TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

Mission System Engineering

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Topics of Discussion

- **PDR Action Item Status**
- **Mission Requirements**
- **Mission System Overview**
- **System Partitioning**
- **Margin Management**
- **Documentation**
- **Summary**

PDR Action Item Status

AI No.	Assignee	Status	Memo No.
1	Yee	Open	
2	Nordeen	Closed	SEI-97-068
3	Heffernan	Closed	SRI-97-059
4	Duven	Closed	SRM-97-016
5	Perschy	Closed	SEE-97-0076
6	Bokulic	Closed	SER-97-048
7	Vernon	Closed	SEM-2-779
8	Kusnierkiewicz	Closed	SEA-97-0065
9	Kusnierkiewicz	Closed	SEA-97-0037
10	Kusnierkiewicz	Closed	SEA-97-0038

PDR Action Item Status

AI No.	Assignee	Status	Memo No.
11	Kusnierkiewicz	Closed	SEA-97-0039
12	Cameron	Closed	GEC-97-09
13	Reiter	Closed	SRI-97-041
14	Dakermanji/Kozuch	Closed	SEE-97-0069
15	Heffernan/Sadilek	Open	
16	Radford	Closed	SEE-97-0091
17	Mosher	Closed	SEM-1-1509
18	LeFevere	Closed	SEE-97-0087
19	Cameron	Closed	GEC-97-09
20	Harvey	Closed	SEI-97-121
21	Vernon/Yee	Closed	SEM-2-778

PDR Action Item Summary

AI No. 1: Reconsider the need for 99% end-to-end data recovery to see if it can be reduced.

Ans: The 99% end-to-end data recovery requirement has been reduced to 95%.

AI No. 2: Show that the 2 kbps command uplink is consistent with anticipated upload volume.

Ans: It was shown that uploading the nominal daily command volume requires ~ 50 sec.

AI No. 3: Justify the decision to not pin SEE.

Ans: It was shown that the anticipated errors when re-attaching SEE are "in the noise".

PDR Action Item Summary

AI No. 4: Account for the distance separating phase centers of the GPS antennas and the CG of the spacecraft for orbit determination.

Ans: Done.

AI No. 5: Consider utilizing a common oscillator for the GNS and C&DH subsystems.

Ans: This would result in a net cost increase.

AI No. 6: Find a simple protection against damaging the transmitter card by turning on the RF power supplies in the wrong order.

Ans: Done.

PDR Action Item Summary

AI No. 7: Add a test to deploy or "walk out" the solar arrays while attached to the S/C.

Ans: This test was found to add exceptional risk to the S/C without commensurate benefit.

AI No. 8: Perform an analysis to demonstrate the reliability of the IEM in several different cross-strapping arrangements.

Ans: An extensive analysis was performed which concluded that reliability could be improved by eliminating the IEM cross-strapping and keeping the redundant unit powered off; this is now the baseline.

PDR Action Item Summary

AI No. 9: Re-examine and justify the use of the latching relays in series with the battery.

Ans: The use of these relays was reviewed, justified, and found to cause minimal risk.

AI No. 10: The chart showing redundancy should add the solar array drives, antennas, etc.

Ans: Done.

AI No. 11: Develop a series of graphic plots to track the growth of mass and power.

Ans: Done.

PDR Action Item Summary

AI No. 12: Reconsider the surface cleanliness requirement (Class 750 at launch) to include effects of launch on contamination.

Ans: The surface cleanliness in orbit can not be verified; the Class 750 launch requirement considered the effects of launch sources.

AI No. 13: Consider adding a calibration channel to each RIU and adding external ID straps.

Ans: Both suggestions incorporated into design.

PDR Action Item Summary

AI No. 14: Consider changing the fusing approach to use the "NASA Standard" fuse topology.

Ans: No "NASA Standard" fuse topology exists; the approach planned for TIMED was shown to provide adequate protection.

AI No. 15: Demonstrate that the alignment plan properly budgets alignment errors and meets instrument requirements.

Ans: ???

AI No. 16: Demonstrate that the separation attitude capture sequence (no star cameras) works regardless of beta angle or initial attitude.

Ans: Done.

PDR Action Item Summary

AI No. 17: Will the power up of reaction wheels while attached to the Delta LV cause problems?

Ans: No.

AI No. 18: Does the IEM test bed fully support testing of IEM redundancy, e.g., cross-strapping?

Ans: IEM cross-strapping has been eliminated.

AI No. 19: Clean up the requirements for orbit determination accuracy for the GNS.

Ans: An inconsistency in orbit determination requirements was corrected.

PDR Action Item Summary

AI No. 20: Does safe mode work in eclipse? Does ambiguity about the sun vector adversely affect the thermal state of the spacecraft?

Ans: Safe mode works in eclipse; the worst case thermal state in safe mode is acceptable.

AI No. 21: Perform a complete glint analysis.

Ans: A glint analysis has been completed; no problems were discovered.

