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EOSDIS Core System Project

Release A Maintainability Predictions for the ECS Project

Final

July 1995

Hughes Information Technology Corporation
Landover, Maryland

Release A Maintainability Predictions for the ECS Project

July 1995

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APPROVED BY

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Preface

This document is a contract deliverable with an approval code of 3. This document is delivered to NASA for information only, but is subject to approval as meeting contractual requirements.

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Abstract

This Release A Maintainability Predictions report (CDRL 91, DID 518) presents Commercial-Off-The-Shelf (COTS) vendors predicted and actual field mean-time-to-repair (MTTR) data for all ECS hardware configuration items (HWCIs) which are presented at the Release A Critical Design Review (CDR). These MTTRs are required to support the availability modeling task in which the results are documented in CDRL 88, DID 515.

Keywords: maintainability, availability, prediction, MTTR, MDT, worksheet, maintenance, BIT, repair, GFE

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1. Introduction

1.1 Identification of Document

This Release A Maintainability Predictions Report, Contract Data Requirements List (CDRL) item 091, whose requirements are specified in Data Item Description (DID) 518/PA3, is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract (NAS5-60000).

1.2 Scope of Document

This report is the updated version of the preliminary submittal which was generated at the ECS Release A Preliminary Design Review (PDR) time frame. This report version presents detailed predicted and operational MTTRs of the proposed ECS hardware configuration items (HWCI) presented at the Release A CDR time frame. These HWCI's MTTRs are provided by the commercial-off-the shelf (COTS) vendors and are thoroughly reviewed for accuracy by the ECS reliability and hardware procurement organizations. These HWCI's represent the Flight Operation Segment (FOS) Release A/B configuration, the Science and Data Processing Segment (SDPS) and the Communications and Systems Management Segment (CSMS) Release A configuration. The applicable Distributed Active Archive Center (DAAC) sites for the Release A SDPS and CSMS are: Goddard Space Flight Center (GSFC), Earth Resources Observations System (EROS) Data Center (EDC), Marshall Space Flight Center (MSFC), and Langley Research Center (LaRC). FOS Release A/B is only applied to GSFC.

The report also presents the maintainability prediction methodology, ground rules and assumptions in accordance with MIL-HDBK-472, Prediction Procedure II, which are required when specific COTS vendor data or comparable vendor data is not available.

This document reflects the June 21, 1995 Technical Baseline maintained by the contractor configuration control board in accordance with the ECS Technical Direction No.11, dated December 6, 1994.

1.3 Purpose and Objectives of Document

The Maintainability Predictions report provides the ECS predicted hardware maintainability data to support the availability modeling activity which was documented in DID #515/PA2, Availability Models/Predictions. Maintainability prediction is a continuous and iterative process throughout the program life cycle to ensure that the ECS system will achieve its functional availability requirements. This task is performed early in the design process or once hardware is identified, in order to be an effective aid in evaluating the ECS design by providing information that can be used as the basis for design decisions such as redundancy, fault management design approach, accessibility to facilitate repair, and hot switchable LRUs.

The maintainability prediction procedure highlights for the designer, those areas of poor maintainability which justify product improvement, modification, or a change of design. It also permits the user to make an early assessment of whether the predicted downtime, quality and quantity of personnel, tools and test equipment are adequate and consistent with the needs of system availability requirements.

Results from this report will be used to serve as inputs for determining life cycle costs, sparing requirements, maintenance planning, and the development of the availability models/predictions report.

1.4 Document Status and Schedule

This submittal of DID 518/PA3 meets the milestone specified in the Contract Data Requirements List (CDRL) of NASA contract NAS5-60000. It is anticipated that this submittal will be reviewed during the Release A Critical Design Review (CDR), and that subsequent changes to the document will be incorporated into a resubmittal to be delivered two weeks after receiving comments from the customer.

Subsequent maintainability prediction updates for each release configuration will be submitted at each release Incremental Design Review (IDR), CDR, and throughout the ECS life cycle.

1.5 Document Organization

The document is organized into five (5) sections and one Appendix:

- Section 1 Introduction, contains the identification, scope, purpose and objectives, status and schedule, and document organization.
- Section 2 Related Documentation, provides a bibliography of parent, applicable and information documents for the Maintainability Predictions.
- Section 3 ECS Maintainability Predictions Methodology, describes the maintainability requirements, vendor data, prediction technique, assumptions and ground rules, and prediction worksheets.
- Section 4 Other MTTR Data Sources, describes GFE provided data.
- Section 5 Maintainability Prediction Data, describes the maintainability data for the FOS, SDPS, and CSMS.
- Appendix A Maintainability Data, provides detailed spreadsheets divided into three sections. One for FOS, one for SDPS and one for CSMS hardware.

2. Related Documentation

2.1 Parent Documents

The parent documents are the documents from which this Maintainability Predictions document scope and content are derived.

