief, Space Station Support Office

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A&DC	Administration and Data Communication
AP	Application Processor
ATE	Automated Test Equipment
BCDS	Broadband Communication Distribution System
BETUS	Bar Code Equipment Tracking and Utilization System
BIOP	Buffer Input/Output Processor
BIT	Built in Test
BOI	Break Of Integrity
BPA	Blanket Purchase Agreement
CAD/CAE	Computer Aided Design/Computer Aided Engineering
CAF/CSF	Central Avionics Facility/Central Software Facility
CCATS	Configuration, Calibration and Test Set
CCB	Configuration Control Board
CCBD	Configuration Control Board Directive
CCMS	Checkout, Control and Monitor Subsystem
CCSS	CAF/CSF Support System
CDBFR	Common Data Buffer
CEC	Core Electronics Contractor
CM	Configuration Management
CO	Change Order
COTS	Commercial-Off-The-Shelf
CPR	Component Problem Report
CPU	Central Processing Unit
DAOS	Dual Attach Optical Switch
DAS	Dual Attached Station
DBS	Data Base Subsystem
DMS	Data Management System
DNS	Display Network Subsystem
DP	Display Processor
DSRS	Data Storage and Retrieval Subsystem
F/E	Fiber to Ethernet
F/F	Fiber to Fiber
FDDI	Fiber Distributed Data Interface
FEP	Front End Processor
FEU	Functional Equivalent Unit
FIT	Functional Interface Tool
FND	First Need Date
FSN	Federal Stock Number
GDPB	Global Display Bus
GOF	Global Operations Facility

GSE	Ground Support Equipment
GW	Gateway
HDA	Hardware Dispositioning Area
HIM	Hardware Interface Module
HIMSIM	Hardware Interface Module Simulator
HOSF	Hazardous Operations Support Facility
I/O	Input/Output
ID	Interface Device
IDMM	Intermediate and Depot Maintenance Manual
IDMMSS	Intermediate and Depot Maintenance Manual Summary Sheet
IGW	Intermediate Gateway
ILMF	Intermediate Level Maintenance Facility
ILSP	Integrated Logistics Support Plan
IPR	Interim Problem Report
IRGW	Intermediate Rate Gateway
IRIG	Inter-Range Instrumentation Group
JSC	Johnson Space Center
KDN	Kennedy Data Network
KIMS	Kennedy Inventory Management System
KSC	Kennedy Space Center
LAN	Local Area Network
LCWS	Local Control Workstation
LDPB	Local Display Bus
LIOS	Local Bus Input/Output Subunit
LPC	Local Processor Control
LPS	Launch Processing System
LRU	Line Replaceable Unit
LSA	Logistics Support Analysis
LWO	Laboratory Work Order
MAN	Metropolitan Area Network
MCOE	Master Console Operations Engineer
MDM	Multiplexer/Demultiplexer
MDS	Microprocessor Development System
MIOP	Monitor Input/Output Processor
MIP	Modification Instruction Package
MIS	Multiplexer/Demultiplexer Interface Subunit
MOA	Memorandum of Agreement
MODB	Master Object Data Base
MPAC	Multipurpose Applications Console
MRB	Material Review Board
MRC	Material Review Center
MSC	Material Service Center
MSE	Maintenance Support Equipment

MSU	Mass Storage Unit
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NASA	National Aeronautics and Space Administration
NCC	Network Control Center
NEMS	NASA Equipment Management System
NMS	Network Monitor Subunit
NMU	Network Monitor Unit
NSL	Non-Stock Listed
NSS	Network Simulator Subunit
NSU	Network Simulation Unit
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OIS-D	Operational Intercom System - Digital
OJT	On-the-Job Training
OMI	Operations and Maintenance Instruction
ORT	Operational Readiness Test
OSA	Off-Line Support Area
OSS	Off-Line Support Set
PAM	Permanent Archive Media
PCM	Pulse Code Modulation
PDMS	Payload Data Management System
PDR	Processed Data Recorder
PDRD	Program Definitions and Requirements Document
PGOC	Payload Ground Operations Contractor
PHS&T	Packaging, Handling, Storage, and Transportation
PMOMI	Preventive Maintenance Operational and Maintenance Instructions
PMR	Parts and Material Request
PON	Payload Operations Network
POW	Payload Office Workstation
PP	Patch Panel
PR	Problem Report
PRACA	Problem Reporting and Corrective Action
PROM	Programmable Read Only Memory
PSCNI	Program Support Communications Network Internet
PSTF-R	Payload Spin Test Facility - Replacement
PTS	Production Tracking System
QA	Quality Assurance
QE	Quality Engineering
RC	Ring Concentrator
RLA	Repair Level Analysis
RMRS	Repeatable Maintenance Recall System
RTN	Real Time Network

RTV	Return To Vendor
SAS	Single Attached Station
SBC	Single Board Computer
SDDS	System Developmental and Diagnostic Subunit
SDP	Standard Data Processor
SIB	Simulation Interface Buffer
SMR	Source, Maintenance, and Recoverability
SN	Service Network
SN0	Serial Number Zero
SOW	Statement Of Work
SP	Standard Practice
SPDMS	Shuttle Processing Data Management System
SPF	Software Production Facility
SRU	Shop Replaceable Unit
SSEDF	Software Support Environment Development Facility
SSFP	Space Station Freedom Program
SSLB	Space Station Local Bus
SSMB	Space Station Manned Base
SSPF	Space Station Processing Facility
SSPF-A	Space Station Processing Facility - Set A
SSPSE	Space Station Payload Software Engineering
SST	Set Support Team
STE	Special Test Equipment
SYM	System Maintenance
TAM	Temporary Archive Media
TCID	Test Configuration Identification
TCMS	Test Control and Monitor System
TD	Terminal Distributor
TD&D	Technical Data and Documentation
TDC	Technical Data Center
TGS	Time Generation Subunit
TPS	Test Program Sets
TRS	Test Resource Sets
TTSS	Training, Tracking and Scheduling System
UUT	Unit Under Test
VME	Versa Module European
WAD	Work Authorization Document
WAN	Wide Area Network
WP2	Work Package 2

DEFINITIONS

CORRECTIVE MAINTENANCE

Corrective maintenance is any unscheduled maintenance activity required as a result of the random failure of equipment. It includes the restoration to a functional condition of a failed subsystem, end item, component or part.

DEPOT LEVEL MAINTENANCE

Depot level maintenance consists of those actions that are performed by designated maintenance sources (i.e., depots) such as Original Equipment Manufacturers (OEMs), NASA Centers, etc. Depot maintenance normally consists of activities that require test equipment, facilities, or skills that are not economically available at the intermediate level. This may include removal and replacement of individual components on an LRU, overhauling, manufacturing of unavailable parts, rebuilding parts, and providing technical assistance to the organizational and intermediate levels.

HARDWARE MAINTENANCE ENGINEER

A Test Control and Monitor System (TCMS) Hardware Maintenance Engineer is a member of the TCMS Operations and Maintenance (O&M) organization who is responsible for the Organizational Level maintenance of TCMS. He performs scheduled and unscheduled Organizational Level maintenance/repair of the TCMS hardware.

INTERMEDIATE LEVEL MAINTENANCE

Intermediate level maintenance consists of maintenance activities in direct support of Organizational maintenance that are at a level between Organizational and Depot maintenance. Intermediate level maintenance includes troubleshooting and repair of custom LRUs, isolation to the LRU level for TCMS subsystems that are removed during Organizational level maintenance, and monitoring of intermittent failures.

LINE REPLACEABLE UNIT (LRU)

An LRU is any item that can be removed and replaced during Organizational level maintenance in order to keep TCMS operational. LRUs commonly are printed circuit boards, modules, fuses, subassemblies, or in some cases complete assemblies such as printers.

MASTER CONSOLE OPERATIONS ENGINEER

A TCMS Master Console Operations Engineer (MCOE) is a member of the TCMS O&M organization who is responsible for the operation of TCMS. The

MCOE manages and controls the overall operation of TCMS via the Master Console DP for each test resource set.

MATERIAL SERVICE CENTER (MSC)

The MSC is an activity established to furnish supply support services to all organizations in the immediate area. Each MSC will provide a single point of contact with the Kennedy Space Center (KSC) Supply System. It will receive, stock, and issue material required by the area served.

OFF-LINE MAINTENANCE

Off-line maintenance consists of those functions performed at the Intermediate and Depot levels

OFF-SITE MAINTENANCE

Off-site maintenance refers to maintenance performed by an organization other than Payload Ground Operations Contractor (PGOC).

ON-LINE MAINTENANCE

On-line maintenance functions are those performed at the Organizational level.

ON-SITE MAINTENANCE

On-site maintenance refers to maintenance performed by PGOC organizations.

ORGANIZATIONAL LEVEL MAINTENANCE

Organizational level maintenance consists of actions performed on-line in direct support of Operations. It includes scheduled and unscheduled maintenance actions required to repair, service, calibrate, and verify systems and subsystems. Repair actions will typically be to remove and replace defective LRUs identified by Health and Status or diagnostics.

PIECE PARTS

Piece parts are the individual components used during Intermediate and Depot level, to repair Line Replaceable Units and Shop Replaceable Units. Piece parts consist of components such as resistors, capacitors, semiconductors, etc.

PREVENTIVE MAINTENANCE

Preventive maintenance consists of those actions performed to retain an item in an operable condition by systematic inspection, detection, prevention of incipient failures, replacement of life/cycle limited components, adjustment, calibration, cleaning, and lubrication.

SCHEDULED MAINTENANCE

Scheduled maintenance refers to any preventive maintenance activity.

SHOP REPLACEABLE UNIT (SRU)

SRUs are components or modules for an LRU that can be removed during Intermediate or Depot level maintenance.

SOFTWARE MAINTENANCE ENGINEER

A TCMS Software Maintenance Engineer is a member of the TCMS O&M organization who is responsible for the troubleshooting and maintenance of TCMS software.

SYSTEM SOFTWARE

System software refers to Core Electronic Contractor (CEC) provided software.

UNSCHEDULED MAINTENANCE

Unscheduled maintenance refers to any corrective maintenance activity.

USER

A TCMS user is a member of the KSC test engineering, applications, or simulation software development organizations. Users are responsible for developing the application software and conducting a coordinated test of flight hardware.

SECTION I

INTRODUCTION

1.1 GENERAL

This plan describes the maintenance requirements for TCMS and the method for satisfying these requirements prior to First Need Date (FND) of the last TCMS set. The method for satisfying maintenance requirements following FND of the last TCMS set will be addressed by a revision to this plan. This maintenance plan serves as the basic planning document for maintenance of this equipment by the NASA Payloads Directorate (CM) and the Payload Ground Operations Contractor (PGOC) at KSC.

Throughout this document the terms TCMS Operations and Maintenance (O&M), Payloads Logistics, TCMS Sustaining Engineering, Payload Communications, and Integrated Network Services refer to the appropriate NASA and PGOC organizations.

For the duration of their contract, the Core Electronic Contractor (CEC) will provide a Set Support Team (SST). One of the primary purposes of this team is to help NASA and PGOC operate and maintain TCMS. Throughout this document It is assumed that SST is an integral part of TCMS O&M.

1.2 PURPOSE

The purpose of this plan is to describe the maintenance concept for TCMS hardware and system software in order to facilitate activation, transition planning, and continuing operation. When software maintenance is mentioned in this plan, it refers to maintenance of TCMS system software.

1.3 APPLICABILITY AND SCOPE

This plan is applicable to TCMS equipment and the CM and PGOC organizations involved with the operation and maintenance of this equipment. It describes the maintenance approach and planned methods for satisfying the TCMS maintenance requirements.

1.4 GROUND RULES

The following ground rules provide the baseline for maintaining the TCMS equipment:

a. Preventive and routine maintenance will be integrated with user test and hardware utilization schedules and, to the maximum extent possible, performed on a non-interference basis.

b. On-line (non-intrusive) and/or off-line (intrusive) diagnostic software, and self-test hardware capabilities will be able to isolate malfunctions and degraded performance to the LRU level. Corrective organizational level maintenance will consist of replacing the LRU with a functional spare.

c. The Off-Line Support Area (OSA), located in the Space Station Processing Facility (SSPF), will provide on-line support in the form of hot spares, operations support, and training, as well as vendor on-site support. The OSA will also provide the capability for intermediate level repair of selected TCMS LRUs. Prior to FND of the last TCMS set, this capability may be utilized on an emergency basis if adequate support is not available from other sources. The KSC Core ILMF will provide the capability for repair of custom LRUs.

d. TCMS O&M will provide requirements for Depot Level maintenance (e.g., quality, timelines, spares, etc.) to Payload Logistics in order to select repair facilities that meet the needs of TCMS O&M.

e. Payload Logistics will process LRUs from outside vendors through the OSA so TCMS O&M personnel may ensure they are functional before returning them to Logistics for stocking as a spare. TCMS LRUs repaired by the KSC Core ILMF may be processed directly into stock.

f. Automated Test Equipment (ATE) will be utilized when possible for fault verification of LRUs.

g. Test Program Sets (TPSs) supporting the CEC custom designed hardware, and selected Commercial-Off-The-Shelf (COTS) hardware will be contract deliverables and will undergo acceptance test and be approved by NASA.

h. Special Test Tools and Fixtures will be developed as required to supplement system level troubleshooting and ATE testing. Configuration will be controlled by TCMS O&M utilizing the software tools provided with the HP 3070 ATE.

i. TCMS hardware spares will be located in the SSPF.

j. TCMS O&M will assume operations responsibility at Acceptance Testing Complete (ATC) and Organizational Level maintenance responsibility at FND for each set. The CEC will turn over spares associated with each set delivery at set FND.

k. In some cases a subsystem may exhibit an intermittent failure. In these cases the Organizational Level Maintenance Engineer may choose to send the entire subsystem to the OSA for further troubleshooting and fault isolation.

l. When more detailed troubleshooting is required, the Organizational Level Maintenance Engineer may replace an entire subassembly. When this occurs he will send the suspect assembly to the OSA for fault isolation to the defective LRU.

m. TCMS maintenance responsibilities are shown in table 1-1. The asterisks in the table indicate the organization with primary responsibility. For DMS kits, the organizations responsible for maintenance have not yet been determined.

	CBC	TCMS O&M	TCMS SUSTAINING ENGINEERING	INTEGRATED NETWORK SERVICES	PAYLOADS LOGISTICS	WPI
TCMS ORGANIZATIONAL MAINTENANCE PRIOR TO FND FOR EACH SET	X					
TCMS ORGANIZATIONAL MAINTENANCE AFTER FND FOR EACH SET		X				
TCMS INTERMEDIATE LEVEL MAINTENANCE PRIOR TO FND FOR EACH SET	X					
TCMS INTERMEDIATE LEVEL MAINTENANCE AFTER FND FOR EACH SET					X	
TCMS DEPOT LEVEL MAINTENANCE PRIOR TO FND FOR EACH SET	X					
TCMS DEPOT LEVEL MAINTENANCE AFTER FND FOR EACH SET					X	
TCMS SOFTWARE MAINTENANCE PRIOR TO END OF CONTRACT	X					
TCMS SOFTWARE MAINTENANCE AFTER END OF CONTRACT		X	X*			
TCMS PATCHING		X				
NETWORKS INTERNAL TO TCMS		X				
NETWORKS EXTERNAL TO TCMS		X		X*		
PAYLOAD OFFICE WORKSTATION MAINTENANCE				X		
DMS KIT HARDWARE MAINTENANCE		X?				X?
DMS KIT SOFTWARE MAINTENANCE		X?				X?