Mission Requirements

- **All top-level requirements are captured in the System Requirements Document, 7363-9001 Rev. B**
- **This revision, released 01 December 1997, captures changes in requirements since PDR in February 97**
- **All of the mission-level requirements are shown in this presentation, with changes shown in underline**
- **A summary of the mission-level requirements changes is provided in the next chart**

Mission Requirements Changes

- **The circular orbit has changed from 600 km/74.4° inclination to 625 km/74.1° inclination**
- **The LV manufacturer (McDonnell-Douglas) is now Boeing (but the LV remains the same)**

Orbit Description

- **Insertion Altitude: 625 ± 25 km**
- **Inclination: 74.1 ± 0.1°**
- **Nodal Regression Rate: 720 ± 10 deg/year**
- **Orbit Maintenance: None**
- **Mission Lifetime: 2 years**
- **Total Radiation Dose: 5 krads (2 years, 2X safety margin)**
- **Launch Constraints:**
  - **The injection orbit shall provide for observation of the Summer Mesopause Temperature Minimum for the SABER instrument**

Launch Vehicle (LV)

- **TIMED is planned to launch on a Boeing Delta II 7920-10 Medium Expendable Launch Vehicle**

Redundancy

- **Redundancy is a GOAL for all Critical Subsystems**
- **A Critical Subsystem is one whose failure would end the mission (if not redundant).**
- **NO SINGLE INSTRUMENT IS CONSIDERED TO BE MISSION CRITICAL**

Cleanliness

- **Materials lists to be screened per NASA RP 1124**
  - **TML < 1%**
  - **CVCM < 0.1%**
- **Bakeout of subsystems on a case-by-case basis**
- **I&T Environment**
  - **Class 100,000 in APL Clean Room**
  - **Class 100,000 in Test Facilities at Goddard Space Flight Center**
- **Launch Processing Environment**
  - **Class 100,000 in Shipping Container**
  - **Class 100,000 at Spacecraft Processing Facility**

Cleanliness (Continued)

- **LV Environment**
  - Class 100,000 in LV Fairing during launch
- **Nitrogen Purge**
  - Shall be provided for all instruments from spacecraft integration until launch
  - Nitrogen shall be boil-off gas from liquid N_2 or equivalent purity
- **Surface Cleanliness**
  - Spacecraft surface cleanliness shall be Class 750 or better at the time of launch

Communications

- The communication system shall utilize frequency assignments in the S-Band spectrum
- Communications protocols for command and telemetry shall be in accordance with CCSDS
- High data rate and signaling format shall be selected to allow 24 hours of stored telemetry to be downlinked in a single pass at the Primary GS
- Data rates and formats shall be selected to allow 24 hours of stored telemetry to be downlinked in a single cluster of passes at the Backup GS
- Low data rate and format shall be selected to allow real-time engineering housekeeping telemetry to be downlinked to a remote station or network

Integration & Test (I&T)

- **The Integration and Test Segment is required to:**
  - **Prepare a comprehensive integration and test plan**
  - **Plan and execute effective Integration and Test operations in accordance with the objectives established in the I&T Plan**
  - **Command the S/C from arrival of the first subsystem to launch**
  - **Maintain spacecraft command and TM dictionaries during I&T**
  - **Process and transmit all spacecraft commands during I&T**
  - **Process and evaluate all spacecraft telemetry data during I&T**
  - **Collect and archive all raw telemetry during I&T**
  - **Collect, process, and transmit commands from the instrument Payload Operations Centers (POCs) to their instruments**
  - **Transmit all science telemetry data to the POCs and coordinate with them to assure the proper operation of the instruments**
  - **Establish the capability of the spacecraft bus and payload to carry out the TIMED mission in accordance with the SRD**

Mission Operations (MO)

- **The Mission Operations Segment is required to:**
  - **Plan and execute effective Mission operations in accordance with the science objectives of the TIMED program**
  - **Command the spacecraft from launch to the end of mission**
  - **Collect, process, and transmit commands from the TIMED instrument Payload Operations Centers to the instruments**
  - **Collect all raw telemetry**
  - **Process all spacecraft health and status telemetry data and maintain the spacecraft**
  - **Assess spacecraft performance and adapt operations to changes**
  - **Collect all science data for processing and distribution to POCs**
  - **Maintain command and TM dictionaries during the flight phase**

Data Analysis (DA)

- **The Science Data System (SDS) is required to:**
  - **Archive and serve all raw telemetry**
  - **Serve all data products needed to support the mission, including level 0-4 products required by the PIs and science community**
  - **Provide access to ground-based measurements**
  - **Provide timely data distribution among program elements**
  - **Provide scientifically useful products derived from the TIMED measurements to the scientific community in a timely manner**
  - **Provide relevant and useful educational products derived from the data to K-12 educators and the public in a timely manner**
  - **Provide for the long term utility and archiving of data products generated by the TIMED program in cooperation with the Space Physics Data System (SPDS) Archive**

Launch Site

- **The launch site will be selected to be compatible with TIMED orbit injection requirements and the selected Launch Vehicle; it is presently assumed that TIMED will be launched from the Western Range (Vandenberg Air Force Base)**