194-207-SE1-001	Systems Design Specification for the ECS Project
420-05-03	Goddard Space Flight Center, Earth Observing System (EOS) Performance Assurance Requirements for the EOSDIS Core System (ECS)
423-41-01	Goddard Space Flight Center, EOSDIS Core System Statement of Work
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System
423-41-03	Goddard Space Flight Center, EOSDIS Core System Contract Data Requirement Document

2.2 Applicable Documents

The following documents are referenced within this Maintainability Predictions document, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this volume.

194-501-PA1-001	Performance Assurance Implementation Plan for the ECS Project
194-502-PA1-001	Contractor's Practices & Procedures Referenced in the PAIP for the ECS Project
515-CD-001-003	Availability Models/Predictions for the ECS Project
516-CD-001-003	Reliability Predictions for the ECS Project
613-CD-001-001	COTS Maintenance Plan for the ECS Project
MIL-HDBK-472	Department of Defense Military Handbook: Maintainability Predictions

2.3 Information Documents

The following documents, although not referenced herein and/or not directly applicable, do amplify or clarify the information presented in this document. These documents are not binding on the content of the Maintainability Predictions document.

MIL-STD-470B	Department of Defense Military Standard: Maintainability Program for Systems and Equipment
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3. ECS Maintainability Predictions Methodology

3.1 Maintainability Prediction Requirements

The ECS design uses state-of-the-art COTS hardware to meet requirements and take advantage of the rapidly evolving technology; therefore, the primary source for maintainability data is COTS vendor supplied data.

Maintainability Predictions are required to support the Availability Modeling/Prediction activity (DID 515/PA2). The maintainability data supporting the maintainability predictions will be obtained or developed in the following order of priority in accordance with the ECS performance requirements of paragraph 5.4.2 in document 420-05-03:

- 1) COTS vendor supplied maintainability data will be utilized at the purchased hardware unit level. If this data is unavailable;
- 2) Historical or comparable data for like hardware items using similar technologies and construction/packaging will be utilized. If this data is unavailable;
- 3) A Maintainability Prediction will be performed on the hardware per MIL-HDBK-472, Prediction Procedure II. This maintainability prediction will use equipment drawings as well as a list of standard equipment repair times provided by the COTS vendors.

3.2 COTS Vendor Data

All COTS vendors will be required to provide maintainability values down to the line-replaceable-unit (LRU) level with their identified source. Maintainability data sources can be either of the following:

- a. Field service data,
- b. Test data,
- c. Predicted data.

Vendor maintainability data will be collected by the ECS M&O (Maintenance and Operations) group as part of the procurement process. ECS Systems Maintainability engineers will participate in this process to ensure the validation and integrity of the maintainability data. This process is detailed in document 194-502-PA1-001, Contractor's Practices & Procedures Referenced in the PAIP for the ECS Project, project instruction RM-1-002, Control of COTS Subcontractors and Suppliers. Figure 3.2-1 presents the COTS vendor maintainability data flow process for the ECS program. This data will first be recorded in the Integrated Logistic System (ILS) database called Vendor Costing And Tracking System (VCATS). The Systems Engineering group will then receive a report identifying the hardware description, vendor, and maintainability data. This data is then used as the basis for the maintainability predictions (MTTR values) for each segment and is shown in Appendix A.1 for FOS, Appendix A.2 for SDPS, and Appendix A.3 for CSMS with detailed explanations in Section 5.0. If vendor data on specific COTS products is not available,

historical or comparable data for like hardware using similar technology in similar environments will be utilized if available and acceptable. In the case where vendor, historical or comparable maintainability data is unavailable, COTS vendor equipment drawings as well as the vendor's list of standard equipment repair times will be requested. Maintainability prediction worksheets will be generated and their outputs will become part of the Maintainability Predictions Report.