NOTES: 1. * INDICATES ORGANIZATION HAVING PRIMARY RESPONSIBILITY
2. ? INDICATES THAT RESPONSIBLE ORGANIZATIONS HAVE NOT YET BEEN DETERMINED

Table 1-1
Maintenance Responsibilities Matrix

1.5 REFERENCE DOCUMENTS

NUMBER	TITLE
83K00007	Core Logistics Plan
83K00015	Core Maintenance Plan
83K03802	Hardware Design and Maintenance for the Software Production Facility (SPF) HWCI
(Number not yet assigned)	Depot Maintenance Support Baseline
K-CTE-63.2	Space Station Test, Control and Monitor System (TCMS) Production Control Plan
KCA-HB-0018.0	Payload Operations Work Authorization Document (WAD) Handbook
KPD-8040.17	Space Station Configuration Management Plan
KSC-STA-05.4	KSC Space Station Quality Assurance Management Plan
KSC-STA-05.5	KSC Space Station Software Product Assurance Management Plan
KSC-STA-20	KSC Space Station Integrated Logistics Support Plan
KSC-STA-20.01	KSC Space Station Logistics Support Analysis (LSA) Plan
KSC-STA-20.02	KSC Space Station Technical Data and Documentation (TD&D) Plan
KSC-STA-20.03	KSC Space Station Maintenance Support Equipment (MSE) Plan
KSC-STA-20.04	KSC Space Station Supply Support Plan
KSC-STA-20.05	KSC Space Station Packaging, Handling, Storage and Transportation (PHS&T) Plan
KSC-STA-20.06	Logistics Information System Plan
KSC-STA-20.07	KSC Space Station Maintenance Plan
KSC-STA-20.08	LMRT Plan
KSC-STA-20.09	KSC Space Station Training Plan
KSC-STA-20.10	KSC Space Station Logistics Facilities Plan
MDC Y1159	Space Station Freedom Program Quality Assurance Plan
MDC-Y1160	Space Station Freedom Program Software Product Assurance Plan
S 00000-8	KSC IDMM Handbook
SP 8.007-A91	Operations and Maintenance Instructions (OMI) Preparation, Publication, and Implementation

SP 10.001-A91	Nonconformance/Problem Reporting and Corrective Action System
SSP 30000 Section 4 Part 2	Program Definitions and Requirements Document (PDRD): Space Station Integrated Logistics Support Requirements
SSP-30000 Section 9	Space Station Freedom Program Definition and Requirements Document, Product Assurance Requirements
TS-TCMS-92001	TCMS Operations and Maintenance Philosophy
TS-TCMS-92002	TCMS Operations Plan
TS-TCMS-92004	TCMS Communication and Patching Plan
(Number not yet assigned)	TCMS Security Plan
(Number not yet assigned)	TCMS Database Management Plan

SECTION II
SYSTEM DESCRIPTION

2.1 GENERAL

TCMS is a major KSC/Core Electronics Contractor (CEC) developed system supporting the Space Station Freedom Program (SSFP) at KSC and Johnson Space Center (JSC). The equipment consists of Commercial-Off-The-Shelf (COTS) and custom hardware, software, and firmware. It is configured into various subsystems and sets to meet the automation requirements of the space station checkout activities. This section describes the major hardware components of TCMS. Figure 2-1 shows a high level view of the TCMS architecture. Figure 2-2 shows a typical TCMS operational set configuration

2.2 TCMS SETS

TCMS is configured into sets and subsets of end-item equipment at various locations. The CEC will deliver three sets (configured as six half sets) for support of the SSPF test stand area, one set to the OSA, one set to the hazardous facility, one set to the CAF/CSF at JSC, and SN0. TCMS sets are configured from the following assemblies:

2.2.1 DISPLAY PROCESSOR. The Display Processor (DP) is the system interface to the user within the Core distributed architecture. It includes a 32 Bit Central Processing Unit (CPU) running UNIX based ULTRIX, a keyboard, a pointing device, a primary display, up to three slave monitors, a removable media device, and an MS DOS compatible floppy disk drive. The DPs directly interface with the Display Network Subsystem (DNS) for accessing the Application Processor (AP), Processed Data Recorder (PDR), Data Base Subsystem (DBS), Service Network (SN), Software Production Facility (SPF), and external systems such as Payload Data Management System (PDMS).

2.2.2 APPLICATION PROCESSOR. The Application Processor (AP) is the UNIX based data processing node within the Core distributed architecture. It is a computation intensive subsystem that primarily executes real time system services and test application programs. It consists of two 32 bit CPUs, a 500 megabyte hard disk drive (upgradeable to 2 gigabytes), and a removable media device. It interfaces directly with the DNS for access to the DPs and through a Buffer Input/Output Processor (BIOP) to the Real Time Network (RTN).

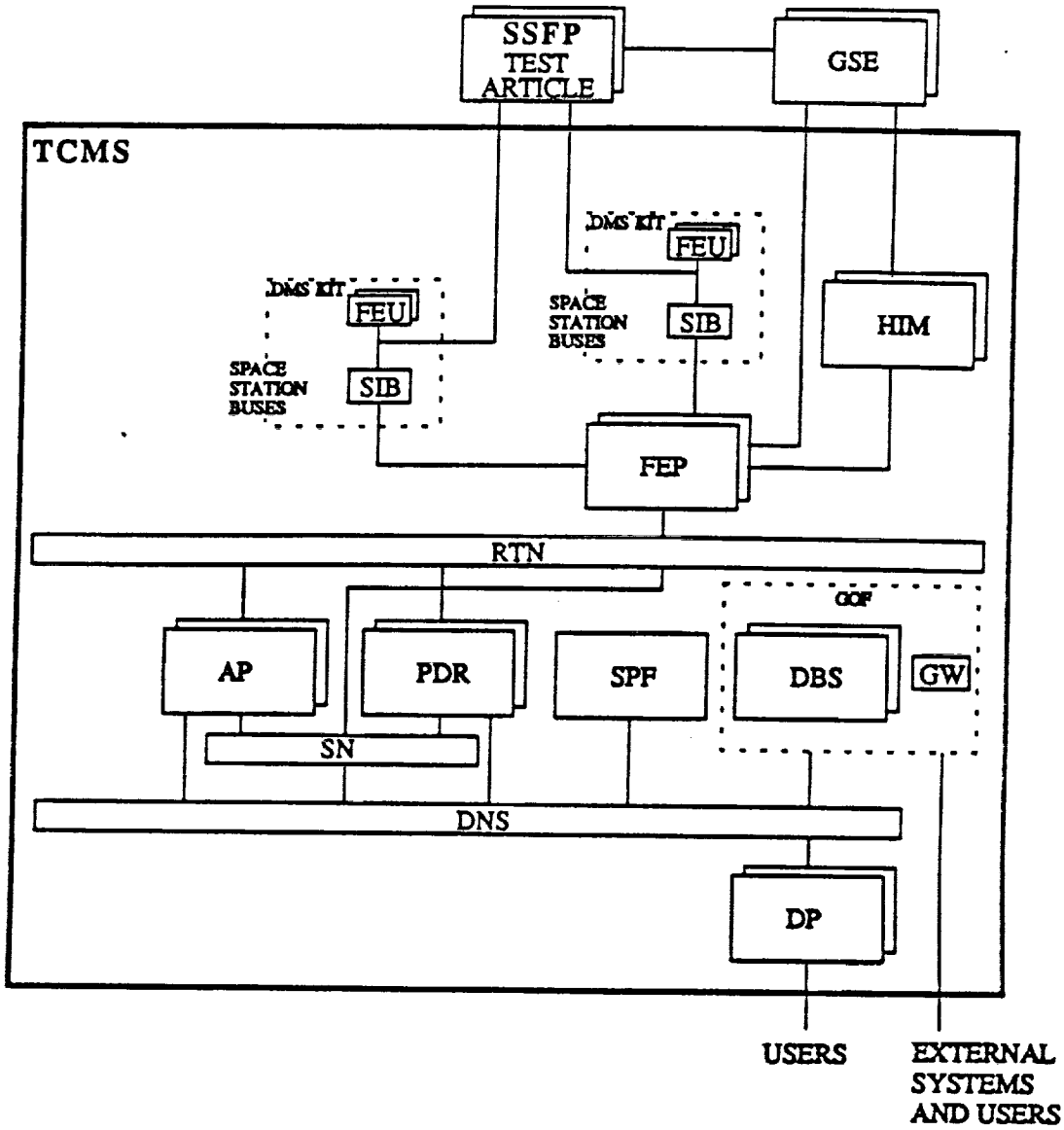

FIGURE 2-1
TCMS ARCHITECTURE

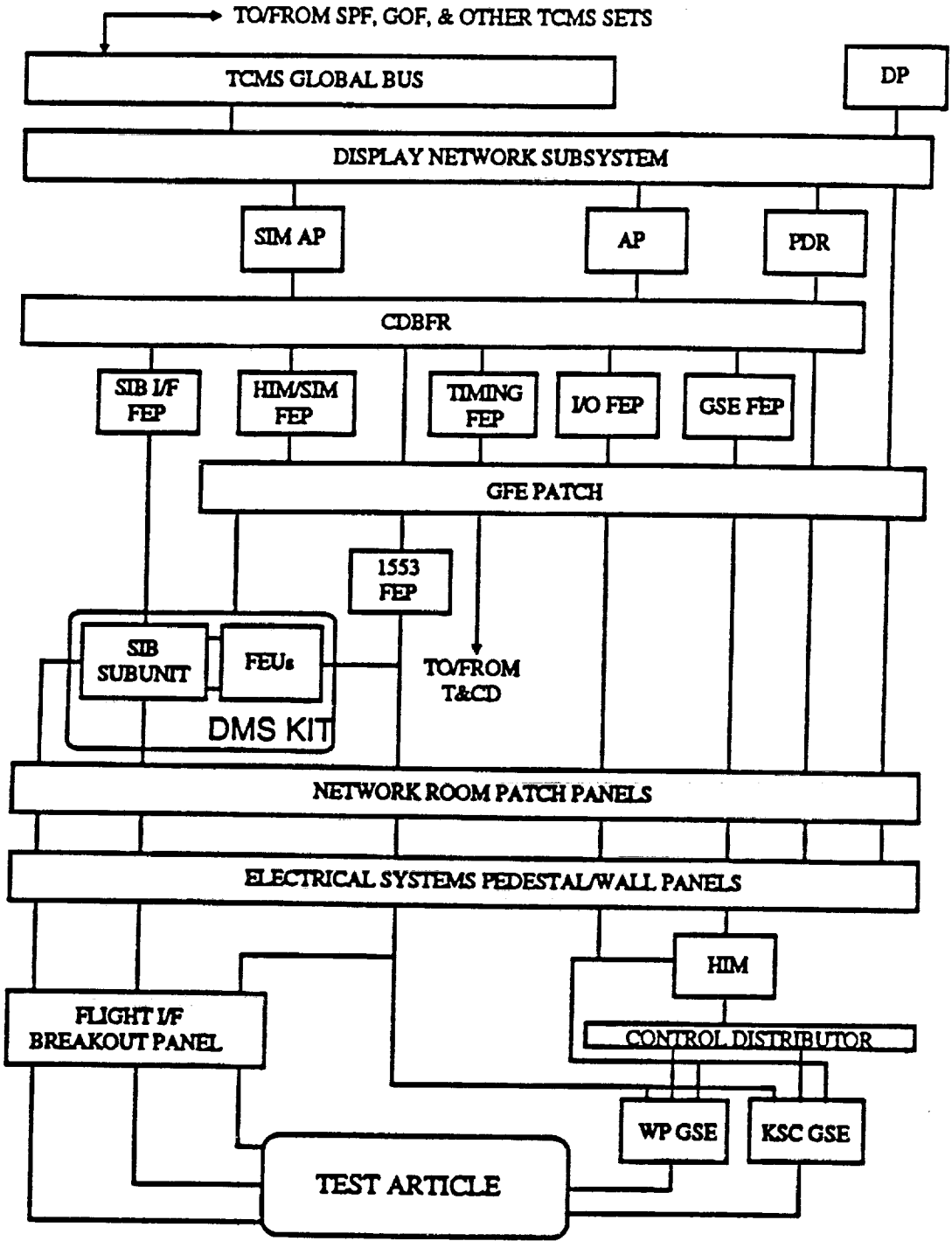

FIGURE 2-2
TYPICAL TCMS OPERATIONAL SET CONFIGURATION

2.2.3 FRONT END PROCESSOR. The Front End Processor (FEP) is a universal hardware element that performs the data processing necessary to support a wide variety of synchronous and asynchronous test article control and data acquisition at the front end interfaces. It consists of several CPU and interface modules housed in a Versa Module European (VME) bus chassis. The specific interfaces required govern the configuration of this subsystem. The FEP has the capability to process all known Space Station, Payload, and Ground Support Equipment (GSE) data types by configuration of interface cards, custom software, and customized high performance filter modules. The FEP communicates to the other subsystems by way of the RTN through a BIOP.

2.2.4 REAL TIME NETWORK. The Real Time Network (RTN) provides message and data communication capability for attached processors. The RTN utilizes star topology with hosts connected to the central node through dedicated, high speed, point-to-point links. Through access control of shared data storage area and message routing tables, the hosts attached to the RTN can be configured into multiple Test Resource Sets (TRSs) to support parallel operations.

The RTN consists of the Common Data Buffer (CDBFR), host resident BIOPs, and host resident Monitor Input/Output Processors (MIOPs). The BIOP supports the exchange of single, multiboard, and homogeneous data sets as well as messages. Error detection and correction and/or error reporting mechanisms ensure the integrity of the information. The MIOP is a unidirectional link that routes data passing through the RTN to a Processed Data Recorder (PDR).

2.2.5 DISPLAY NETWORK SUBSYSTEM. The Display Network Subsystem (DNS) provides a communication path for system operations. The DNS provides the capability to isolate the DPs and APs into Local Display Buses (LDPBs) with filtered interfaces to the Global Display Bus (GDPB). The LDPB allows all local traffic to be generated without interfering with data traffic on the GDPB.

2.2.6 SERVICE NET. The Service Net (SN) provides a communication path for maintenance operations. The SN provides capability for remote and local access to operation and maintenance services for applicable TCMS hardware.