Spacecraft Processing Facility

- **The SPF shall be an existing facility**
- **The SPF shall provide at least a Class 100,000 clean room environment for processing**
- **The SPF shall provide at least 1000 sq. ft. space for the spacecraft and clean room GSE**
- **The SPF shall provide (8) 120 VAC single-phase 20A receptacles for power**
- **The SPF shall provide an overhead crane with a capacity of 5 tons or greater**
- **The SPF shall have existing comm capabilities compatible with I&T requirements**

I&T Operations Center (ITOC)

- **The ITOC shall be an existing facility, preferably co-located with the SPF**
- **The ITOC shall provide a shirtsleeve environment for I&T Operations personnel**
- **The ITOC shall provide at least 400 sq. ft. of space for the Ground Support System**
- **The ITOC shall provide a single 208 VAC three-phase 100A receptacle for power**
- **The ITOC shall have existing comm capabilities compatible with I&T requirements**
- **The ITOC shall be located with access to office facilities sufficient to support 15 people**

I&T Communications

- The I&T Operations Team shall require a primary and backup voice network joining the SPF, ITOC and MOC during all operations at the launch site
- A primary and backup voice network shall be required joining the ITOC and MOC to the countdown net during launch operations
- I&T Operations shall require a primary and backup data network joining the SPF, ITOC and MOC during all operations at the launch site
- I&T Operations shall require a video circuit to allow personnel at the ITOC to monitor the SPF

Daily Operations

- **The primary TIMED Ground Station shall be selected to keep operations costs low**
- **The TIMED Ground Station shall have a backup**
- **Pass times shall be selected to require only single-shift (daytime) operations**
- **The Mission Operations Center location shall be selected to keep operations costs low**
- **Spacecraft command uploads shall be prepared at the Mission Operations Center**
- **Instrument command uploads shall be prepared at the Payload Operations Centers and forwarded to the Mission Operations Center on a daily basis**

Software Quality Assurance

- **Differing requirements will apply to spacecraft and instrument software; software requirements will be separately negotiated with each instrument team**
- **The following requirements apply to s/c software:**
  - **All software development efforts shall adhere to an established development process**
  - **Quality Assurance Mechanisms shall be established to monitor development processes**
  - **Configuration Control shall be maintained throughout the development life cycle**
  - **Software development shall be in accordance with SDO-9989, Space Department Software Quality Assurance Guidelines**

Performance Assurance (PA)

- **Different PA Requirements will apply to spacecraft and instrument hardware; PA guidelines will be developed by the institution fabricating the instrument in coordination with APL**
- **The following apply to spacecraft hardware:**
  - **Flight Model designs shall be reviewed in formal design reviews in accordance with Space Department Design Review Guidelines, SDO-8336, dated February 6, 1987**
  - **Spacecraft Flight Hardware shall be fabricated to Hardware Type A (fully Qualified) and Drawing Level 2 (fully configured) per APL TSD-STD-400.1**
  - **Flight harnesses shall be fabricated to Level 2a drawings (redlined prints acceptable)**

Performance Assurance (Cont'd)

- Subcontractor control shall be through Interface Control Documents (ICDs) or standard specifications
- NASA Grade Levels 1, 2, and 3 EEE parts are approved for flight use; other EEE parts shall require qualification by screening, thermal cycling, or other appropriate tests
- SOR shall assess performance capabilities of EEE parts that do not have demonstrated high reliability
- Electrical, Electronic, and Electromechanical (EEE) parts shall be procured to Hi-Rel Military Specifications, Hi-Rel manufacturer's P/N, or design specifications; special Purchase Instructions (PIs) shall be reviewed by SOR
- SOR shall monitor supplier PA activities and perform source inspection for critical flight parts

Performance Assurance (Cont'd)

- EEE parts that cannot be purchased screened will be screened or tested for flight acceptability
- EEE parts shall be issued under control of SOR
- EEE part identification and controls shall be maintained on the flight hardware
- Failure analysis and corrective actions shall be conducted for critical flight parts and components
- The as-built configuration for the flight model shall be maintained and verified during fabrication
- The disposition of non-conforming parts and materials shall be documented in accordance with TIMED Material Review Board (MRB) procedures

Safety

- **All Integration and Test activities at APL, GSFC, and at the launch site shall be conducted according to approved test procedures and in accordance with the TIMED Program Safety Plan**
- **The spacecraft must be in compliance with Western/Eastern Range Regulation 127-1 and NASA KSC Safety Regulations**

TIMED

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TIMED Mission Overview

- **TIMED is an atmospheric remote sensing mission sponsored by the NASA Office of Space Science; TIMED is the first *Solar Connections* program**
- **TIMED is a two-year mission intended to launch in MAY 2000 on a Delta co-manifested with Jason-1**
- **TIMED will launch into a 625-km circular orbit inclined 74.1° with a 720° per year nodal regression**
- **The four TIMED instruments (GUVI, SABER, SEE, and TIDI) operate on a 100% duty-cycle**
- **The TIMED instruments, spacecraft and ground system incorporate advanced autonomy features and use a decoupled operations concept to lower the cost of Mission Operations and Data Analysis**