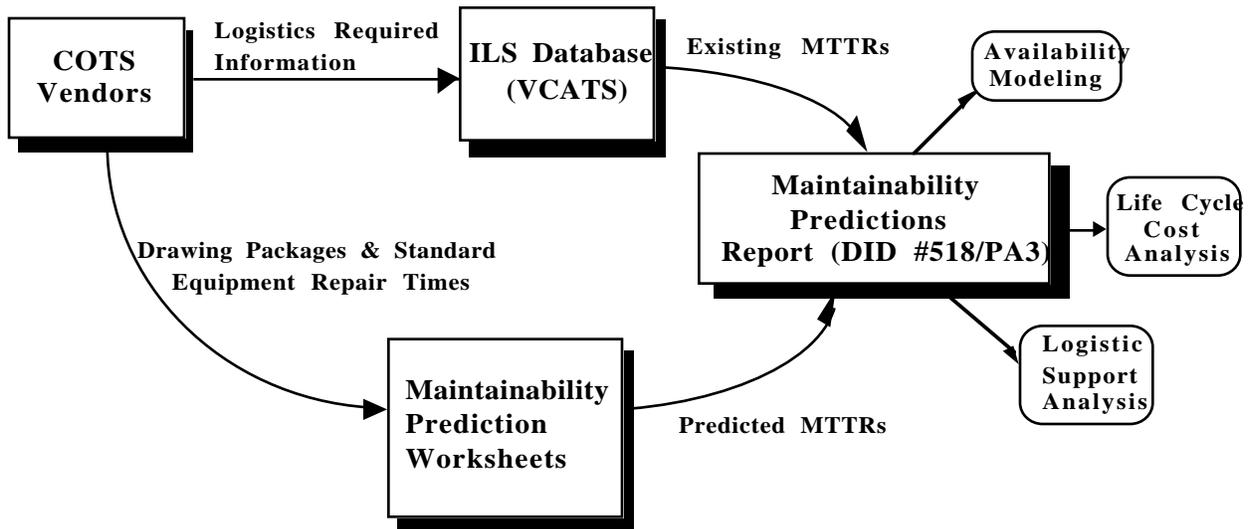


Figure 3.2-1 COTS Vendor Maintainability Data Flow Process

3.3 Maintainability Prediction Technique of MIL-HDBK-472, Procedure II

If vendor maintainability data is unavailable and no historical or comparable data is available for like items using similar technologies and construction/packaging, a maintainability calculation will be made using the methodology defined in MIL-HDBK-472, Procedure II. The general mathematical expression for equipment MTTR using this method is:

$$MTTR = \frac{\sum_{i=1}^n \lambda_i M_{c_i}}{\sum_{i=1}^n \lambda_i}$$

λ_i = i^{th} Subassembly's or Line Replaceable Unit's (LRU) failure rate in failures per million hours

M_{c_i} = i^{th} LRU's corrective maintenance repair time in hours

n = total number of LRUs

MTTR = Mean Time To Repair in hours

The value for M_C will be calculated using the Maintainability Prediction Worksheets described in Section 3.5.

3.4 Assumptions and Ground Rules

The following are assumptions and ground rules for the ECS maintainability predictions in accordance with MIL-HDBK-472, Prediction Procedure II:

- 1) Maintainability predictions will be performed using the LRU level data. All maintenance task times associated with the LRUs will be listed on the maintainability prediction worksheet (Figure 3.5-1) in conjunction with their failure rates (derived from the MTBF values in the Reliability Predictions document, DID 516/PA2) to produce the MTTR results.
- 2) The Maintainability Prediction will be based on corrective maintenance task times. Corrective maintenance is the maintenance performed to restore an item to a satisfactory condition by providing correction of a malfunction which has caused degradation of the item below its specified performance level.
- 3) Corrective maintenance times include only actual repair time which is the period when repair work is in progress. Therefore, it excludes such parameters of measure as administrative time or logistic time, etc.
- 4) The Preventive Maintainability task times will be taken into consideration by the ILS group for scheduling and manpower requirements. Preventive maintenance is the maintenance performed to retain an item in satisfactory operational condition by providing systematic inspection, detection, and prevention of incipient failures. Preventive maintenance can be either scheduled or unscheduled depending upon the requirements of the mission.
- 5) The Administrative Logistics Delay Time (ALDT) will be determined based on each site's maintenance concept documented in the ECS COTS Maintenance Plan, 613-CD-001-001, and on the individual hardware. For prediction purposes the average estimated Administrative Logistics Delay Time (ALDT) is four (4) hours. The MDT value is used to calculate the required functional availabilities which was documented in the Availability Models/Predictions report, 515-CD-002-003.

3.5 MTTR Calculation Worksheets

The ECS maintainability prediction method described in this document depends upon utilizing the estimated Maintenance Task Times required for performing the specific maintenance tasks which, in total, comprise a repair or maintenance action. These Maintenance Task Times are part of the Maintainability Prediction Worksheet as shown in Figure 3.5-1.

System _____

Page ___ Of ___

Segment _____

Date _____

Element/Function _____

Prepared By _____

Approved By _____

[-----Maintenance Task Times-----]

LRU Description	LRU Part Number	Failure Rate (λ)	Localization	Isolation	Disassembly	Interchange	Reassembly	Alignment	Checkout	Repair Time (M_c)	Failure Rate x Repair Time (λM_c)	
		$\lambda =$									$\lambda M_c =$	

Figure 3.5-1. Maintainability Prediction Worksheet

The Maintainability Prediction worksheet is completed for each piece of hardware requiring a predicted MTTR. The hardware is broken down into LRUs. Each LRU is entered into a row in the worksheet. The LRUs failure rate (λ) is taken from the Reliability Predictions document, DID 516/PA2. The Maintenance Task Times are then entered in hours.

The following are descriptions of the seven Maintenance Tasks Times:

- a. Localization - Determining the location of a failure to the extend possible, with the assistance of Built-In-Test (BIT) capability but without using accessory equipment.
- b. Isolation - Determining the location of a failure to the extend possible, with the assistance of Built-In-Test (BIT) capability and by the use of accessory test equipment.
- c. Disassembly - Equipment disassembly to the extend necessary, to gain access to the item that is to be replaced.
- d. Interchange - Removing the defective item and installing the replacement.
- e. Reassembly - Closing and reassembling of the equipment after the replacement has been made.
- f. Alignment - Performing any alignment, minimum tests and/or adjustment made necessary by the repair action.
- g. Check Out - Performing checks or tests required to verify that the equipment has been restored to satisfactory performance.