2.2.7 HARDWARE INTERFACE MODULE. The Hardware Interface Module (HIM) acts as the front-end element of TCMS and is connected to the GSE Data Bus for communications with the FEP. A FEP may control up to sixteen HIMs via a ground data bus. The modular design of the HIM accommodates several types of interfaces depending upon the particular configuration required.

There are two basic types of HIMs, slave and standalone (also known as a smart or Local Processor Control (LPC) HIM). The slave HIM is always connected to a FEP and its sole function is to transfer measurement data from a GSE device to the FEP, or to pass a

command from the FEP to the specific GSE device. Thus, there is no algorithmic processing of measurements or command generation in the slave HIM. The standalone HIM interfaces to GSE equipment as in a slave HIM, but it gathers measurements and issues GSE commands without requiring a FEP.

2.2.8 PROCESSED DATA RECORDER. The Processed Data Recorder (PDR) records data from the RTN to support near real time retrievals and post-test retrievals. The data consists predominantly of preprocessed test article data from a FEP. The PDR records on two different media simultaneously. One media, Temporary Archive Media (TAM), supports the near real time retrievals and the other, Permanent Archive Media (PAM), supports a historical record. The PDR interfaces with the RTN for data recording.

2.2.9 DATA BASE SUBSYSTEM. The Data Base Subsystem (DBS) provides the data management and data handling functions to support the data display and analysis performed during and after tests. The DBS supports real time data storage and retrieval as well as media library data base management. During a test the DBS supports data retrieval and analysis of the PDR recorded data.

2.2.10 DATA MANAGEMENT SYSTEM. A Data Management System (DMS) kit is an integrated set of electronic units and an interface device to connect these components to a host computer. DMS kits are used for code verification and test support in place of the flight hardware.

The DMS kit typically contains a TCMS Simulation Interface Buffer (SIB) and a set of DMS Functional Equivalent Units (FEUs). The SIB is the interface device within the DMS kit that provides the interface bridge to the Space Station Freedom environment, including the local buses and networks. The FEUs are non-flight versions of various space station flight components.

The DMS kit configuration will vary depending on mission specific requirements and phase of testing. The kit operational components are:

- Simulation Interface Buffer
  - Local Control Workstations (LCWS)
  - System Development and Diagnostic Subunit (SDDS)
  - Network Monitor Subunit (NMS)
  - Network Simulator Subunit (NSS)
- Functional Equivalent Units
  - Intermediate Rate Gateway (IRGW)
  - Intermediate Gateway (IGW)
  - Multiplexer/Demultiplexer (MDM)
  - Ring Concentrator (RC)

- Standard Data Processor (SDP)
- Mass Storage Unit (MSU)
- Multipurpose Applications Console (MPAC)
- Time Generation Subunit (TGS)

The space station DMS buses and networks include MIL-STD 1553B local buses, ANSI X3T9.5/83-15FDDI networks, and an EIA RS-422A time distribution bus.

2.2.11 PATCH PANELS. The TCMS Patch Panels provide for the interconnection of TCMS subsystems and the connection with systems external to TCMS. SSPF patching is accomplished in the Central Communications Room (Rm. 1025), the Networks Room (Rm. 1026), the Communications & Tracking Room (Rm. 1062), the Test & Simulation Room (Rm. 2021), the Control Support Room (Rm. 2023), High Bays, Intermediate Bays, and Off-line labs (Rms. 1077, 1083 & 1098). Payload Spin Test Facility - Replacement (PSTF-R) patching is accomplished in the Flight Data Communications Room (Rm. 117). Patching for the Hazardous Operations Support Facility (HOSF) is accomplished in the HOSF Control/User Room (Rm. S109).

Currently there are 97 DMS Kit patch racks, the majority of them being in SSPF Rm. 2021. Because of the complexity involved in patching this quantity of racks, default patching configurations will be used as much as possible as long as modifications can still be made as required.

Figure 2-3 is a diagram of the patching scheme used on TCMS. This diagram is preliminary and has areas of uncertainty shown with question marks. TCMS O&M will revise this drawing when the interfaces in question are firmed up. For more detailed information on TCMS patching, and a description of all the interfaces needed to support testing in each of the three facilities (SSPF, PSTF-R, and the HOSF), reference the TCMS Communications and Patching Plan (TS-TCMS-92004).

2.2.12 SOFTWARE PRODUCTION FACILITY. The SPF is the hardware set used for development and configuration management of applications and simulation software. It allows software developers to perform final compiles on the target subsystems and serves as a local repository for downloaded Master Object Data Base (MODB) data, build data, and test configuration functions. The SPF is composed of the following baseline equipment:

- Host Computer Systems
- Cluster Controller to Disk Drive Interface

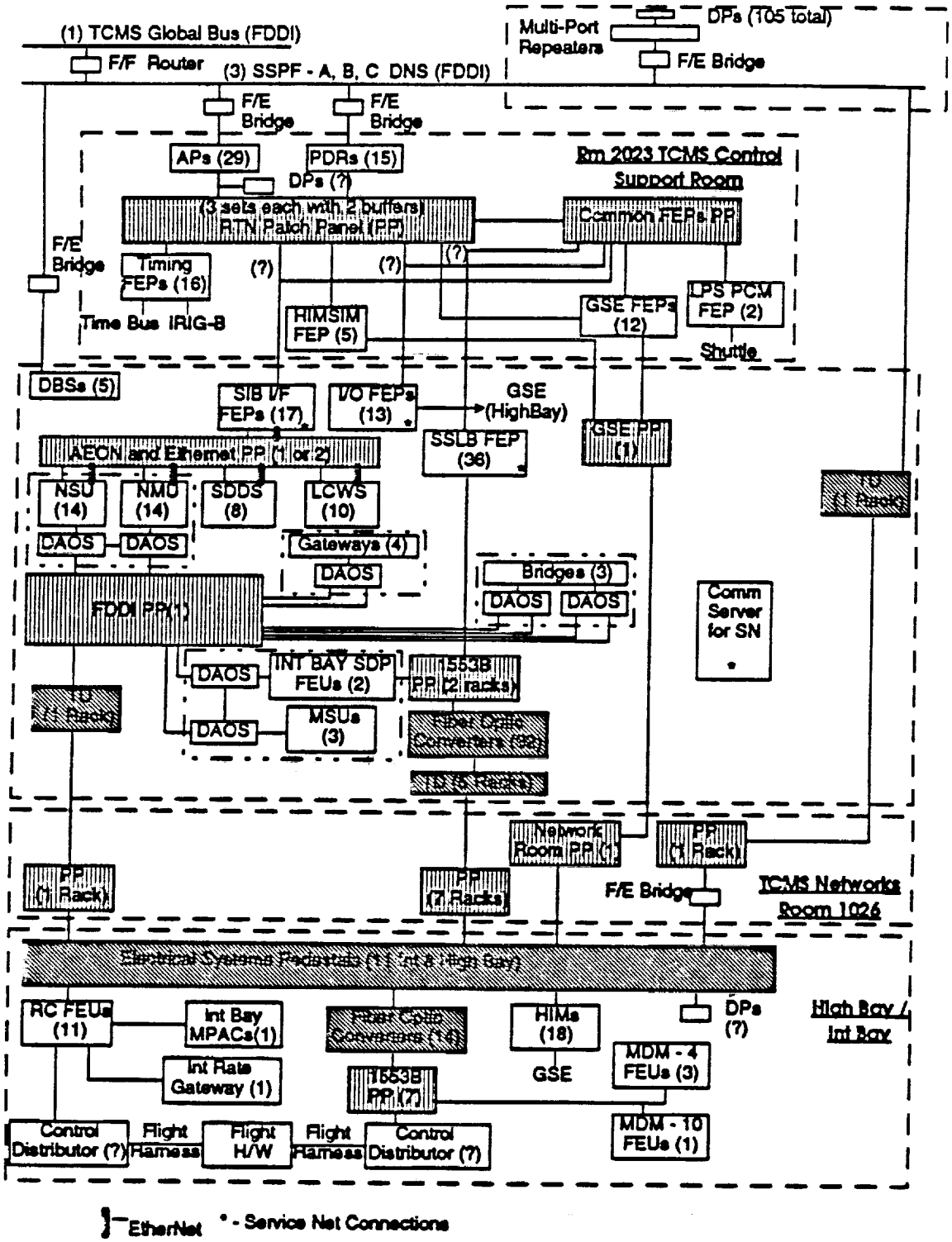

FIGURE 2-3
PATCHING DIAGRAM

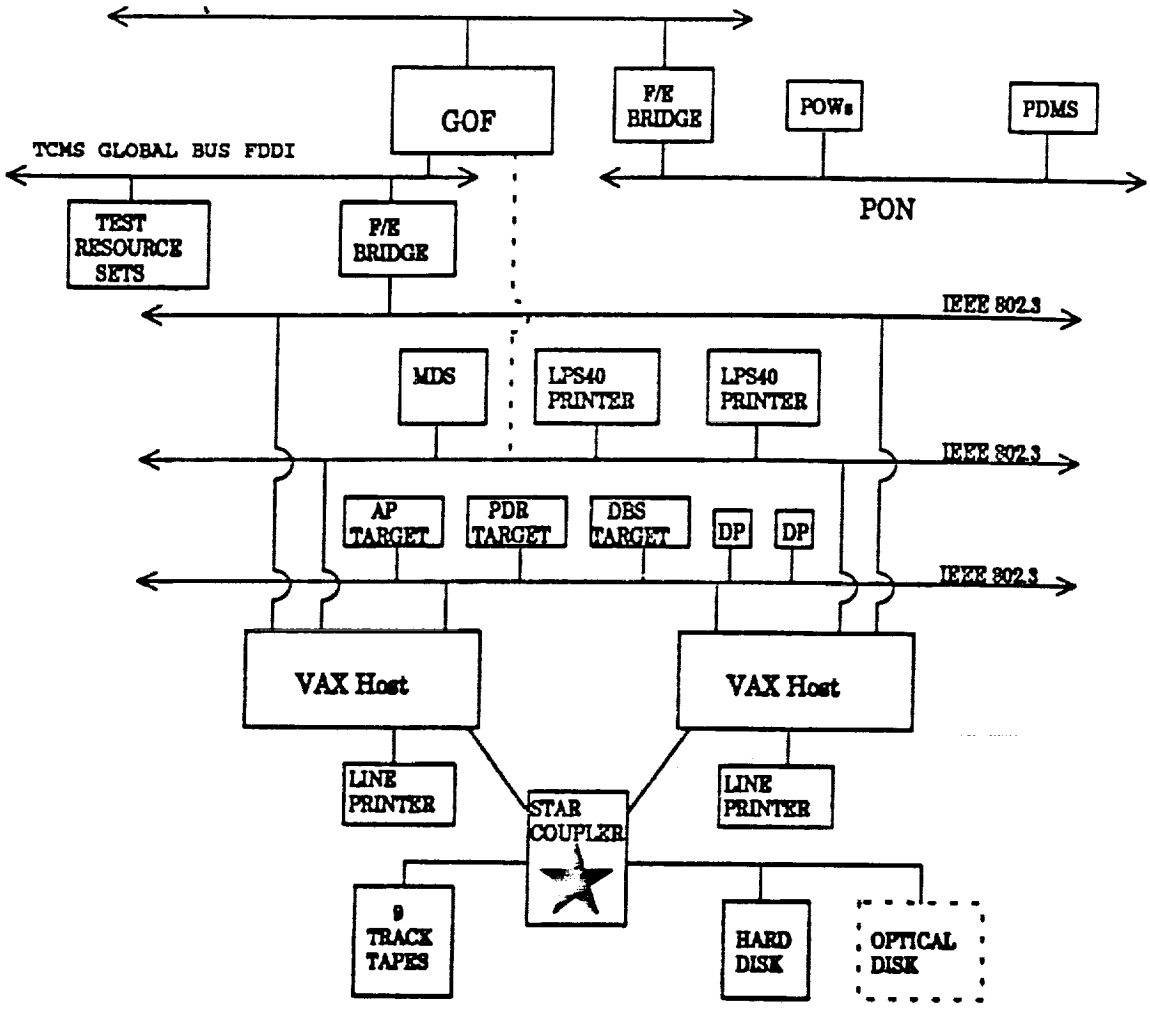

FIGURE 2-4
SPF ARCHITECTURE

- Disk Drive Storage Unit
- Tape Drive
- Target APs
- Target PDR
- Target DBS
- Line Printers

Figure 2-4 describes the SPF architecture. For a more detailed description of the SPF equipment see Hardware Design and Maintenance for the SPF HWCI (83K03802).

2.2.13 NETWORK INTERFACES. TCMS internal network interfaces include the DNS, the SN, and the RTN. The DNS; which consists of the TCMS Global Bus, the GDPB, and the LDPB, provides the communication path for normal system operations. The SN provides the communication path used for maintenance and diagnostic operations. The RTN provides for test data flow between the FEPs and the AP and PDR. In addition, it provides subsystem interfaces, message routing, common data storage, and a data logging interface. Through control of the subsystem interfaces, the RTN provides for the addition, deletion, and logical partitioning of attached resources into Test Resource Sets (TRSs).

TCMS external network interfaces are accessed via the Payload Operations Network (PON). The PON is an administrative network that provides connectivity to PDMS, Payload Office Workstations (POWs), the Production Tracking System (PTS), Computer Aided Design/Computer Aided Engineering (CAD/CAE), Broadband Communication Distribution System (BCDS), and Program Support Communications Network Internet (PSCNI). Once approved, Security ESRs that are now pending will protect TCMS and Test Articles from access by unauthorized clients.

Figure 2-5 describes the TCMS network interfaces. For more detailed information on TCMS network interfaces, refer to the TCMS Communications and Patching Plan (TS-TCMS-92004).