Reducing Operations Costs

- **Post-launch MO&DA cost is dominated by staffing costs; to save on MO&DA, you must cut out people**
- **For TIMED, choices were early on made to save MO&DA costs without degrading science goals:**
  - **All operations will use a single shift of operators each day**
    - » **All operations are essentially daytime-only (6 AM to 6 PM)**
  - **Time-consuming analytical functions (orbit determination and propagation, attitude determination) are automated on-board**
  - **A common ground system will be used for I&T and MO&DA**
  - **The Ground System will incorporate autonomy to the greatest extent possible within the limits of reason and cost efficiency**
  - **Instrument and spacecraft operations will be decoupled to reduce the overhead associated with resource deconfliction; TIMED will use a unique ops concept to save on MO&DA costs**

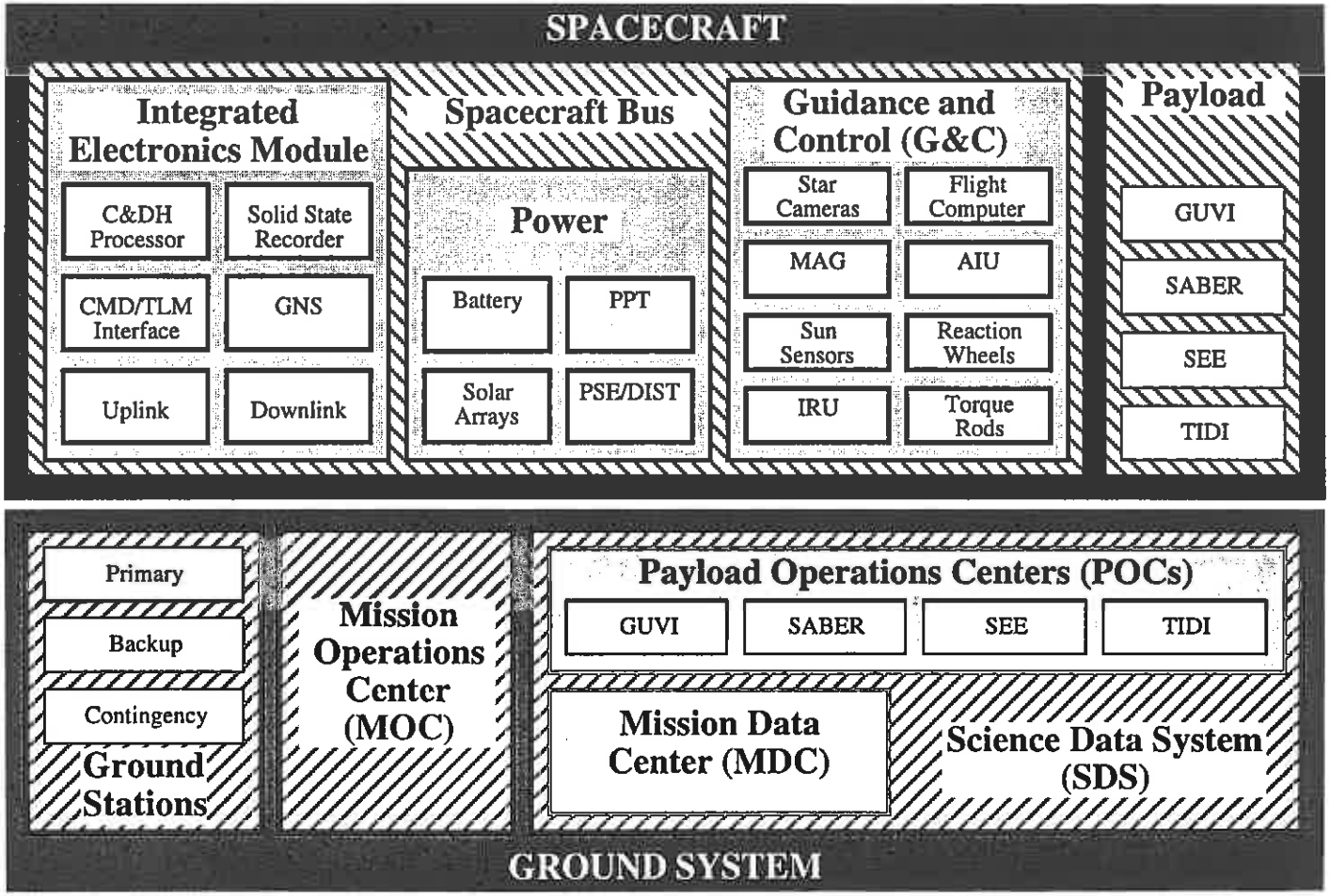
Event-Based Commanding

- **Spacecraft activities are usually driven by events**
  - **terminator or polar crossings, geographical location, etc.**
- **Spacecraft commands are usually time-tagged**
  - **complex to schedule; requires prediction of event times**
- **TIMED will use *Event-Based Commanding* (EBC)**
  - **events are announced on-board and each instrument responds**
- **EBC eliminates the need to predict the timing of events to generate daily command uploads**
- **Command uploads can be reused day after day, orbit after orbit, until events warrant changes**

TIMED Mission System

- **The TIMED Mission System is envisioned as being composed of five major elements or functions:**
  - **Instruments (Payload)**
  - **Spacecraft**
  - **Ground System**
  - **Integration and Test**
  - **Mission Operations and Data Analysis**