The calculations made in the Maintainability Prediction Worksheet in Figure 3.5-1 are as follows:

- 1) The sum of the Maintenance Task Times equals the Repair Time (M_c).
- 2) The Repair Time (M_c) is multiplied by the failure rate (λ) of the LRU, expressed in failures per million hours (FPMH), to obtain an estimate of the number of maintenance hours (λM_c) for that specific maintenance or repair action.
- 3) The maintenance hours are summed (λM_c).
- 4) The failure rates are summed (λ).
- 5) The MTTR is calculated by dividing the summed maintenance hours by the summed failure rates ($\lambda M_c / \lambda$).

The equation used for this calculation was defined earlier in Section 3.3. The MTTRs for each piece of hardware is shown in Appendix A.1 for FOS, A.2 for SDPS, and A.3 for CSMS.

The Appendices are explained in Section 5.0.

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4. Other MTTR Data Sources

4.1 Government Furnished Equipment (GFE) Provided Data

Since all required RMA functional hardware strings within the DAACs consist of COTS equipment, a GFE provided data list is not required for these functions.

For the inter-DAAC required function (EOSD3990: SDPS Function of Data Order Submission Across DAACs), a GFE list will be requested and incorporated by the WAN network provider. ECS Reliability Engineering group will ensure that quantitative RMA requirements are appropriately specified for the network by the WAN provider so that the overall functional requirement can be achieved.

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5. Maintainability Prediction Data

The maintainability data presented in Appendix A is divided into three sections. Each section contains a segment. The first section A.1 contains FOS maintainability data, the second section A.2 contains SDPS maintainability data, and the third section A.3 contains CSMS maintainability data.

The definition for each worksheet column follows:

Column Title	Description
Site	Physical location of hardware
HWCI	Hardware Configuration Item within the Segment
Rel	Release in which hardware is delivered
Qty	Number of items used in this subsystem
Item Description	Hardware name and/or description
Model	Manufacturer model number of hardware
MTTR	Mean Time To Repair
Data Source	Source of MTTR data. (i.e. Vendor, Maintainability Prediction, Similar to..., etc.)

5.1 Flight Operations Segment (FOS) Maintainability Prediction Data

Appendix A.1 presents the detailed listings of the FOS hardware for Release A/B at GSFC with their associated MTTRs. These MTTRs are predicted and/or field return maintainability data which were provided by the COTS vendors. As the FOS design evolves, any changes to the hardware list will be updated with latest vendor's MTTR data.

5.2 Science Data Processing Segment (SDPS) Maintainability Prediction Data

Appendix A.2 presents the detailed listings of the SDPS hardware for Release A at GSFC, LaRC, MSFC, and EDC DAAC sites with their associated MTTRs. These MTTRs are predicted and/or field return maintainability data which were provided by the COTS vendors. As the SDPS design evolves, any changes to the hardware list will be updated with latest vendor's MTTR data.

5.3 Communications and System Management (CSMS) Maintainability Prediction Data

Appendix A.3 presents the detailed listings of the CSMS hardware for Release A at GSFC, LaRC, MSFC, and EDC DAAC sites with their associated MTTRs. These MTTRs are predicted and/or

field return maintainability data which were provided by the COTS vendors. As the CSMS design evolves, any changes to the hardware list will be updated with latest vendor's MTTR data.

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Appendix A. Detailed MTTR Prediction Data

A.1 Flight Operations Segment (FOS) Maintainability Prediction Data

FOS COTS Hardware RMA Data For Releases A and B

Site	HWC I	Rel.	Qty	Item Description	Model	MTTR (Hours)	Data Source
GSFC	EOC-SRV	A/B	3	Real Time Server:256MB,2GB,CDROM, Dual FDDI Card	DEC Alpha 1000 4/200	.60	Vendor
GSFC	EOC-SRV	A/B	3	Data Server:256MB,2GB,CDROM, Dual FDDI Card	DEC Alpha 1000 4/200	.60	Vendor
GSFC	EOC-WS	A/B	36	User Station: 64MB,2GB, CD ROM, Ethernet Card, 20" monitor	SUN Sparc20 Model 71	.60	Vendor
GSFC	EOC-T-SRV	A/B	2	Timing System and Rack	TYMESERV2000 IRIG	.50	Vendor
GSFC	EOC-RAID	A/B	2	RAID Front End Processor: 64MB, CD ROM, Dual FDDI Card	DEC Alpha 1000 4/200	.60	Vendor
GSFC	EOC	A/B	1	Network attached RAID 5, 25-2.1GB	DEC Storage Works	.50	Vendor
GSFC	EOC	A/B	7	Laser Printer	HP Laser Jet 4M	1.50	Vendor
GSFC	EOC	A/B	5	Color Printer	HP Laser Jet	1.00	Vendor
GSFC	EOC	A/B	12	20-Inch Color Monitor GX	SUN Monitor	.50	Vendor

A.2 Science Data Processing Segment (SDPS) Maintainability Prediction Data

SDPS COTS Hardware RMA Data For Release A (1 of 5)