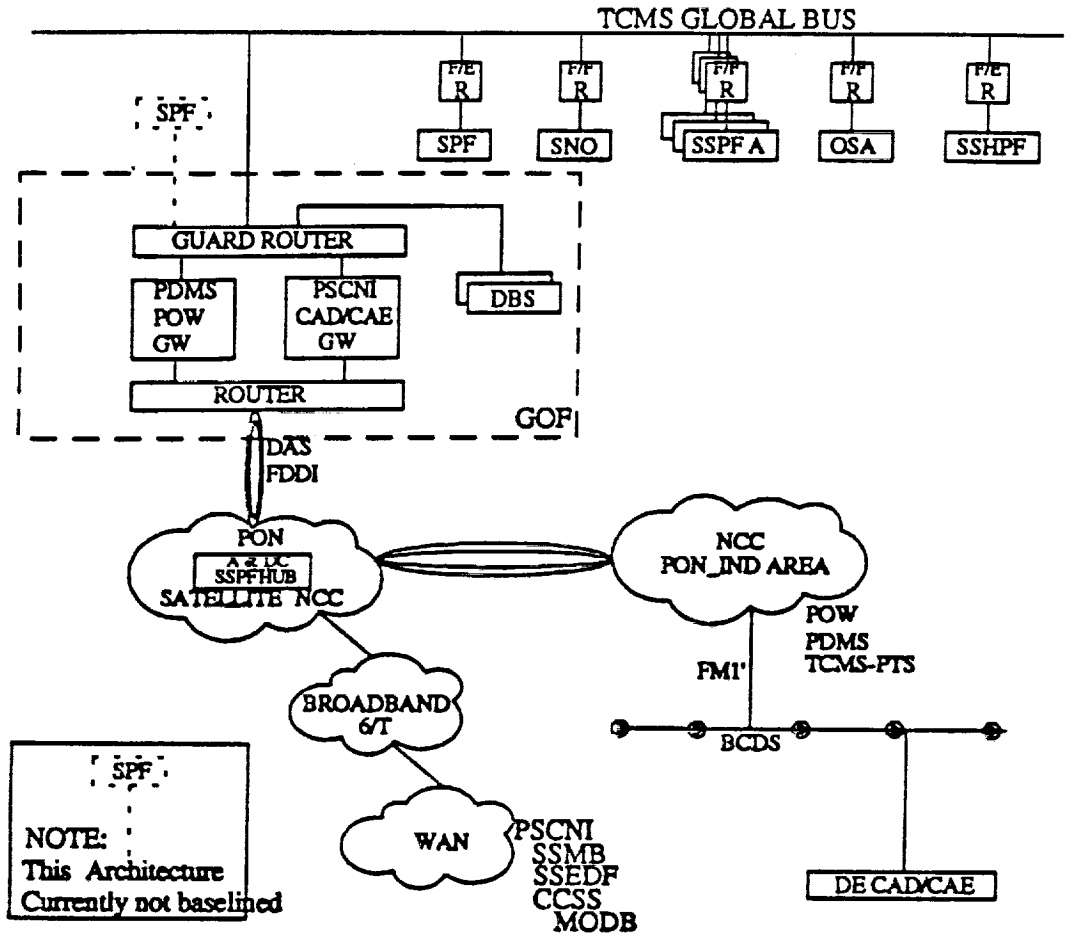

FIGURE 2-5
NETWORK INTERFACES

SECTION III
ORGANIZATIONAL MAINTENANCE

3.1 GENERAL

Operations and Maintenance of TCMS sets will initially be the responsibility of the CEC. The present plan calls for TCMS O&M to assume operations responsibility at Acceptance Testing Complete (ATC) and Organizational Level maintenance responsibility at First Need Date (FND) for each set. Prior to turnover of responsibility, TCMS O&M will work with NASA DL and the CEC to operate, monitor health and status, run diagnostics, troubleshoot, repair, and verify TCMS. This will help to ensure an efficient turn over of responsibilities and will give KSC TCMS O&M personnel an insight into the operation and maintenance of the TCMS hardware.

Organizational level maintenance below the LRU level will be minimal with maintenance normally consisting of LRU removal and replacement on a scheduled or unscheduled basis. TCMS O&M will replace a defective LRU with a spare provided by Logistics Supply Support or with a hot spare from the Off-Line Support Set (OSS) that is part of the OSA. Once the defective LRU is replaced, Operational Readiness Test (ORT) will be used to verify the repair, first at the subsystem level and then at the system level.

Organizational maintenance consists of preventive (scheduled) and corrective (unscheduled) maintenance. TCMS O&M will perform preventive maintenance activities primarily during non operating periods in order to optimize system availability for operational activities. Corrective maintenance will be performed when problems are detected by health and status monitoring or other diagnostic software as described in paragraph 5.2. All corrective maintenance activities will be documented per SP 10.001-A91, Nonconformance/Problem Reporting And Corrective Action. See paragraph 6.3 for more detail.

3.2 PREVENTIVE MAINTENANCE APPROACH

TCMS O&M will determine preventive maintenance requirements using applicable system specification documents, LSA, and O&M manuals supplied with the hardware. TCMS O&M will modify and refine these requirements based on failure and trend data obtained from the Production Tracking System (PTS) and other maintenance records. TCMS O&M will add or delete specific tasks and adjust maintenance frequencies to minimize system down time and optimize system performance. TCMS Maintenance Engineering will provide all preventive maintenance requirements to TCMS Operations Engineering for scheduling.

TCMS O&M will document these scheduled system maintenance tasks using Preventive Maintenance Operations and Maintenance Instructions (PMOMIs). Quality Assurance (QA) will approve these procedures prior to their usage. These PMOMIs will specify inspection of assemblies for dust, dirt, corrosion, and visible damage or wear. If applicable, the PMOMI will specify running diagnostic programs to check the operation of systems and subsystems. Each PMOMI will also incorporate the specific maintenance tasks required for the identified hardware.

3.3 CORRECTIVE MAINTENANCE APPROACH

The TCMS corrective maintenance approach will be to remove and replace the defective LRU identified by diagnostics and to perform alignment, and verification of the repaired equipment. All stages of corrective maintenance will be coordinated with the MCOE.

Problem Reporting And Corrective Action (PRACA) guidelines and procedures will be followed as outlined in section 6.3. After replacing the LRU, the Hardware Maintenance Engineer will re-test the subsystem using subsystem Operational Readiness Test (ORT) and diagnostics.

The Hardware Maintenance Engineer may also use general test equipment or specialized test equipment such as Configuration, Calibration and Test Set (CCATS), FIT, or RTN Analyzer to provide the stimuli and test equipment to validate the set hardware and software.

When the Hardware Maintenance Engineer has repaired the subsystem, he will notify and work with the responsible TCMS MCOE who will load the appropriate software, configure the set, and run set level ORT and/or diagnostics to functionally test all allocated resources. Once the set hardware is satisfactorily repaired, the Hardware Maintenance Engineer will summarize the maintenance steps and provide a recommendation for closure on the PRACA form.

3.4 OSA SUPPORT FOR ORGANIZATIONAL MAINTENANCE

3.4.1 TIME CRITICAL REPAIR. On some occasions, failure of a TCMS component may occur during a critical test or event and the replacement of an entire subsystem with a known fully functional subsystem from the Off-Line Support Set may be the most efficient and effective method to minimize downtime. On these occasions, the defective subsystem will be sent to the OSA for troubleshooting and further analysis. Once the defective LRU in the subsystem is isolated, it will be removed and replaced with a functional spare.

3.4.2 TROUBLESHOOTING INTERMITTENT FAILURES. On some occasions a subsystem will exhibit an intermittent failure that cannot be isolated on-line without

causing undue system downtime. When this occurs it will be necessary to remove and replace the entire subsystem using a replacement subsystem from the OSA. The suspect subsystem will then be sent to the OSA for in-depth troubleshooting. Once the problem is isolated and the defective LRU is identified, the subsystem will be repaired by removal and replacement of the LRU. The repaired subsystem will then be returned to the Off-Line Support Set or the operational set as appropriate.

3.4.3 HOT SPARES. For reasons such as schedule impact, the Test Conductor in conjunction with TCMS O&M may decide that turn-around time for set repair is critical. In these cases, hot spares may be removed from the Off-Line Support Set. Replacement LRUs for the Off-Line Support Set will then be ordered through the normal channels and installed when they arrive. Spares from the Off-Line Support Set have several advantages:

- They are from a working system and therefore have the highest confidence level.
- They are located nearby operational sets in the OSA and therefore require minimal time to acquire.
- LRUs requiring configuration may already be in the proper configuration.

3.5 DMS KIT MAINTENANCE APPROACH

Maintenance responsibility for DMS kits has not yet been defined. At the present time TCMS O&M has no requirements to maintain DMS kits but this is subject to change. Since Work Package 2 (WP2) developed DMS kits as Special Test Equipment (STE), they will not supply documentation meeting the same standards as GSE. In addition, WP2 is not currently planning to perform an LSA. They do not intend to provide any Mean Time Between Failures (MTBF) data either. Therefore, TCMS O&M does not know the extent of the effort required to perform maintenance on the DMS kits. TCMS O&M will need to fully understand the effort required and the support provided by WP2 if given the responsibility of DMS kit maintenance. Specifics have not been determined at the time of this writing.

3.6 PSTF-R MAINTENANCE APPROACH

Organizational level maintenance of TCMS equipment located in the Payload Spin Test Facility - Replacement (PSTF-R) will be performed in an identical manner to the maintenance of TCMS hardware located elsewhere, with few exceptions. Due to the limited amount of equipment and the remote location, maintenance personnel and supplies will not be located in the PSTF-R. Instead, when the TCMS MCOE encounters a problem, he will schedule and dispatch personnel from the SSPF to investigate. Maintenance personnel will take the replacement LRU and any special tools needed.

3.7 TCMS CABLE AND PATCHING MAINTENANCE APPROACH

TCMS O&M should have sufficient test equipment to determine when an anomaly is due to patching or cabling. If a problem exists with a patching cable, TCMS O&M will remove and replace it with a suitable spare. When the TCMS Maintenance Engineer determines that the problem is due to facility cabling, he will notify Payload Communications which has the responsibility for resolution of the problem.

3.8 CAF/CSF MAINTENANCE APPROACH

At the time of this writing the maintenance approach for the CAF/CSF set located at JSC has not been determined. It is envisioned that a small team from KSC will be permanently transferred to Houston to perform Operations and Organizational Maintenance functions. Organizational Maintenance approaches will be identical to those used at KSC wherever possible. It is also envisioned that a stock of spares will be available at JSC to support organizational maintenance and that defective LRUs will be returned to KSC for disposition and repair.

3.9 MAINTENANCE APPROACH FOR SETS LOCATED AT THE CEC

The CEC will have responsibility for all maintenance of TCMS sets while they are located at the CEC. This will include responsibility for Organizational level, Intermediate level, and Depot level maintenance as well as generation of the required PRACA paperwork.

The CEC will maintain a dedicated pool of spare LRUs to support maintenance. Defective LRUs will be repaired by the CEC, returned to the OEM, or sent to the appropriate depot for repair. Repaired LRUs may be verified using SN0, assuming it is not already in use and is in the proper configuration. If spares cannot be verified using SN0 they may be installed directly into the system requiring maintenance with no prior verification.

TCMS O&M personnel will be temporarily stationed at the CEC when the TCMS B1 set is delivered. This will accomplish the following goals:

- Familiarize personnel with the system and provide On-the-Job Training (OJT)
- Develop and test O&M concepts, procedures, and Operations and Maintenance Instructions (OMIs)
- Assess the adequacy of TCMS system maintenance software, diagnostics, and CEC provided test equipment.
- Provide additional O&M support

3.10 MAINTENANCE FLOW DIAGRAMS

3.10.1 ANOMALY RESOLUTION FLOW. Figure 3-1 describes the overall flow for TCMS organizational maintenance and anomaly resolution. In some cases, the root cause of a particular problem may not be known and it may therefore be unclear whether TCMS O&M or Integrated Network Services has responsibility for correcting the problem. In these cases, a joint effort between TCMS O&M and Integrated Network Services will be initiated to isolate the problem. TCMS O&M will be the lead during this anomaly resolution. Integrated Network Services will be responsible for correcting any problems with the POWs. The "Joint TCMS and Integrated Network Services Maintenance" box in figure 3-1 refers to this cooperative troubleshooting effort.

Once the problem is isolated to hardware or software, the repair flow continues on figure 3-2 or figure 3-4.

3.10.2 HARDWARE REPAIR FLOW. Figure 3-2 describes the flow for hardware maintenance of TCMS. It also includes the decision to use hot spares or to obtain an LRU through the normal channels. After completion of the steps on figure 3-2, the flow continues on figure 3-1.

3.10.3 LRU REPAIR FLOW. Figure 3-3 describes the flow for repair of LRUs removed in figure 3-2. The "Vendor Repair" box in this figure refers to both Return to Vendor (RTV), and on-site vendor contracts.

3.10.3.1 Special Hardware Dispositioning The box in figure 3-3 marked "Special Hardware Dispositioning" represents the actions taken as the result of recurring failures. Each time an LRU is processed through the OSA, failure data will be entered into the PTS. When the OSA cannot verify a problem with an LRU sent to the OSA, the PTS will be used to determine if the problem is recurring. It is anticipated that the quantity of this type of failure will be limited and each will be handled on a case-by-case basis. For recurring problems, TCMS O&M personnel have several options depending on the circumstances.

1. If the problem is not an isolated case (i.e., it appears to be a design problem) and the LRU is custom, TCMS O&M may work with the CEC or TCMS Sustaining Engineering to ensure that the problem is properly resolved.
2. If the problem appears to be a design problem with a COTS LRU, TCMS O&M may elect to return the LRU, through Payloads Logistics, to the appropriate repair facility and work with that repair facility to ensure the problem is corrected.