System Partitioning



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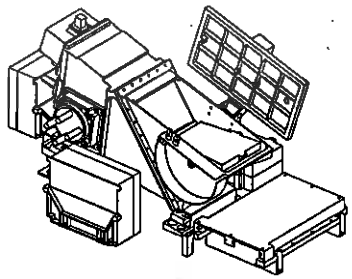
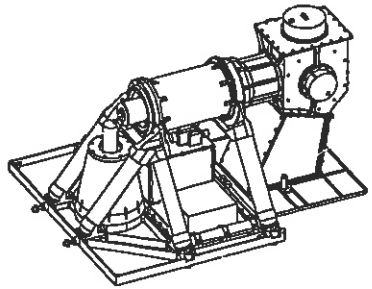
TIMED Instruments (Payload)



GUVI
(Aerospace/APL)

- COMPOSITION
- TEMPERATURE
- AURORAL INPUTS
- ELECTRON DENSITY

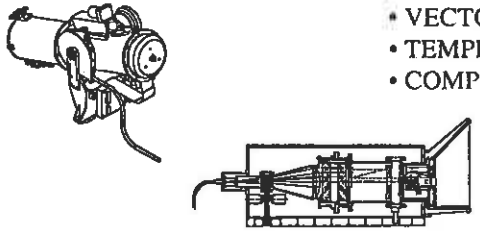
Global Ultra-Violet Imager



SABER
(LaRC/SDL)

- PRESSURE
- TEMPERATURE
- INFRARED COOLING
- COMPOSITION

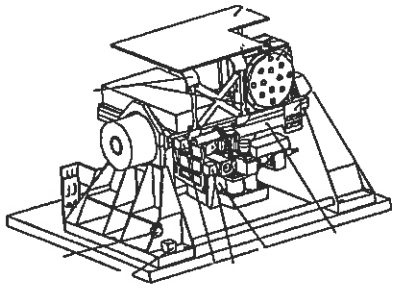
Sounding of the Atmosphere using Broadband Emission Radiometry



TIDI
(SPRL/APL)

- VECTOR WINDS
- TEMPERATURE
- COMPOSITION

TIMED Doppler Interferometer

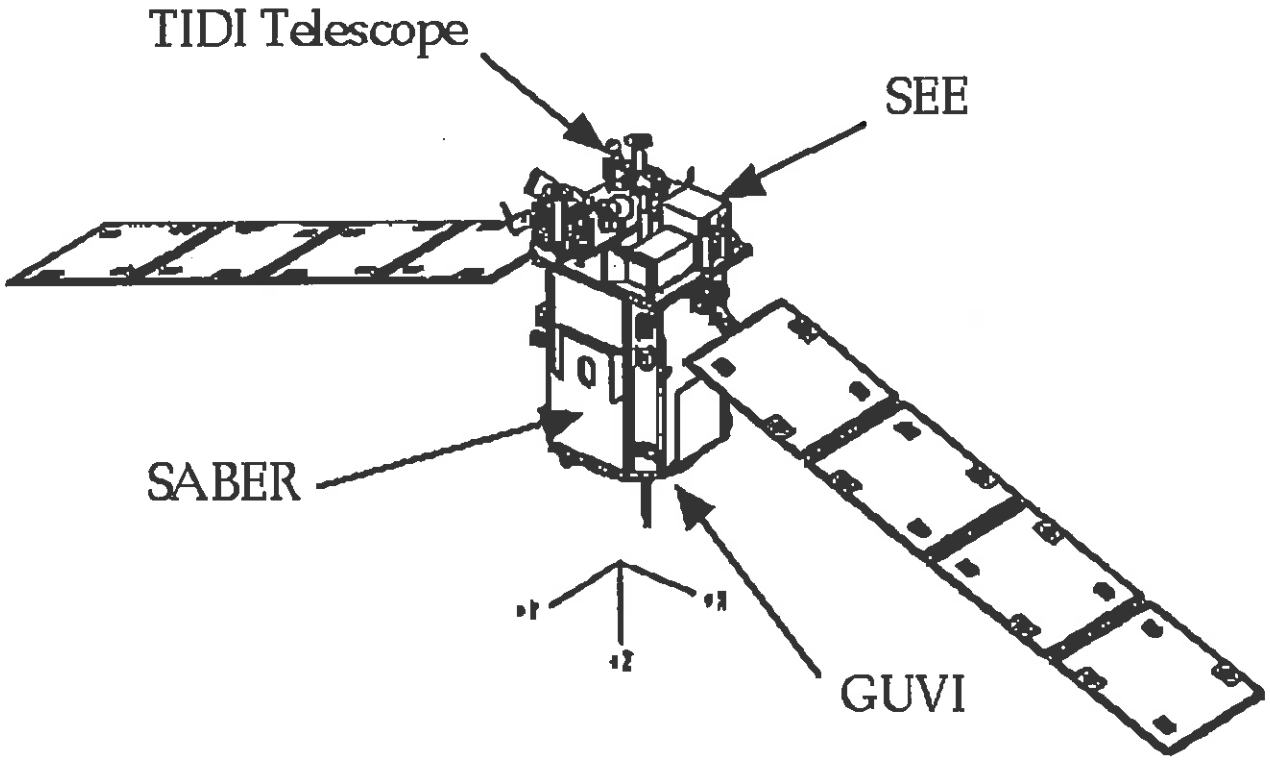


SEE
(LASP)