Site	HWCI	Rel	Qty	Item Description	Model	MTTR (Hrs)	Data Source
GSFC	ACM	A	1	RAID	SGI 42 GB RAID	0.5	Vendor
GSFC	ACM	A	2	SERVER HOST	SGI Challenge L, 2CPU,256MB,6GB,FDDI	1.5	Vendor
GSFC	ACM	A	2	OPS WS	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
GSFC	AQA	A	1	QA WORKSTATION	SUN Sparcstation 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
GSFC	AIT	A	1	AIT WORKSTATION	SUN Sparc 20/50	0.5	Vendor
GSFC	AIT	A	1	AIT WS/DBMS SERVER	SUN Sparc 20/50, 128 MB, 4 GB disk	0.5	Vendor
GSFC	AIT	A	1	PRINTER	HP LaserJet 4M+, 12ppm, 14 MB RAM	1.5	Vendor
GSFC	DIP	A	1	1600/6250 BPI Tape Drive	1600/6250 BPI Tape Drive - DEC3490 Drive - EMASS	1.0	Vendor
GSFC	DIP	A	1	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
GSFC	DIP	A	1	CD ROM JUKEBOX	CD ROM Jukebox - JVC	0.5	Vendor
GSFC	DIP	A	1	RAID	SGI 22 GB RAID	0.5	Vendor
GSFC	DIP	A	2	LASER PRINTER	HP LaserJet 4M - HP	1.5	Vendor
GSFC	DIP	A	2	DISTRIBUTION SERVER	SUN Sparcstation 20/712, 256MB, 6GB,20" Mon.,FDDI	0.5	Vendor
GSFC	DMG	A	1	DMG SERVER	HP K200/1,1CPU, 256MB, 6GB RAID,FDDI	2.60	Vendor
GSFC	DMG	A	1	DMG SERVER	HP J200/1,1CPU,512MB, 6GB RAID,FDDI	2.60	Vendor
GSFC	DMG	A	3	DATA SPECIALIST WORKSTATION	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
GSFC	DMG	A	1	OPS WS	HP 715/64, 8mm	1.0	Vendor
GSFC	DRP	A	1	ARCHIVE ROBOTICS	G-Series robotic archive - EMASS 57 TB capacity	1.0	Vendor
GSFC	DRP	A	1	RAID	SGI 10 GB RAID	0.5	Vendor
GSFC	DRP	A	2	LINEAR MAG DR	NTP Linear Tape Drive - EMASS	1.0	Vendor
GSFC	DRP	A	2	DBMS SERVER	SGI Challenge XL, 4CPU, 256MB, 4GB,FDDI	1.5	Vendor
GSFC	DRP	A	2	FSMS SERVER	SGI Challenge XL, 4CPU, 256MB, 6GB,FDDI	1.5	Vendor

SDPS COTS Hardware RMA Data For Release A (2 of 5)

Site	HWCI	Rel	Qty	Item Description	Model	MTTR (Hrs)	Data Source
GSFC	DRP	A	1	DOCUMENT SERVER	SUN Sparcstation 20/712, 256MB, 6GB	0.5	Vendor
GSFC	ICL	A	1	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
GSFC	ICL	A	1	INGEST SERVER	SGI Indigo 2, 6GB	1.5	Vendor
GSFC	PLN	A	1	PLANNING DBMS SERVER	SUN Sparcstation 20/71, 384MB, 8GB,20" Mon.,FDDI	0.5	Vendor
GSFC	PLN	A	1	PLANNING WS	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
GSFC	SPR	A	1	SCIENCE PROCESSOR	SGI Power Challenge XL, 14CPU, 1024MB, 8GB,FDDI	1.5	Vendor
GSFC	SPR	A	1	QUEUING SERVER	SUN Sparcstation 20/71, 384MB, 8GB,20" Mon.,FDDI	0.5	Vendor
GSFC	SPR	A	1	RAID	SGI 68 GB RAID	0.5	Vendor
GSFC	SPR	A	1	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
GSFC	SPR	A	2	X Terminals	X Terminals (NCD)	0.5	Vendor
GSFC	WKS	A	1	RAID 30 GB	SGI 30 GB RAID	1.0	Vendor
LARC	ACM	A	1	RAID	SGI 35 GB RAID	0.5	Vendor
LARC	ACM	A	2	SERVER HOST	SGI Challenge L, 2CPU,256MB,6GB,FDDI	1.5	Vendor
LARC	ACM	A	2	OPS WS	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
LARC	AQA	A	1	QA WORKSTATION	SUN Sparcstation 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
LARC	AIT	A	1	AIT WORKSTATION	SUN Sparc 20/50	0.5	Vendor
LARC	AIT	A	1	AIT WS/DBMS SERVER	SUN Sparc 20/50, 128 MB, 4 GB disk	0.5	Vendor
LARC	AIT	A	1	PRINTER	HP LaserJet 4M+, 12ppm, 14 MB RAM	1.5	Vendor
LARC	DIP	A	1	1600/6250 BPI Tape Drive	1600/6250 BPI Tape Drive - DEC3490 Drive - EMASS	1.0	Vendor
LARC	DIP	A	2	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
LARC	DIP	A	1	CD ROM JUKEBOX	CD ROM Jukebox - JVC	0.5	Vendor
LARC	DIP	A	1	RAID	SGI 20GB RAID	0.5	Vendor
LARC	DIP	A	2	LASER PRINTER	HP LaserJet 4M - HP	1.5	Vendor