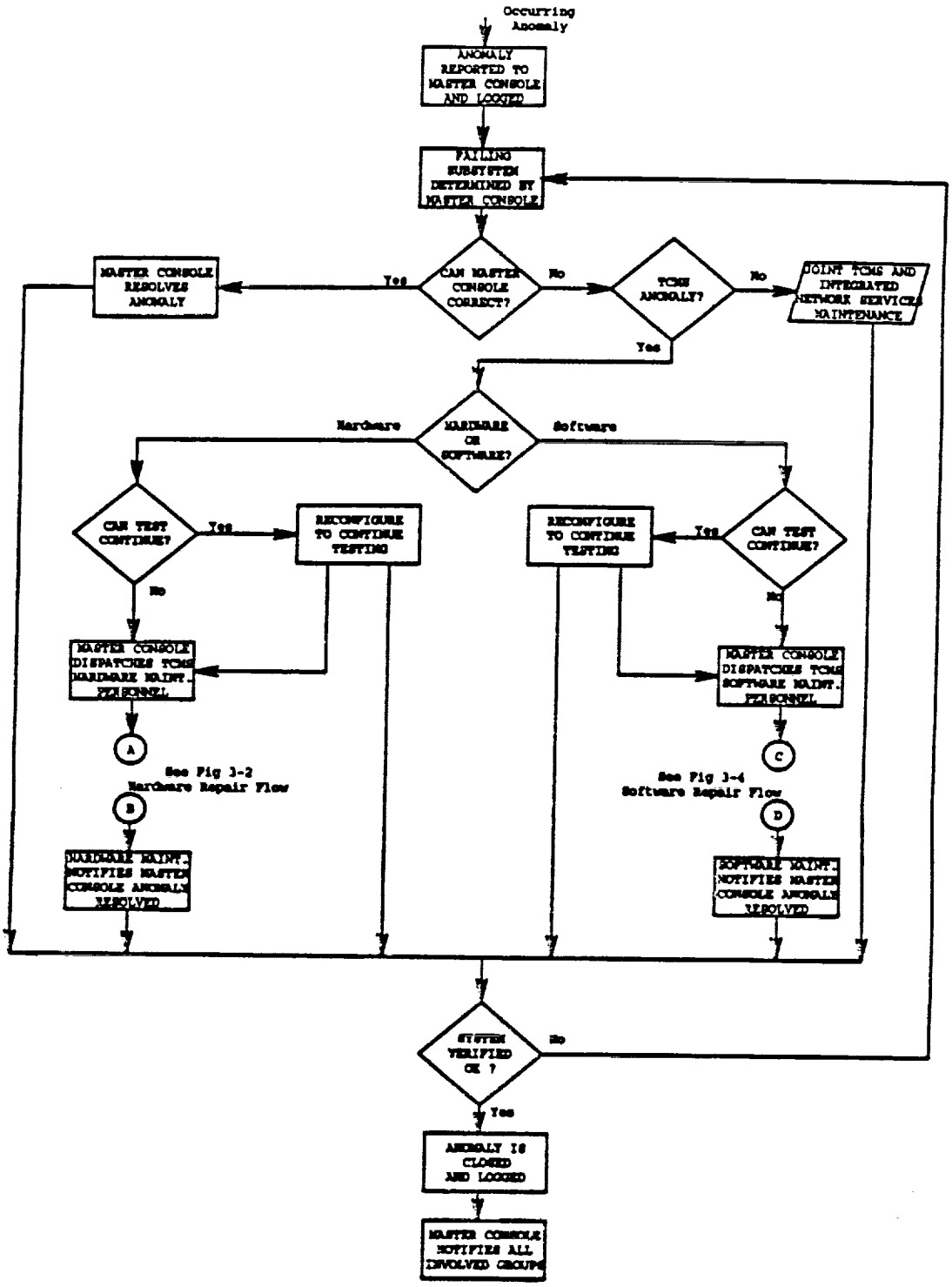

FIGURE 3-1
ANOMALY RESOLUTION FLOW

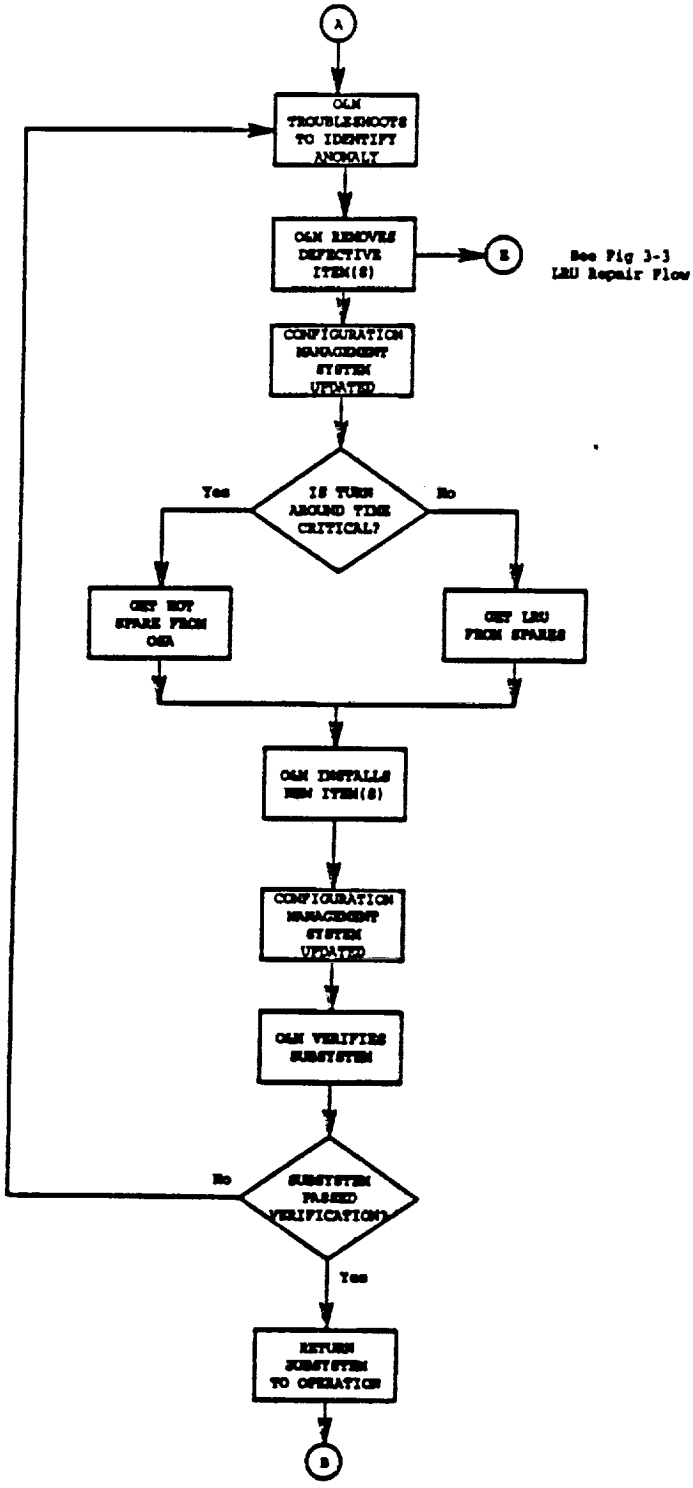

FIGURE 3-2
HARDWARE REPAIR FLOW

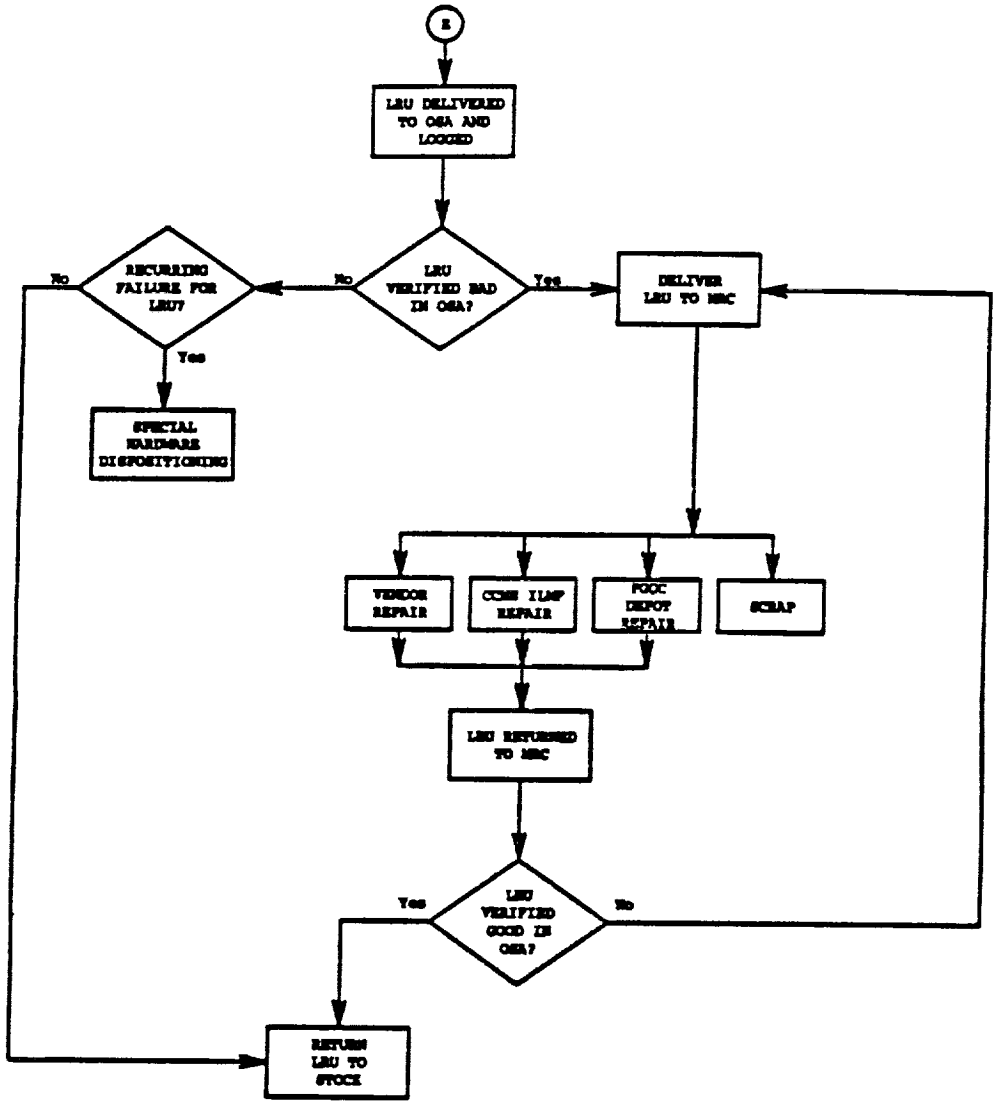

FIGURE 3-3
LRU REPAIR FLOW

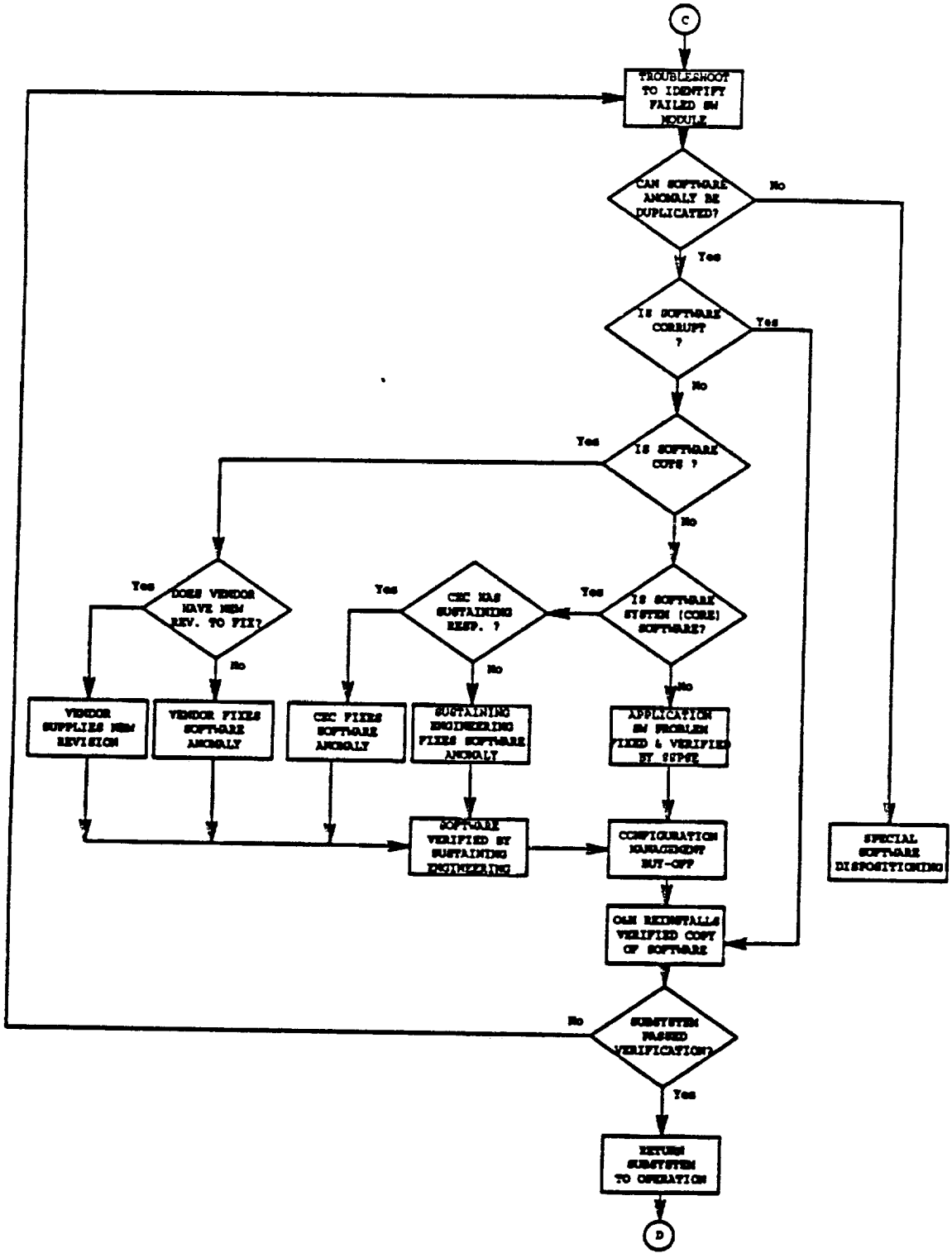

FIGURE 3-4
SOFTWARE REPAIR FLOW

3. TCMS O&M may elect to have the LRU scrapped through the Material Review Center (MRC).

Some LRUs will not exhibit a problem after being returned to the OSA. In most of these cases this will be because they are functional LRUs that were inadvertently removed during Organizational Maintenance. It is conceivable that two or more LRUs may be removed and replaced before the defective LRU is isolated. In this case, all removed LRUs would be sent to the OSA for identification of the defective LRU and verification of the functional LRUs.

3.10.4 SOFTWARE REPAIR FLOW. Figure 3-4 describes the software maintenance flow. This figure contains a box marked "Special Software Dispositioning" that represents the actions taken when a software problem cannot be duplicated.

All software repairs will require PRACA to be opened and coordinated through the appropriate approval signatures before work may begin.

3.10.4.1 Special Software Dispositioning. When software anomalies cannot be readily duplicated, TCMS O&M Software Engineering will work with the CEC, TCMS Sustaining Engineering, Space Station Payload Software Engineering (SSPSE), or the COTS software vendor as appropriate to isolate and resolve the difficulty. TCMS O&M Software Engineering will track and status these anomalies until they are fully resolved.

3.11 MAINTENANCE SCENARIOS

Maintenance scenarios will vary slightly, as described below, depending on where the problem is encountered. Problems may be experienced by users of a DP, users of a POW, they may be reported to the MCOE via System Maintenance (SYM), or they may be discovered during preventive maintenance or subsystem validation. Regardless of the origin of the trouble report, the MCOE will log all anomalies in the problem tracking database. The exact details of the database that will be used for problem tracking have not been determined at the time of this writing.

3.11.1 PROBLEM DETECTED AT A DISPLAY PROCESSOR. The user's method of interfacing with an active set is primarily through a DP in one of the nine user control rooms. During testing, the Test Conductor is responsible for directing the test and monitoring all activity in the user room. Users who encounter any hardware or software problems will report them directly to the Test Conductor. The Test Conductor will then notify the Client Support Area via OIS-D. If OIS-D is unavailable, a telephone is available. If a Test Conductor is not present, user reports will go directly to the Client Support Area. The Client Support Area, which is a subset of the Master Console, serves as the link between users and O&M personnel.

The MCOE will request QA to open an Interim Problem Report (IPR) before an investigation of the problem is started and troubleshooting begins. QA may not be located at the set but they will be available via OISD. Refer to section 6.3 for a more detailed discussion of IPRs, PRs and PRACA.