- SOLAR EUV
- COMPOSITION

Solar EUV Experiment

TIMED Spacecraft



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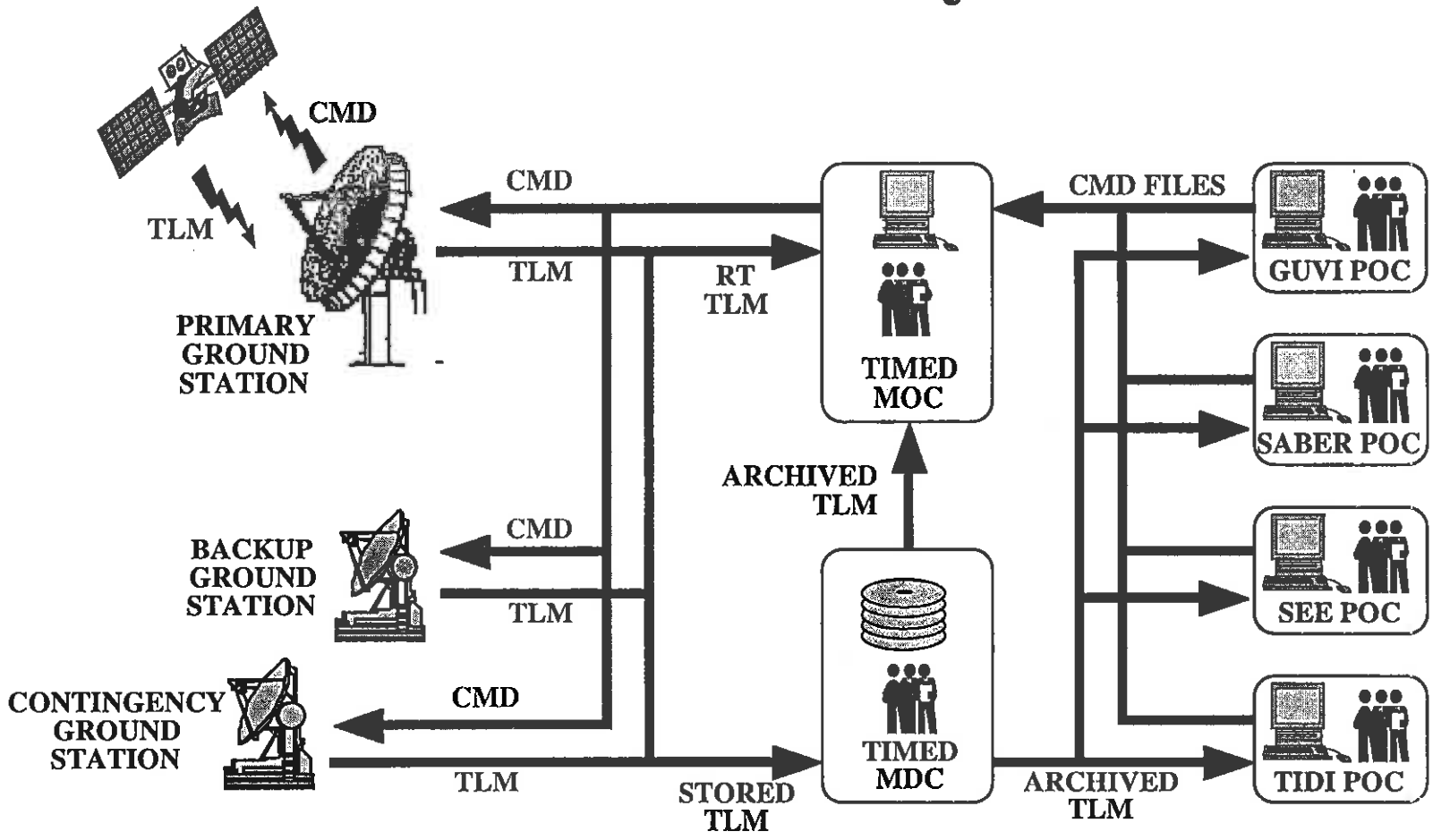
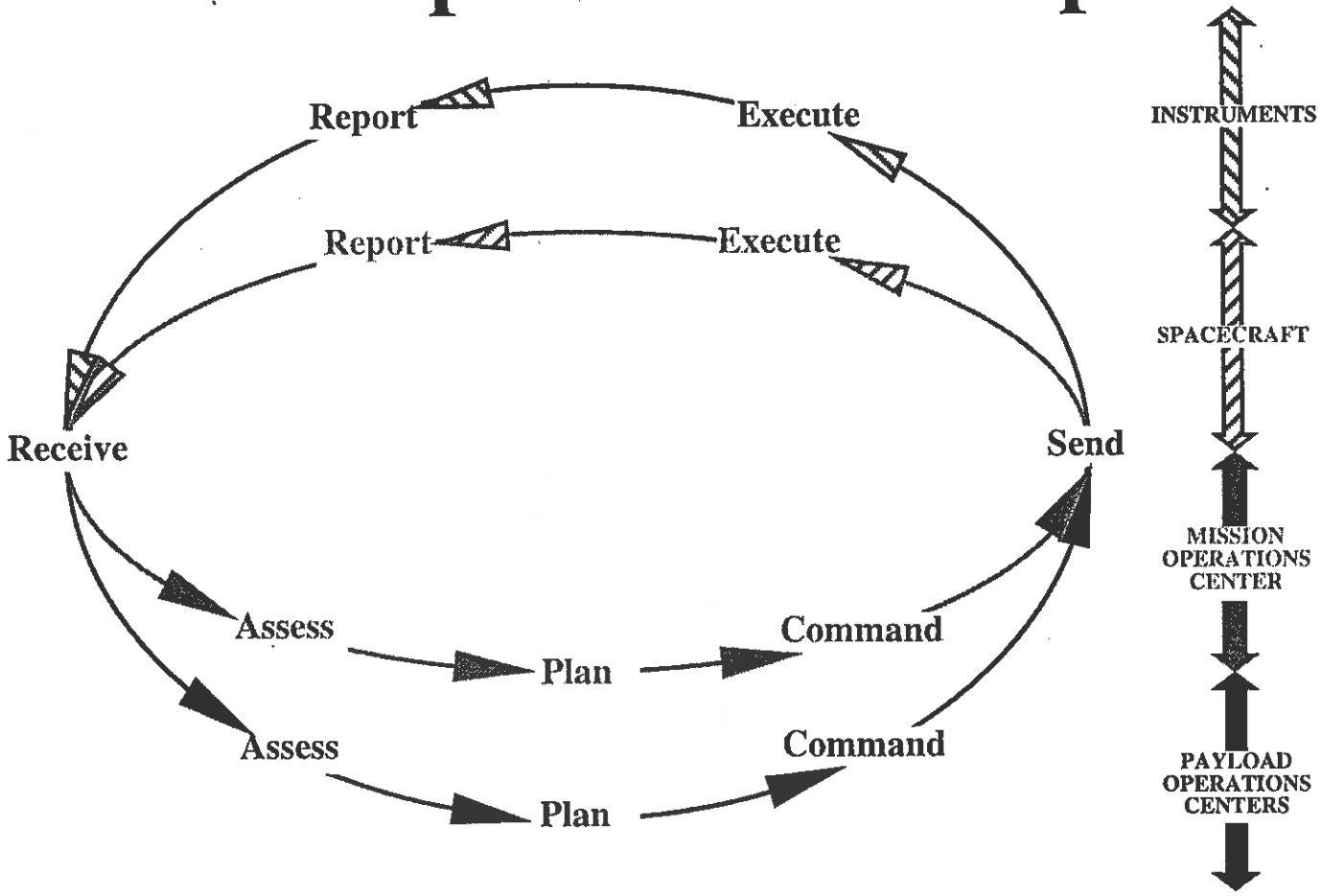
TIMED Ground System