SDPS COTS Hardware RMA Data For Release A (3 of 5)

Site	HWC	Rel	Qty	Item Description	Model	MTTR (Hrs)	Data Source
LARC	DIP	A	2	DISTRIBUTION SERVER	SUN Sparcstation 20/712, 256MB, 4GB,20" Mon.,FDDI	0.5	Vendor
LARC	DMG	A	1	DMG SERVER	HP K2000/1,1CPU, 256MB, 6GB RAID,FDDI	2.6	Vendor
LARC	DMG	A	1	DMG SERVER	HP J200/1,1CPU,512MB, 6GB RAID,FDDI	2.6	Vendor
LARC	DMG	A	3	DATA SPECIALIST WORKSTATION	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
LARC	DMG	A	1	OPS WS	HP 715/64, 8mm	1.0	Vendor
LARC	DRP	A	1	ARCHIVE ROBOTICS	G-Series robotic archive - EMASS 57 TB capacity	1.0	Vendor
LARC	DRP	A	1	RAID	SGI 10 GB RAID	0.5	Vendor
LARC	DRP	A	2	LINEAR MAG DR	NTP Linear Tape Drive - EMASS	1.0	Vendor
LARC	DRP	A	2	DBMS SERVER	SGI Challenge XL, 4CPU, 256MB, 4GB,FDDI	1.5	Vendor
LARC	DRP	A	2	FSMS SERVER	SGI Challenge XL, 4CPU, 256MB, 4GB,FDDI	1.5	Vendor
LARC	DRP	A	1	DOCUMENT SERVER	SUN Sparcstation 20/712, 256MB, 6GB	0.5	Vendor
LARC	ICL	A	1	RAID	SGI 100 GB RAID	1.0	Vendor
LARC	ICL	A	2	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
LARC	ICL	A	2	INGEST SERVER	SGI Challenge L, 2CPU, 256MB, 6GB,FDDI	1.5	Vendor
LARC	ICL	A	1	X TERMINAL	X TERMINAL (NCD)	0.5	Vendor
LARC	PLN	A	2	PLANNING DBMS SERVER	SUN Sparcstation 20/71, 384MB, 8GB,20" Mon.,FDDI	0.5	Vendor
LARC	PLN	A	1	PLANNING WS	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
LARC	SPR	A	2	SCIENCE PROCESSOR	SGI Power Challenge XL, 12 CPU, 1024MB, 8GB,FDDI	1.5	Vendor
LARC	SPR	A	1	QUEUEING SERVER	SUN Sparcstation 20/71, 384MB, 8GB,20" Mon.,FDDI	0.5	Vendor
LARC	SPR	A	2	RAID	SGI 68.8 GB RAID	0.5	Vendor
LARC	SPR	A	1	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
LARC	SPR	A	3	X TERMINAL	X TERMINAL (NCD)	0.5	Vendor
LARC	WKS	A	1	RAID	SGI 40 GB RAID	1.0	Vendor

SDPS COTS Hardware RMA Data For Release A (4 of 5)

Site	HWC	Rel	Qty	Item Description	Model	MTTR (Hrs)	Data Source
MSFC	ACM	A	1	RAID	SGI 42 GB RAID	0.5	Vendor
MSFC	ACM	A	2	SERVER HOST	SGI Challenge L, 2CPU,256MB,6GB,FDDI	1.5	Vendor
MSFC	ACM	A	2	OPS WS	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
MSFC	AQA	A	1	QA WORKSTATION	SUN Sparcstation 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
MSFC	AIT	A	1	AIT WORKSTATION	SUN Sparc 20/50	0.5	Vendor
MSFC	AIT	A	1	AIT WS/DBMS SERVER	SUN Sparc 20/50, 128 MB, 4 GB disk	0.5	Vendor
MSFC	AIT	A	1	PRINTER	HP LaserJet 4M+, 12ppm, 14 MB RAM	1.5	Vendor
MSFC	DIP	A	1	1600/6250 BPI Tape Drive	1600/6250 BPI Tape Drive - DEC3490 Drive - EMASS	1.0	Vendor
MSFC	DIP	A	1	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
MSFC	DIP	A	1	CD ROM JUKEBOX	CD ROM Jukebox - JVC	0.5	Vendor
MSFC	DIP	A		RAID	SGI 22GB RAID	0.5	Vendor
MSFC	DIP	A	2	LASER PRINTER	HP LaserJet 4M - HP	1.5	Vendor
MSFC	DIP	A	2	DISTRIBUTION SERVER	SUN Sparcstation 20/712, 256MB, 4GB,20" Mon.,FDDI	0.5	Vendor
MSFC	DMG	A	1	DMG SERVER	HP K2000/1,1CPU, 256MB, 6GB RAID,FDDI	2.6	Vendor
MSFC	DMG	A	1	DMG SERVER	HP J200/1,1CPU,512MB, 6GB RAID,FDDI	2.6	Vendor
MSFC	DMG	A	2	DATA SPECIALIST WORKSTATION	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
MSFC	DMG	A	1	OPS WS	HP 715/64, 8mm	1.0	Vendor
MSFC	DRP	A	1	ARCHIVE ROBOTICS	G-Series robotic archive - EMASS 57 TB capacity	1.0	Vendor
MSFC	DRP	A	1	RAID	SGI 25 GB RAID	0.5	Vendor
MSFC	DRP	A	2	LINEAR MAG DR	NTP Linear Tape Drive - EMASS	1.0	Vendor
MSFC	DRP	A	2	DBMS SERVER	SGI Challenge XL, 4CPU, 256MB, 4GB,FDDI	1.5	Vendor
MSFC	DRP	A	2	FSMS SERVER	SGI Challenge XL, 4CPU, 256MB, 4GB,FDDI	1.5	Vendor