The MCOE will attempt to isolate which subsystem is at fault and whether the problem is due to hardware or software. When the MCOE verifies the problem and is unable to correct it, TCMS Organizational Maintenance Engineering will be contacted and they will begin troubleshooting the problem. Typically, once the problem has been isolated to an LRU, the IPR will be upgraded to a Problem Report (PR). TCMS O&M will then remove and replace the defective LRU and run subsystem diagnostics to verify the repair. When satisfied with the repair, the Maintenance Engineer will notify the MCOE. The MCOE, in conjunction with the Maintenance Engineer, will then re-load system software and run system level diagnostics to verify the repair.

When the MCOE and the Maintenance Engineer determine that the system has been repaired, it will be returned to operation and the problem report will be closed following PRACA guidelines. A Component Problem Report (CPR) will be generated for any defective LRUs removed during Organizational Level Maintenance. This CPR, along with a copy of the closed system level PR, will accompany the LRU to the repair facility. The Client Support Area will then notify the user who originally encountered the problem.

3.11.2 PROBLEM DETECTED ON A WORKSTATION. If a user on a POW encounters a problem, they will notify the Integrated Network Services Help Desk via telephone. Integrated Network Services will log the trouble ticket into the Integrated Management Tracking System (IMTS) and initiate troubleshooting to determine if it is a TCMS problem or an Integrated Network Services problem. If the problem is due to the POW or the PON, they will correct the problem. If they determine the problem is due to TCMS, they will contact the TCMS Client Support Area and the remainder of the scenario will be identical to 3.11.1 with the exception that Integrated Network Services will be notified when the problem is corrected and they will notify the user who encountered the problem.

3.11.3 PROBLEM REPORTED TO THE MASTER CONSOLE. The MCOE will be continually monitoring the TCMS hardware using the Hardware Monitor graphical window. This window will provide the MCOE with notification of failures in addition to Health and Status information. In addition, Health and Status will provide a system message for any system errors. When an error is reported, the MCOE will then attempt to isolate and/or correct the problem. If he is unable to correct the problem, he will notify TCMS Organizational Maintenance Engineering and the remainder of the scenario will be identical to 3.11.1.

3.11.4 PROBLEM DETECTED DURING PREVENTIVE MAINTENANCE. If a TCMS Maintenance Engineer discovers a problem while performing preventive maintenance, he will notify the TCMS Client Support Area via OIS-D or telephone. The MCOE may then run additional diagnostics if appropriate. Depending on the severity of the problem and the criticality of need for the equipment, the MCOE may opt to delay repair until a more appropriate time. The remainder of the scenario will be identical to 3.11.1.

3.11.5 PROBLEM DETECTED DURING SUBSYSTEM VALIDATION. If a TCMS Maintenance Engineer discovers a problem during subsystem validation, he will notify the TCMS Client Support Area via OIS-D or telephone. The MCOE will then attempt to isolate and/or correct the problem. If he is unable to correct the problem, he will contact TCMS Organizational Maintenance Engineering and the remainder of the scenario will be identical to 3.11.1.

3.12 TEST EQUIPMENT

The CEC will provide test equipment to support TCMS set maintenance in a phased manner as new TCMS sets are activated. Additional test equipment that may be required will be procured later. TCMS O&M will enter this test equipment into the payloads Bar Code Equipment Tracking & Utilization System (BETUS) for tracking of location, utilization, and calibration due date. The Repeatable Maintenance Recall System (RMRS) will notify TCMS O&M in advance of calibration due dates but BETUS will provide additional features. BETUS utilizes barcodes and will provide real time information that will be used for resource planning. Test equipment will be stored in the OSA for on-line support of TCMS

SECTION IV
LINE REPLACEABLE UNIT MAINTENANCE

4.1 GENERAL

TCMS LRUs removed during Organizational Level Maintenance will be sent to the OSA and the associated paperwork will be sent to the MRC for disposition. LRUs will normally be forwarded to Logistics for repair at the KSC Core ILMF, the OEM, or at an approved repair depot. If necessary to keep TCMS sets operational prior to FND of the last TCMS set, O&M may repair LRUs that would normally be repaired elsewhere, providing the capability exists. During this developmental period, it is anticipated that flexibility will be required to maintain TCMS operational posture. This plan will be revised to meet maintenance requirements. Figure 3-3 describes the repair flow for LRUs.

TCMS O&M will use documented PGOC Standard Practices (SPs) to open Problem Reports (PRs) - (KSC form 2-151) and troubleshooting plans (KSC form 2-155) for all TCMS LRUs . Refer to paragraph 6.3 for PRACA procedures.

4.2 OFF-LINE SUPPORT AREA

The TCMS Off-Line Support Area (OSA) is scheduled to be located in the SSPF in October of 1994 and will include space for locating the CEC deliverable OSA TCMS equipment, HP 3070 ATE, test tools, test equipment, and queues for incoming LRUs. It will provide space to support current and projected TCMS requirements. TCMS O&M will utilize the OSA to satisfy the following requirements:

a. Providing hot spares for expediting operational support maintenance
b. On-line operations support
c. On-line test equipment control and storage
d. LRU test and verification
e. Separation of defective LRUs from functional LRUs when multiple LRUs are removed during Organizational level troubleshooting
f. LRU modification and refurbishment
g. Fabrication and assembly of TCMS special test equipment
h. Hardware Sustaining Engineering activity
i. ATE program development and enhancement
j. ATE interface control and storage
k. Documentation library
l. Failure history data from the PTS
m. TCMS O&M training
n. Vendor support work areas
o. Subassembly monitoring

p. Staging
q. TCMS software disk and tape control and storage

Organizational level failure data will be available to assure duplication of identified problems. If TCMS personnel utilizing the OSA cannot duplicate the problem, they will subject the LRU to special dispositioning procedures as outlined in paragraph 3.10.3.1.

The OSA will have the capability to perform verification testing of all TCMS LRUs using the HP3070 ATE or the Off-Line Support Set. TCMS O&M will verify all LRU spares from outside vendor repair facilities prior to placing them in program stock. LRUs from outside vendor sources that fail verification testing will be returned to Payloads Logistics for dispositioning back to the appropriate off-site repair facility for corrective action. The OSA will also be used to identify the defective LRU when a group of LRUs is removed during Organizational level troubleshooting. The defective LRUs will be repaired and the functional LRUs will be verified prior to restocking.

4.3 INTERMEDIATE AND DEPOT LEVEL MAINTENANCE APPROACH

TCMS O&M personnel will log LRU's into the Production Tracking System (PTS) and Payloads Logistics will disposition them by utilizing the space station Source, Maintenance, and Recoverability (SMR) codes as guidelines. Appendix A contains a listing of the SMR codes. TCMS O&M will assign LRUs to the appropriate OSA test, troubleshooting, or repair area or to Logistics for shipment to an outside repair source.

4.3.1 REPAIR OF LRUS IN THE OSA. Intermediate Level repair of LRUs will not normally be performed in the OSA, however, in emergency situations prior to FND of the last TCMS set, TCMS O&M may perform LRU repairs needed to keep TCMS operational. By FND of the last TCMS set, it is assumed that all the necessary repair facilities will be in place and qualified. As needed, TCMS O&M will use Intermediate and Depot Maintenance Manual Summary Sheets (IDMMSSs) as the procedure to test, repair, and verify any LRUs. The IDMMSS will establish uniform acceptance and verification criteria for LRUs processed through the OSA. When the OSA completes repair of an LRU they will send it to Receiving for processing as a spare.

4.3.2 REPAIR OF LRUS AT OUTSIDE REPAIR FACILITIES. LRUs will be repaired at the KSC Core ILMF, OEM sites, and other PGOC Off-Line repair facilities. According to the present plan, the KSC Core ILMF will perform Intermediate and Depot level repair of custom LRUs. TCMS O&M and Logistics personnel will be required to communicate with the Core and CCMS II ILMF on a regular basis. This will be accomplished via PTS access, status meetings, and tele-conferences. A Memorandum of Agreement (MOA) will be formed between the Payload Management and Operations Directorate (CM) and the Shuttle Management and Operations Directorate (TM) for

utilization of this capability. The OEMs will perform Intermediate and Depot level repair of TCMS COTS LRUs at their repair sites. Other PGOC depot capabilities may be utilized for select off-line maintenance (cables, structures, etc.). For more detail on Depot level repair of LRUs refer to the TCMS Depot Maintenance Support Baseline.

4.4 TCMS HARDWARE DISPOSITIONING

TCMS hardware will be dispositioned using documented KSC and PGOC procedures. Anticipated dispositions for the various LRU types are described below.

4.4.1 CUSTOM LRUs. The present plan is for custom LRUs to be sent to the KSC Core ILMF for off-line maintenance. This is based on the assumption that the KSC Core ILMF organization will be capable of the most economical and timely repair.

4.4.2 COMMERCIAL-OFF-THE-SHELF LRUs. COTS LRUs will be dispositioned to the vendor for maintenance, assuming such service is available and cost effective. Items returning from the vendor will require reverification prior to storage as a spare. The vendor may return an LRU of a different revision level than the one sent in for repair. However, the vendor will be responsible for ensuring compatibility in form, fit, and function for LRU's returned. TCMS O&M will identify and track any changes in part number or configuration of the LRUs.

4.4.3 SUBASSEMBLIES. In cases where a complete subassembly has been replaced during Organizational maintenance, it will be sent to the OSA for fault isolation to the LRU level. For example, an entire DP may be replaced in an operational set, and the failure will be resolved to the LRU level in the OSA. If, for example, the faulty LRU is a disk drive in a DP, it will be replaced and the DP will be verified. After successful verification, the DP will either be returned to stock or kept in the OSA as a hot spare. The faulty disk drive would then be returned to the OEM for repair.

SECTION V
DIAGNOSTIC SOFTWARE AND AUTOMATED TEST EQUIPMENT

5.1 GENERAL

The CEC is under contract to deliver automated test equipment, TPSs, and diagnostic software to support the Organizational and Intermediate level maintenance of TCMS. Software products supporting the various levels of maintenance include, system integrity, system maintenance, subsystem maintenance, COTS maintenance diagnostics (including Built In Test (BIT)), and automated test software for the HP3070 ATE.

5.2 DIAGNOSTICS SOFTWARE

TCMS is designed to integrate the various levels of maintenance for improved fault isolation. The software products supporting Organizational Maintenance include:

a. System integrity - This consists of the on-line non-intrusive testing of the TRS operational status.
b. System maintenance diagnostics - This consists of the off-line intrusive ORT and diagnostic testing.
c. Subsystem maintenance diagnostics - This consists of the off-line intrusive ORT and diagnostic standalone testing.
d. COTS maintenance diagnostics - This consists of the diagnostic and maintenance software provided by the COTS vendor.

5.2.1 SYSTEM INTEGRITY. System integrity detects operational failures and provides the failure symptoms, and parameters that direct the testing to the next level. System integrity provides continuous health and status monitoring of peripherals, software, and network interfaces. It also provides fault detection and isolation to a subsystem.

5.2.2 SYSTEM MAINTENANCE DIAGNOSTICS. System maintenance consists of off-line intrusive testing of the set's operational status. It is composed of two integrated functions, system ORT, and system diagnostics. System maintenance becomes active after the set has been configured and subsystems allocated but not operational. System maintenance provides a functional checkout of resources and peripherals. System maintenance, with system integrity, provides fault detection and isolation to the subsystem level.

5.2.3 SUBSYSTEM MAINTENANCE DIAGNOSTICS. Subsystem maintenance consists of the off-line intrusive testing of a subsystem's operational status. It is composed of two integrated functions; subsystem ORT and subsystem diagnostics. Subsystem

maintenance is active only when a subsystem is not configured or allocated to a TRS. Subsystem Maintenance provides fault detection and isolation to an LRU or peripheral within the subsystem.

5.2.4 COTS MAINTENANCE DIAGNOSTICS. For COTS hardware, diagnostics rely extensively on BIT or routines supplied by the OEM. The Core design approach integrates COTS BIT into ORT. ORT provides the executive routines and additional testing not provided by BIT.

5.2.5 DIAGNOSTIC SOFTWARE SUSTAINING ENGINEERING. For the duration of the Core contract, CEC's sustaining engineering responsibility includes diagnostic software delivered to support TCMS hardware. Problems encountered with delivered software will be documented on Problem Reports in accordance with SP 10.001-A91, Nonconformance/Problem Reporting And Corrective Action System. These problem reports will be dispositioned and when appropriate turned over to NASA DL or the CEC for resolution. All software will be under control of the Configuration Control Board (CCB). A formal release system comparable to the system used for hardware modification is anticipated.

At the end of the Core contract, TCMS Sustaining Engineering will assume responsibility for all sustaining engineering of TCMS. TCMS O&M Software Engineering will work closely with TCMS O&M Hardware Engineering to investigate any suspected anomalies with diagnostic software and will document results following PRACA procedures. If TCMS O&M Software Engineering determines that the software is at fault, they will contact TCMS Sustaining Engineering. TCMS O&M Software Engineering will then work with TCMS Sustaining Engineering to demonstrate the problem, help isolate to the software component, and suggest possible solutions.

If the software component in question is custom, TCMS Sustaining Engineering will correct the problem. If the software component in question is COTS, TCMS O&M Software Engineering and TCMS Sustaining Engineering will work with the vendor to resolve the problem. TCMS Sustaining Engineering will also be responsible for updating all associated documentation as required. The appropriate Configuration Control Board (CCB) will formally control the configuration of all software components.

5.3 AUTOMATED TEST EQUIPMENT

5.3.1 GENERAL DESCRIPTION. The goal of the HP3070 ATE is to test, identify failing components, and verify LRUs. Upon successful verification, the LRU can then be returned to stock as a functional spare. ATE systems allow standardized, efficient, high quality testing of PC boards and LRUs. ATE will be utilized whenever feasible to test and verify TCMS hardware.

The HP 3070 has the capability to perform both an in-circuit and a full functional test on circuit card LRUs. However, a few of the Core RTN cards utilize too many signals simultaneously to perform a full board level functional test on the HP 3070. These boards will be fully in-circuit tested and partially functional tested (cluster tests). After repair, these cards will then be functionally verified using the Off-Line Support Set or a subset of specialized subsystem test fixtures.

5.3.2 TEST PROGRAM SET ELEMENTS. ATE systems utilize TPSs for each Unit Under Test (UUT). A TPS typically consists of software, hardware, and documentation as described below:

a. ATE test program – The test program is a predetermined sequence of instructions under computer control to apply stimuli to the LRU under test and verify response. The test program controls instruments for the purpose of performing functional tests, and in-circuit tests to isolate defective elements.

b. ATE fixture – The fixture is an interface device required to interconnect the UUT (i.e. LRU) with the ATE system.

c. Documentation – The following documentation required to support ATE testing will be stored in electronic format:
   - Test program software listings
   - Interface device engineering drawings (including wire lists)
   - Test diagrams (identify drivers and sensors)
   - Test program master disks or tapes (archiving)
   - Test program disks

5.3.3 TEST PROGRAM CERTIFICATION. TCMS O&M will develop a certification process for new or modified Core TPSs. Prior to release of TPSs to the OSA or the KSC Core ILMF for operational use, TCMS will certify the program according to this procedure. This certification ensures that requirements are satisfied, standards of quality are maintained and the correct documentation is produced for each TPS.