TIMED Operations Concept



Margin Management

- **Explicit margin is carried in three primary categories in the TIMED Spacecraft and Ground System**
  - **Power margins are maintained by the Power System Lead Engineer;**
  - **Weight margin is maintained by the Structural Lead Engineer;**
  - **Data Rate margin is maintained by the Ground System Engineer;**
- **Other margins (pointing, alignment, thermal, etc.) are implicit in the budgets assigned and tracked for those quantities by the lead engineers in the related discipline**

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Documentation

NUMBER	DOCUMENT TITLE	WRITTEN BY	DATE
7363-9001	TIMED Requirements Document	GECameron	Jan-94
7363-9010	TIMED Component Environmental Specification	GECameron	May-97
7363-9020	TIMED Test Plan	SFKozuch	Sep-97
7363-9021	Mission Operations Requirements Document	WLMitnick	Oct-96
7363-9022	TIMED Spacecraft Harness Specification	MJColby	Feb-97
7363-9023	TIMED Star Camera Specification	WERadford	Sep-96
7363-9024	TIMED Torque Rod Specification	WERadford	Sep-96
7363-9025	TIMED Gyro Specification	WERadford	Sep-96
7363-9026	TIMED Reaction Wheel Specification	WERadford	Sep-96
7363-9027	TIMED Flight Computer Specification	WERadford	Sep-96
7363-9028	TIMED Product Assurance Implementation Plan	LMMastracci	Sep-96
7363-9029	TIMED Procurement Product Assurance Requirements	LMMastracci	Aug-96
7363-9030	TIMED Launch Vehicle Interface Document	LEMosher	Oct-96
7363-9031	TIMED Spacecraft Contamination Control Plan	Syed Ali	Nov-97
7363-9032	TIMED Spacecraft Package Count List	MJColby	Nov-97
7363-9034	TIMED Spacecraft Optical Alignment Procedure	ACSadilek	TBS 1998
7363-9035	Mission Operations Center Software Development Plan	WLMitnick	Jan-97
7363-9036	Mission Operations Center Preliminary Software Design Specification	WLMitnick	Nov-96
7363-9037	Concept of Operations Document	RNordeen	Mar-97
7363-9038	TIMED EMC Control Plan and EMI Performance Requirements Specification	GSeylar	Nov-97
7363-9041	TIMED S/C Harness Part's List	VLBailey	Nov-97
7363-9042	TIMED Spacecraft Connector List	VLBailey	Dec-97
7363-9043	TIMED Spacecraft Wire List	VLBailey	Dec-97
7363-9044	TIMED Spacecraft Harness Verification Procedure	VLBailey	Jun-98