SDPS COTS Hardware RMA Data For Release A (5 of 5)

Site	HWCI	Rel	Qty	Item Description	Model	MTTR (Hrs)	Data Source
MSFC	ICL	A	1	RAID	SGI 100 GB RAID	1.0	Vendor
MSFC	ICL	A	2	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
MSFC	ICL	A	2	INGEST SERVER	SGI Challenge L, 2CPU, 256MB, 6GB,FDDI	1.5	Vendor
MSFC	ICL	A	1	X TERMINAL	X TERMINAL (NCD)	0.5	Vendor
MSFC	PLN	A	1	PLANNING DBMS SERVER	SUN Sparcstation 20/71, 384MB, 8GB,20" Mon.,FDDI	0.5	Vendor
MSFC	PLN	A	1	PLANNING WS	SUN Sparcstation 20/50, 64MB, 2GB,20" Mon.,FDDI	0.5	Vendor
MSFC	SPR	A	2	SCIENCE PROCESSOR	SGI Indy, 256MB, 6GB	1.5	Vendor
MSFC	SPR	A	1	QUEUING SERVER	SUN Sparcstation 20/71, 384MB, 8GB,20" Mon.,FDDI	0.5	Vendor
MSFC	SPR	A	1	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
MSFC	SPR	A	1	X Terminal	X TERMINAL (NCD)	0.5	Vendor
MSFC	WKS	A	1	RAID 30 GB	SGI 25 GB RAID	1.0	Vendor
EDC	AIT	A	1	AIT WORKSTATION	SUN Sparc 20/50	0.5	Vendor
EDC	AIT	A	1	AIT WS/DBMS SERVER	SUN Sparc 20/50, 128 MB, 4 GB disk	0.5	Vendor
EDC	AIT	A	1	PRINTER	HP LaserJet 4M+, 12ppm, 14 MB RAM	1.5	Vendor
EDC	ICL	A	1	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
EDC	ICL	A	1	INGEST SERV	SGI Indigo2, 128MB, 6GB, FDDI	1.0	Vendor
EDC	SPR	A	1	RAID	SGI 3 GB RAID	1.0	Vendor
EDC	SPR	A	1	8MM TP STACKER W/4 DR	8mm Drive w/stacker - EXABYTE 210	0.5	Vendor
EDC	SPR	A	1	SCIENCE PROCESSOR	SGI PC XL 2 CPU, 4mm CD-ROM	1.5	Vendor
EDC	SPR	A	2	X Terminal	X Terminal (NCD)	0.5	Vendor

A.3 Communications System Management Segment (CSMS) Maintainability Prediction Data

CSMS COTS Hardware RMA Data For Release A (1 of 2)