5.3.4 NEW TPS DEVELOPMENT. Additional TPSs will be needed in time as new LRUs are added to the system or existing LRUs are modified. TCMS O&M will have the responsibility of developing any new TPSs required.

5.3.5 MAINTENANCE PLAN FOR THE HP3070 ATE. It is envisioned that maintenance for the HP3070 ATE will be handled in a similar manner to other existing HP3070s at KSC. At the present time this is done by way of a vendor support contract.

5.4 CONFIGURATION, CALIBRATION, AND TEST SET

5.4.1 GENERAL DESCRIPTION. CCATS provides the ability to measure the time required for a command or measurement to be processed through a subsystem within the test connection from a DP to a FEP. CCATS can concurrently monitor the front end and back end of a subsystem in the test connection. CCATS interfaces to the FEP via the maintenance port and controls the diagnostic activities of the FEP. In particular, CCATS coordinates the interfaces and performs the appropriate instrument setups. By commanding the FEP via the diagnostics, the CCATS controller can request a test for a particular interface. Then CCATS either provides the stimulus or measures the interface as appropriate for the test. CCATS then compares the results and displays a message on the controlling DP or the CCATS terminal.

CCATS provides for either remote control of CCATS equipment from a DP or local control from a CCATS terminal in a CCATS standalone mode. CCATS can display captured data at a DP in the Core test configuration or locally at a CCATS terminal in a CCATS standalone mode.

5.4.2 CCATS SOFTWARE MAINTENANCE. Most of the software used in CCATS is COTS. It consists primarily of device drivers for the various instruments and associated software for the FDDI, IEEE 488, LAN and WAN analyzers. The CEC is writing a few custom device drivers. The maintenance approach for this software will be identical to the approach for other TCMS software (COTS and custom). CCATS software maintenance flow will follow the appropriate steps shown in figure 3-4.

5.4.3 CCATS HARDWARE MAINTENANCE. The CCATS consists of a FEP simulator, COTS test instruments, and COTS network analyzers. The FEP simulator is made up of standard TCMS FEP LRUs and will be maintained exactly like any other TCMS FEP hardware. The only other custom LRU in the CCATS is a Single Board Computer (SBC) which is custom only because of the Programmable Read Only Memory (PROM) installed. For maintenance of the SBC, the PROMs will be removed and the unit will be returned to the vendor. The remainder of the CCATS is composed of COTS LRUs that will also be returned to the vendor for maintenance.

5.5 REAL TIME NETWORK ANALYZER.

5.5.1 GENERAL DESCRIPTION. The RTN analyzer, which is a tool for monitoring the activity through the RTN, will be physically located in SN0. It consists mostly of Core custom LRUs such as Input/Output Processors (IOPs) which are identical to those used in the RTN. There is currently only one custom card, the link tester, which is unique to the RTN analyzer.

5.5.2 RTN ANALYZER SOFTWARE MAINTENANCE. Almost all of the software used in the RTN Analyzer is HSSC Custom software. This software will analyze the RTN to assist in troubleshooting problems with the hardware. The maintenance approach for this software will be identical to the approach for other TCMS software (custom). The RTN Analyzer software maintenance flow will follow the appropriate steps shown in figure 3-4.

5.5.3 RTN ANALYZER HARDWARE MAINTENANCE. Fault isolation of anomalies in the RTN Analyzer will be accomplished using the internal software diagnostics and routines that are provided with the unit. Once the anomaly has been traced to the defective LRU, it will be removed and replaced with a functional spare.

Repair of defective LRUs will be handled similarly to other TCMS LRUs. It is anticipated that common custom LRUs will be repaired by the KSC Core ILMF. This includes the Link Tester LRU that is unique to the RTN analyzer. The CEC does not plan to provide a TPS for this LRU so CCMS will need to generate a TPS if they plan to use the HP3070. Another alternative would be to install the LRU in a VME chassis and troubleshoot using external test equipment along with the diagnostic software provided with the FIT.

5.6 FUNCTIONAL INTERFACE TOOL.

5.6.1 GENERAL DESCRIPTION. The Functional Interface Tool (FIT) is a portable device that is designed to perform card level testing of the custom Input/Output (I/O) cards in the HIM and the I/O FEP. Specifically, the FIT is able to simulate, record, and verify the HIM's responses to roll calls, FEP commands/queries and I/O card transactions. The FIT consists of an SBC, keyboard, monitor, and a floppy drive. The FIT consists of mostly COTS LRUs with some custom LRUs that are identical to those used in the FEP, and one custom LRU that is unique to the FIT. The FIT is self contained and designed to be hand carried.

5.6.2 FIT SOFTWARE MAINTENANCE. FIT Software is currently over 300K bytes of code, stack, and data, not including Vx Works. Close to half of this consists of tables and processing software for the various forms and menus. Other large data structures include the FEP Simulator Task Table (16K) and Transaction Table (32K). The final product is envisioned to exceed 400K bytes. Almost one third of this code supports hardware maintenance functions including debug forms and Built In Test (BIT). The maintenance approach for this software will be identical to the approach for other TCMS software (COTS and custom). FIT software maintenance flow will follow the appropriate steps shown in figure 3-4.

5.6.3 FIT HARDWARE MAINTENANCE. Fault isolation of anomalies on the FIT will be accomplished using the internal software diagnostics and routines that are provided with the unit. There are three levels of diagnostics available. First, there is a

menu driven self test provided by the CEC that will check out most of the FIT functionality. If the problem requires more in-depth troubleshooting there is a second level of manual diagnostic software also provided by the CEC. This level allows manipulation of data on individual registers. The third level of diagnostic software consists of the routines provided with the COTS Single Board Computer.

Using these diagnostic software routines, the TCMS Maintenance Engineer will troubleshoot any FIT anomalies to the LRU level. The LRU will then be removed and replaced with a spare.

Repair of the LRU will depend on its type. COTS LRUs will normally be sent to the vendor for repair. The custom LRUs that are the same as used in the FEP will be repaired in the same manner as any other custom TCMS LRU.

The FIT unique custom card (Nomenclature TBD) is a special case. Since this LRU falls under the category of a Core common custom LRU, it will be repaired at the KSC Core ILMF. However, the CEC is currently not required to provide a TPS for this LRU. A TPS will need to be developed if the KSC Core ILMF plans to use the HP3070. Another alternative would be to troubleshoot using external test equipment along with the diagnostic software provided with the FIT.

SECTION VI
HARDWARE TRACKING SYSTEMS

6.1 KENNEDY INVENTORY MANAGEMENT SYSTEM

Payload Logistics will use the Kennedy Inventory Management System (KIMS) to track all TCMS hardware, repair piece parts, and consumables while they are in stock. When TCMS hardware is removed from stock it will be tracked by other systems as described below. KIMS will also track all TCMS hardware through the repair cycle, including return-to-vendor repairs.

6.2 HARDWARE CONFIGURATION MANAGEMENT DATABASE

The hardware configuration management database will contain all information necessary to determine the exact configuration of the TCMS sets and the location of individual LRUs at any point in time. This will include the nomenclature, part number, serial number, revision level, bar code number, and movement history of all hardware installed in each TCMS set.

Information about LRU movement and revision level updates needs to be maintained on a real time basis. The system to track this information has not yet been selected but should be in place prior to the activation of TCMS operations. One possibility that is being investigated is the expansion of PTS to support this function. New equipment will be added to this data base as it enters inventory. Various reports and retrieval data will also be available.

6.3 PROBLEM REPORTING AND CORRECTIVE ACTION

The MCOE will be TCMS O&M's point-of-contact for all anomalies within the TCMS set. He will receive anomaly reports via the Test Conductor, the Client Support Area, and/or system software messages and will initiate IPRs. TCMS O&M personnel will follow the guidelines of PGOC Standard Practice SP 10.001-A91, Nonconformance/Problem Reporting And Corrective Action System for all activities involving Problem Reporting And Corrective Action (PRACA).

6.3.1 PRACA SCENARIO. When an anomaly is reported, the MCOE will initiate an IPR to document the investigation and will enter the appropriate data into the TCMS problem tracking database. The exact details of this database have not been determined at the time of this writing. The MCOE will also notify the QA inspector/monitor who will assign a number to the IPR and enter the appropriate data into PRACA. PDMS will be used for recording PRs and IPRs.

The MCOE will then run appropriate diagnostics to attempt to isolate the problem. If the MCOE determines the anomaly is due to a procedural error or other explained condition, a statement will be made on the problem report that the equipment was not damaged. TCMS O&M, their NASA counterpart, and the QA inspector will sign the PRACA form. The QA inspector will then enter the data into PRACA and the IPR will be closed.

If the anomaly requires maintenance action, the MCOE will notify the TCMS Hardware or Software Maintenance Engineer who will continue the troubleshooting. As work continues, the Maintenance Engineer will record all troubleshooting steps taken on the PRACA paperwork. When troubleshooting actions require that integrity seals be broken, QA will become actively involved. The QA inspector will witness and stamp the steps on the PRACA paperwork for all physical intrusion. QA will also document this intrusion in, and maintain the Break Of Integrity (BOI) log. When the Maintenance Engineer isolates the anomaly to a specific item of hardware or software, he will upgrade the IPR to a PR.

Once the defective LRU has been isolated, it will be removed and replaced with a hot spare from the OSA or a spare from Logistics. Either way, the defective LRU will be turned in to Logistics and they will issue a replacement LRU providing they have one available. If a replacement LRU is not available, Logistics will issue a credit and provide a replacement as soon a one becomes available, either through repair or procurement. If the LRU is a non-repairable item, it will be ordered via KIMS which will initiate an order for a replacement LRU from the vendor when the inventory reaches the minimum level.

After the repair has been satisfactorily completed the Maintenance Engineer will run appropriate subsystem diagnostics to verify that the equipment has been returned to an operable condition. Once satisfied with the repair, the Maintenance Engineer will notify the MCOE who will load and configure the equipment. The MCOE will then run the appropriate diagnostics to verify proper system operation. Once TCMS O&M is satisfied with the repair, the Maintenance Engineer will complete the PRACA paperwork including a summary of troubleshooting and a recommendation for closure. With concurrence of QE, the Maintenance Engineer, his NASA counterpart, and the QA inspector will sign the PRACA form. QA will then enter the appropriate data into PRACA and officially close the Problem Report.

A CPR will be generated for any defective LRUs removed during Organizational Level Maintenance. This LRU level CPR, along with a copy of the closed system level PR, will accompany the LRU to the repair facility.

6.4 PRODUCTION TRACKING SYSTEM

The Production Tracking System (PTS) is a data base management system in a Local Area Network (LAN) configuration used for tracking accountability of Work Authorization Documents (WADs) and associated LRUs in the repair cycle. TCMS O&M will be

responsible for operation, system administration, and maintenance of PTS hardware and software. OEM service contracts and/or on-site support will be used as necessary to maintain PTS.

PTS will track LRUs in the OSA and at outside vendor sites. PTS utilizes bar code technology to facilitate LRU and WAD tracking in real time. In addition, the PTS maintains and archives data applicable to LRU failure, repair, and configuration. This data is available real time and will be utilized for various maintenance management functions. Since 1986, CCMS O&M has had a Production Tracking System in place that is totally compatible with the Payloads PTS. The current plan is for the CCMS II ILMF to perform Intermediate Level Maintenance on both TCMS and CCMS custom LRUs. Therefore, the Payloads PTS is required to have the capability to access the Shuttle PTS database.

6.5 BAR CODE EQUIPMENT TRACKING & UTILIZATION SYSTEM

BETUS is a data base management system used for the tracking and accountability of test equipment and selected bench stock items for TCMS. BETUS utilizes bar code technology to facilitate data entry and updating. Bench stock will be ordered via KIMS and when received it will be entered into BETUS for tracking internal to the OSA. TCMS O&M will be responsible for operation, system administration, and maintenance of BETUS hardware and software.

SECTION VII
DOCUMENTATION

7.1 ORGANIZATIONAL LEVEL

TCMS O&M will document all unscheduled system maintenance tasks in PRACA following the guidelines of PGOC Standard Practice SP 10.001-A91, Nonconformance/Problem Reporting And Corrective Action System. For more information on PRACA see paragraph 6.3.

TCMS O&M will use Preventive Maintenance Operational and Maintenance Instruction (PMOMIs) to perform scheduled system maintenance tasks. Results will be documented on PMOMI summary sheets. The PMOMIs will specify inspection of assemblies for dust, dirt, corrosion, and visible damage or wear. PMOMIs will direct the inspection of cabling and connectors for wear or damage such as cuts, breaks, or fraying but connectors will not normally be de-mated for inspection since progressive deterioration may occur. If applicable, the PMOMI will specify running diagnostic programs to check the operation of systems and subsystems. Each PMOMI will incorporate these general requirements and specific maintenance tasks required for the identified hardware.

Completed PRACA forms and PMOMI summary sheets will be sent to the Technical Data Center (TDC) for storage and archiving.

7.2 INTERMEDIATE LEVEL

A complete set of Intermediate and Depot Maintenance Manuals (IDMMs) for TCMS hardware will be located in the OSA to support Organizational Level maintenance and emergency Intermediate Level maintenance of LRUs as outlined in paragraph 4.3.1. The master set of IDMMs will reside on PDMS II, Technical Documentation Subsystem. The CEC will initially provide IDMMs for all repairable TCMS LRUs and SRUs. These IDMMs will be either vendor provided manuals for COTS hardware or CEC developed manuals for custom hardware. IDMMs provide procedures for inspection, cleaning, lubrication, prevention of incipient failures, replacement of life/cycle limited components, adjustment, and verification. IDMMs also contain technical reference data required to perform Intermediate Level Maintenance. OSA engineering personnel will document LRU and SRU repairs using Intermediate and Depot Maintenance Manual Summary Sheets (IDMMSSs). Completed IDMMSSs will be sent to the TDC for storage.

7.3 DOCUMENTATION DEVELOPMENT

TCMS O&M will generate OMIs and PMOMIs in accordance with the Payload Operations WAD Handbook, KCA-HB-0018.0 and PGOC Standard Practice

SP 8.007-A91. Vendor supplied manuals will be used as much as possible to minimize redundancy and cost. Any future revisions to documentation developed by TCMS O&M will be the responsibility of TCMS O&M.

TCMS Sustaining Engineering will be responsible for any revisions to TCMS system software or hardware. As part of this responsibility they will also update any drawings or other documentation as required.

Payload Logistics will develop new IDMMs as required for new or modified LRUs.

7.4 HARDWARE CONFIGURATION MANAGEMENT

The configuration management system will be used for: tracking the current configuration of, providing for the assured integrity of, and introducing approved changes to, the TCMS hardware, not including test equipment.