Site	HWCI	Rel	Qty	Item Description	Model	MTT R (Hrs)	Data Source
GSFC	CSS	A	1	COMM SERVER	HP 755, 256 MB, 6 GB	1.0	Vendor
GSFC	MSS	A	1	LASER PRINTER	HP LaserJet 4M +	1.5	Vendor
GSFC	MSS	A	1	ENT MGT SERVER	HP 755, 256 MB, 6 GB	1.0	Vendor
GSFC	MSS	A	3	MGT WS	SUN Sparcstation 20/50, 128MB, 4GB,20" Mon.,FDDI	0.5	Vendor
GSFC	ISS	A	8	FDDI CONCENTRATOR	FDDI Concentrator - SynOptics 2914-04	0.5	Vendor
GSFC	ISS	A	1	FDDI SWITCH	PowerHub7000 - ALANTEC	0.5	Vendor
GSFC	ISS	A	1	ETHERNET HUB	Ethernet Hub - SynOptics	0.5	Vendor
GSFC SMC	CSS	A	1	COMM SERVER	HP 755, 256 MB, 6 GB	1.0	Vendor
GSFC SMC	MSS	A	1	LASER PRINTER	HP LaserJet 4M +	1.5	Vendor
GSFC SMC	MSS	A	1	ENT MGT SERVER	HP 755, 256 MB, 6 GB	1.0	Vendor
GSFC SMC	MSS	A	3	MGT WS	SUN Sparcstation 20/50, 128MB, 4GB,20" Mon.,FDDI	0.5	Vendor
GSFC SMC	ISS	A	2	FDDI CONCENTRATOR	FDDI Concentrator - SynOptics 2914-04	0.5	Vendor
GSFC SMC	ISS	A	1	ETHERNET HUB	Ethernet Hub - SynOptics	0.5	Vendor
GSFC EOC	ISS	A	6	FDDI CONCENTRATOR	FDDI Concentrator - SynOptics 2914-04	0.5	Vendor
GSFC EOC	ISS	A	2	ETHERNET HUB	Ethernet Hub - SynOptics	0.5	Vendor
LARC	CSS	A	1	COMM SERVER	HP 755, 256 MB, 6 GB	1.0	Vendor
LARC	MSS	A	1	LASER PRINTER	HP LaserJet 4M +	1.5	Vendor
LARC	MSS	A	1	ENT MGT SERVER	HP 755, 256 MB, 6 GB	1.0	Vendor
LARC	MSS	A	2	MGT WS	SUN Sparcstation 20/50, 128MB, 4GB,20" Mon.,FDDI	0.5	Vendor
LARC	ISS	A	8	FDDI CONCENTRATOR	FDDI Concentrator - SynOptics 2914-04	0.5	Vendor
LARC	ISS	A	1	FDDI SWITCH	PowerHub7000 - ALANTEC	0.5	Vendor

LARC	ISS	A	1	ETHERNET HUB	Ethernet Hub - SynOptics	0.5	Vendor
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CSMS COTS Hardware RMA Data For Release A (2 of 2)

Site	HWCI	Rel	Qty	Item Description	Model	MTTR (Hrs)	Data Source
MSFC	CSS	A	1	COMM SERVER	HP 755, 256 MB, 6 GB	1.0	Vendor
MSFC	MSS	A	1	LASER PRINTER	HP LaserJet 4M +	1.5	Vendor
MSFC	MSS	A	1	ENT MGT SERVER	HP 755, 256 MB, 6 GB	1.0	Vendor
MSFC	MSS	A	2	MGT WS	SUN Sparcstation 20/50, 128MB, 4GB,20" Mon.,FDDI	0.5	Vendor
MSFC	ISS	A	8	FDDI CONCENTRATOR	FDDI Concentrator - SynOptics 2914-04	0.5	Vendor
MSFC	ISS	A	1	FDDI SWITCH	PowerHub7000 - ALANTEC	0.5	Vendor
MSFC	ISS	A	1	ETHERNET HUB	Ethernet Hub - SynOptics	0.5	Vendor

Abbreviations and Acronyms

ACMHW	Access and Control Management Hardware CI
AITHW	Algorithm Integration and Test Hardware CI
ALDT	Administrative Logistics Delay Time
AQAHW	Algorithm Quality Assurance Hardware CI
CCR	Configuration Change Request
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CI	Configuration Item
CN	Change Notice
COTS	Commercial Off The Shelf
CSMS	Communications and Systems Management Segment (ECS)
CSS	Communication Subsystem
DAAC	Distributed Active Archive Center
DCN	Document Change Notice
DID	Data Item Description
DIPHW	Distribution and Ingest Peripheral Hardware CI
DMGHW	Data Management Server Hardware CI
DRPHW	Data Repository Hardware CI
ECS	EODIS Core System
EDC	EROS Data Center (DAAC)
EDS	Electronic Data Systems
EOC	EOS Operations Center (ECS)
EOC-SRV	EOS Operations Center (ECS) Server
EOC-WS	EOS Operations Center (ECS) Workstation
EOC-T-SRV	EOS Operations Center (ECS) Timing Server
EOC-RAID	Earth Observing Center RAID
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System

EPL	Engineering Parts List
EROS	Earth Resources Observation System
ESDIS	Earth Science Data and Information System (GSFC)
FPMH	Failure Per Million Hours
FOS	Flight Operations Segment (ECS)
GFE	Government Furnished Equipment
GSFC	Goddard Space Flight Center
ICLHW	Ingest Client Hardware CI
IDR	Incremental Design Review
ILS	Integrated Logistics Support
ISS	Internetworking Subsystem
LaRC	Langley Research Center (DAAC)
LRU	Line Replaceable Unit
MDT	Mean Down Time
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
MSFC	Marshall Space Flight Center
MSS	Management Subsystem
NASA	National Aeronautics and Space Administration
NPRD	Nonelectronic Parts Reliability Data
PAIP	Performance Assurance Implementation Plan
PDR	Preliminary Design Review
PLNHW	Planning Hardware CI
RAID	Redundant Array of Independent Disks
RMA	Reliability, Maintainability, Availability
SDPS	Science Data Processing Segment (ECS)
SMC	System Management Center (ECS)
SPRHW	Science Processing Hardware CI
VCATS	Vendor Costing And Tracking System (ECS)
WKSHW	Working Storage Hardware CI