The configuration management system identifies the hardware items to be placed under configuration control and describes their baseline configuration. The Payload Level III/IV CCB addresses proposed changes to the configuration baseline. Verification of changes is accomplished by reviews to assure that hardware design satisfies approved requirements and that modifications have been incorporated per the modification instructions. Configuration accounting is accomplished by an automated configuration management tracking system that provides visibility of all changes to the current baseline.

7.4.1 CONFIGURATION IDENTIFICATION FOR TCMS HARDWARE.

Configuration identification is the process of selecting hardware items to be under configuration control, describing their baseline configuration in terms of technical documentation and hardware identifiers, and the system for preparing, maintaining, and releasing configuration documentation. The functions of configuration identification are described in the following paragraphs.

7.4.1.1 Identification of TCMS Hardware Under Configuration Control. TCMS hardware items to be under configuration control are established by NASA and accepted by the PGOC during transition. The PGOC authorization to add or delete TCMS hardware items to/from the accepted baseline is by Configuration Control Board Directive (CCBD) and/or Contract Change Order (CO). PGOC Configuration Management Department will maintain a current listing of items under formal program/project configuration control.

7.4.1.2 Baseline Identification for TCMS Ground Hardware. The configuration baseline is the current defined and approved configuration used as a reference point for program/project planning purposes and as a point of departure for control of changes.

The baseline identification and all approved changes thereto are maintained by the PGOC Configuration Management Organization.

7.4.1.3 Engineering Documentation Preparation, Maintenance, Records, and Release System. The PGOC will use or adapt existing methods and systems for the preparation, maintenance, record keeping and release of engineering documentation. Existing systems will be used except when system changes will require NASA approval prior to implementation, e.g., if changes affect non-PGOC.

7.5 SOFTWARE CONFIGURATION MANAGEMENT

Stringent control of TCMS System Software, Test Application Software, Simulation Software, MODB Utilities, Test End Item Data Bank, Flight Software, DMS Kit Software, and Ground Support Equipment System Software is necessary for the successful operation of TCMS. The plan for formal configuration control is described in the Space Station Test, Control and Monitor System (TCMS) Production Control Plan, K-CTE-63.2. Refer to this document for more detail.

SECTION VIII
OFF-SITE MAINTENANCE AND VENDOR REPAIR

8.1 GENERAL

Off-Site Maintenance will be the preferred method of repair and modification for TCMS COTS LRUs and subassemblies. This includes maintenance, complicated adjustments, modifications, and refurbishment of items removed during intermediate or organizational level maintenance. The off-site maintenance facility will normally be the Original Equipment Manufacturer (OEM).

When off-site maintenance is needed, Payloads Logistics will utilize OEM and commercial maintenance sources to provide repair services for TCMS equipment.

8.2 LRU REPAIR OR EXCHANGE

When a repairable LRU has been dispositioned off-site, the appropriate vendor or the KSC Core ILMF will repair, exchange or scrap the LRU in accordance with established and approved criteria. LRUs received from the vendor must be compatible in form, fit, and function to those sent.

Quality Engineering will monitor off-site work performed by vendors. Contractor Source Inspection and Government Source Inspection will be performed as required. TCMS O&M will monitor work performed at the KSC Core ILMF.

Payload Logistics will track LRUs sent to a vendor using the Return-to-Vendor (RTV) portion of the KIMS. In addition, the TCMS O&M PTS will be able to communicate with the CCMS PTS for statusing of TCMS LRUs being repaired at the KSC Core ILMF.

8.3 ORIGINAL EQUIPMENT MANUFACTURER MAINTENANCE CONTRACTS

Where limited maintenance capability exists for specific types of TCMS equipment, Original Equipment Manufacturer (OEM) full service maintenance contracts will be utilized. Guaranteed response time versus cost of the coverage will be analyzed. The most economical solution that will meet TCMS O&M technical and schedule requirements will be selected and administered by Payload Logistics. Work areas will be provided in the OSA to support maintenance contract vendors.

Quality will review all OEM contracts for Quality Statement Of Work (SOW) development and approval of required Quality provisions for the Maintenance Contractor.

SECTION IX
LOGISTICS SUPPORT

9.1 GENERAL

The TCMS Integrated Logistics Support Plan will document logistics support to TCMS. All TCMS logistics planning will be in accordance with the space station Program Definitions and Requirements Document (PDRD) Section 4 Part 2, the KSC space station Integrated Logistics Support Requirements (KSC-STA-20), and its subsequent attachments. TCMS logistics support will stress the aspects of cost, commonality, and utilization of existing logistics resources at all times. TCMS Production Support will actively interface with operations and maintenance personnel, hardware sustaining engineering, sub-contracts, vendors, and quality engineering to meet the TCMS logistics support requirements. TCMS Production Support will provide Logistics Support Analysis, Technical Data and Documentation (TD&D), Maintenance Support Equipment (MSE), Supply Support, Packaging Handling, Storage and Transportation (PHS&T), training, logistics facilities, and procurement capabilities and support to TCMS.

9.2 LOGISTICS SUPPORT

All TCMS logistics planning and support will be in accordance with the Space Station Program Definitions and Requirements Document (PDRD), section 4, part 2 and the KSC Space Station Integrated Logistics Support Requirements (KSC-STA-20) and its subsequent attachments. These are listed below for reference.

KSC-STA-20.01	Logistics Support Analysis Plan
KSC-STA-20.02	Technical Data and Documentation Plan
KSC-STA-20.03	Maintenance Support Equipment Plan
KSC-STA-20.04	Supply Support Plan
KSC-STA-20.05	Packaging, Handling, Storage, and Transportation Plan
KSC-STA-20.06	Logistics Information System Plan
* KSC-STA-20.07	Maintenance Plan
KSC-STA-20.08	LMRT Plan
KSC-STA-20.09	Personnel and Training Plan
KSC-STA-20.10	Logistics Facilities Plan

* Note: This reference document is the Space Station Maintenance Plan. TCMS will be maintained in accordance with TS-TCMS-92003.

9.3 LOGISTICS SUPPORT ANALYSIS

The CEC will perform LSA for the TCMS hardware. The LSA will be the principle tool utilized to identify the TCMS logistics support requirements. The CEC will conduct equipment level analysis on candidate TCMS hardware. This analysis will consist of performing Repair Level Analysis (RLA) to determine economical repair levels (intermediate, depot, discard) of LRUs and SRUs. A detailed analysis will then be conducted to identify logistics resources required to accomplish the appropriate level of repair. Necessary level of spare LRUs, SRUs, piece parts, and consumables will be identified with appropriate minimum and maximum levels. All TCMS LSA data developed by CEC will be provided to TCMS Logistics for review to insure support requirement identification is coordinated for continued support of the system. The CEC will develop TCMS LSA data in accordance with the KSC Space Station LSA Plan (KSC-STA-20.01). Core will provided LSA data to CM logistics organizations on a scheduled basis. Final transfer of TCMS LSA from the CEC to TCMS Logistics will take place at the end of the Core contract. Continued update and development of TCMS LSA data will be the responsibility of TCMS Production Support and will be based on actual TCMS operations and maintenance experience.

9.4 TECHNICAL DATA AND DOCUMENTATION

TCMS logistics TD&D planning will be developed in accordance with KSC Space Station TD&D Plan (KSC-STA-20.02). Logistics support TD&D will be developed to meet TCMS logistics support and off-line maintenance requirements. The CEC will develop the initial TD&D for TCMS. Scheduled reviews of the CEC TCMS TD&D will take place to ensure that system logistics documentation requirements are easily transferred to TCMS Logistics. Phased TD&D responsibility transfers will occur throughout the Core contract. Transferred TCMS logistics TD&D will become the responsibility of TCMS Production Support for redevelopment or modification for the life of the system as required.

9.5 MAINTENANCE SUPPORT EQUIPMENT

TCMS Maintenance Support Equipment (MSE) planning will be developed in accordance with the KSC Space Station MSE Plan (KSC-STA-20.03). The CEC will identify and procure MSE items necessary to support TCMS. Any shortfalls in MSE procurement will be coordinated with CM logistics organizations to avoid continued maintenance shortfalls. Scheduled reviews of MSE procurement and support requirements will take place to ensure proper integration into PGOC operations. TCMS Production Support and the TCMS Operations and Maintenance organizations will provide continued support of TCMS MSE. All MSE will be maintained in a test pool controlled by BETUS.

9.6 SUPPLY SUPPORT

TCMS Supply Support planning will be developed in accordance with the KSC Space Station Supply Support Plan (KSC-STA-20.04). The CEC will identify and provide initial spares for TCMS Hardware. Ideally, initial spares will be of a quantity sufficient to allow TCMS Logistics time to provide for continuing spares acquisition. Schedule reviews of CEC spares procurement requirements will take place as a part of the provisioning conferences to ensure proper integration into PGOC operations. TCMS Production Support organizations will store all TCMS LRUs and SRUs in a functional condition to satisfy requests submitted by TCMS O&M utilizing the standard Parts and Material Request (PMR).

9.6.1 MATERIAL SERVICE CENTER. The MSC is responsible for processing LRUs in support of TCMS operations, maintaining bench stock parts, and processing documentation. In addition TCMS property movement, transfers, equipment excess, and RTV items will be coordinated with the MSC. The MSC will be located in the SSPF for support to organizational and off-line maintenance.

9.6.2 PIECE PARTS AND BENCH STOCK. Piece parts required to meet operational needs and schedules will be identified by Production Support for provisioning. Maximum and minimum levels will be established and their usage will be monitored.

9.6.3 OPERATING SUPPLIES. Operating supplies are those materials necessary to support the SSPF administratively. TCMS O&M will identify and submit to the appropriate provisioning organization, operating material used on a recurring basis in support of TCMS. When required to meet operational needs, these items will be entered into the appropriate bench stock maintained by Production Support. Hand tools will be issued to each TCMS technician for utilization on the TCMS equipment. Each technician will check out any special tools required using hand receipts.

9.6.4 PROPERTY ADMINISTRATION. All NASA capital equipment will be tracked in the NASA Equipment Management System (NEMS). Production Support property administration organizations will be the focal point for assuring a smooth transfer of accountability for TCMS equipment entering the inventory and TCMS equipment being removed from service.

9.7 PACKAGING, HANDLING, STORAGE, AND TRANSPORTATION

TCMS PHS&T planning will be developed in accordance with the KSC Space Station PHS&T Plan (KSC-STA-20.05). The CEC will develop initial PHS&T requirements. Scheduled reviews of CEC developed PHS&T requirements will take place to ensure proper integration into PGOC operations. The CEC has the responsibility for initial shipment of TCMS hardware, software, initial spares, support equipment and all other

CEC TCMS procured items to the designated KSC location. Continuing PHS&T support will be the responsibly of TCMS Production Support.

9.8 TRAINING

TCMS training will be developed in accordance with the KSC Space Station Training Plan (KSC-STA-20.09). The CEC will develop initial training courses. Scheduled reviews of CEC developed training courses will take place to ensure proper integration into PGOC operations. The CEC has the responsibility to train TCMS personnel in operations, utilization, maintenance, and support of TCMS hardware, software, and support equipment. This training will be to the appropriate level for personnel and will impart knowledge, skills, and abilities they will require to perform their duties. Developed courses will include complete documentation and provide an in-class instructor. The developed courses will include instruction packages that run on workstations and will be available on easily reproducible media. The CEC will transfer all CEC training material (slides, overheads, video, mock-ups, simulators, and documentation) to the appropriate PGOC organizations for continued TCMS training. Due to the system's complexity and the size of the TCMS student population, it is anticipated that the OSA and Space Station Software Engineering will provide TCMS hardware, software, support equipment and appropriate personnel to support continued TCMS training as required. TCMS O&M will coordinate with Production Support Technical Training for the development and maintenance of continued TCMS training. Production Support Technical Training will schedule and track TCMS training in the Training Tracking and Scheduling System (TTSS) database. Technical Training will coordinate TCMS training closely with TCMS O&M to avoid impacts with OSA operations and to ensure the availability of the necessary equipment and personnel.

9.9 LOGISTICS FACILITIES

TCMS logistics facilities will be developed in accordance with the KSC Space Station Logistics Facilities Plan (KSC-STA-20.10). The CEC will develop TCMS logistics facility requirements. Scheduled reviews of CEC developed logistics facility requirements will take place to ensure proper integration into PGOC operations. Utilization of existing KSC logistics facilities will be exercised at all times to avoid unnecessary facility cost impacts.

9.10 OSA SUPPORT

Production Support will perform logistics research on piece-part and SRU hardware needed to support the LRU repair cycle as required. Information necessary to initiate procurement documents for Non-Stock Listed (NSL) items will be researched and provided.

APPENDIX A

SMR CODES

SOURCE		MAINTENANCE		RECOVERABILITY	SPECIAL HANDLING
		USE	REPAIR		
1ST POSITION	2ND POSITION	3RD POSITION	4TH POSITION	5TH POSITION	6TH POSITION
P PROCURABLE	A STOCKED B INSURANCE E SUPPORT EQUIP. G LIFE CYCLE BUY	C REPLACE AT ORGANIZATIONAL LEVEL ON-ORBIT	Z NO REPAIR B NO REPAIR, RECONDITION OR CALIBRATE, ETC.	Z NON REPAIRABLE CONDEMN AT ANY AUTHORIZED LEVEL	NOT APPLICABLE
K COMPONENT OF A REPAIR KIT (NON STOCKED)	H INTERMEDIATE KIT D DEPOT KIT B IN BOTH KITS	O REPLACE AT ORGANIZATIONAL LEVEL ON-GROUND	C NO REPAIR, CLEAN REPLACE SOFT GOODS ONLY	O REPAIRABLE, CONDEMN AT ORGANIZATIONAL LEVEL ON GROUND	
M MANUFACTURED (NON STOCKED)	O ORGANIZATIONAL H INTERMEDIATE D DEPOT	H REPLACE AT INTERMEDIATE LEVEL ON-ORBIT F REPLACE AT INTERMEDIATE LEVEL ON-GROUND	O REPAIR AT ORGANIZATIONAL LEVEL ON GROUND H REPAIR AT INTERMEDIATE LEVEL ON-ORBIT F REPAIR AT INTERMEDIATE LEVEL ON-GROUND	F REPAIRABLE, CONDEMN AT INTERMEDIATE LEVEL ON GROUND	
A ASSEMBLED (NON STOCKED)				D REPAIRABLE, CONDEMN AT DEPOT LEVEL	
X NON STOCKED	A SEE NEXT HIGHER ASSEMBLY B RECLAMATION REQUISITION FROM ITEM MANAGER C DRAWINGS OBSOLETE, ETC.	D REPLACE AT DEPOT LEVEL	D LIMITED REPAIR AT INTERMEDIATE LEVEL, OVERHAUL AT DEPOT LEVEL L DEPOT REPAIR ONLY	A SPECIAL HANDLING	