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Documentation (Cont'd)

NUMBER	DOCUMENT TITLE	WRITTEN BY	DATE
7363-9045	TIMED Spacecraft Thermal Wire List	MJColby	Feb-98
7363-9046	GUVI Instrument Specific Instrument Interface Specification	KJHeffernan	Jul-96
7363-9047	SABER Instrument Specific Instrument Interface Specification	KJHeffernan	Jul-96
7363-9048	SEE Instrument Specific Instrument Interface Specification	KJHeffernan	Jul-96
7363-9049	TIDI Instrument Specific Instrument Interface Specification	KJHeffernan	Jul-96
7363-9050	TIMED Spacecraft General Instrument Interface Specification	KJHeffernan	Jul-96
7363-9051	TIMED Mechanical I&T Procedures	SRVernon	TBS 1998
7363-9052	TIMED Spacecraft Handling Procedure	SRVernon	TBS 1998
7363-9053	GSS Setup and Validation Procedures	WCDove	TBS 1998
7363-9054	TIMED Launch Site Test Plan	SFKozuch	Sep-99
7363-9055	Launch Countdown Procedure	SFKozuch	Oct-99
7363-9056	TIMED Program Introduction Document	JJohnson	Jul-97
7363-9057	TIMED Program Requirements Document	JJohnson	Dec-98
7363-9058	TIMED Spacecraft Vibration Test Procedure	ESchaefer	TBS 1998
7363-9059	TIMED Spacecraft Acoustic Test Procedure	ESchaefer	TBS 1998
7363-9060	TIMED Spacecraft Thermal Vacuum Test Procedure	BWilliams	Jun-99
7363-9061	Spacecraft Shock Test Procedure	ESchaefer	TBS 1998
7363-9062	TIMED Program GSFC/APL Test Interfaces and Requirements Document (TIRDOC)	WESkullney	
7363-9063	TIMED Spacecraft Static Load Test Procedure	E Schaefer	TBS 1998
7363-9065	TIMED Program Safety Plan	SKDion	Aug-97
7363-9066	TIMED Preliminary Missile System Prelaunch Safety Package	SKDion	Apr-98
7363-9067	TIMED Final Missile System Prelaunch Safety Package	SKDion	Jul-99
7363-9068	TIMED Debris Assessment	SKDion	Jan-98
7363-9070	TIMED Spacecraft GUVI Instrument Integration Procedure	SFKozuch	Apr-98

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Documentation (Cont'd)

NUMBER	DOCUMENT TITLE	WRITTEN BY	DATE
7363-9071	TIMED SABER Instrument Integration Procedure	SFKozuch	Apr-98
7363-9072	TIMED Spacecraft SEE Instrument Integration Procedure	SFKozuch	Apr-98
7363-9073	TIMED Spacecraft TIDI Instrument Integration Procedure	SFKozuch	Apr-98
7363-9074	TIMED Spacecraft Guidance & Control Subsystem Integration Procedure	SFKozuch	Jun-98
7363-9075	TIMED Spacecraft IEM Subsystem #1 Integration Procedure	MJColby	Mar-98
7363-9076	TIMED Spacecraft IEM Subsystem #2 Integration Procedure	MJColby	Apr-98
7363-9077	TIMED Spacecraft SSR #1 Integration Procedure	MJColby	Feb-98
7363-9078	TIMED Spacecraft SSR #2 Integration Procedure	MJColby	Mar-97
7363-9079	TIMED Spacecraft Antennas & RF Switch Assembly Integration Procedure	MJColby	Feb-98
7363-9080	TIMED Spacecraft Power System Integration Procedure	MJColby	May-98
7363-9081	TIMED Spacecraft Survival Thermal Control System Checkout Procedure	MJColby	Aug-98
7363-9082	TIMED Spacecraft Operational Thermal Control System Checkout Procedure	MJColby	Aug-98
7363-9083	TIMED Spacecraft Battery Thermal Control System Checkout Procedure	MJColby	Aug-98
7363-9087	TIMED Spacecraft System Functional Test Procedure	MJColby	Oct-98
7363-9088	TIMED Spacecraft System Performance Test Procedure	MJColby	Nov-98
7363-9089	NiCd Battery Charge and Reconditioning Procedure	MButler	Oct-98
7363-9090	Power Cartridge PC16-005 Checkout Procedure	REBachtell	Jun-98
7363-9091	Instrument Cover Pyrotechnic Checkout Procedure	REBachtell	Jun-98
7363-9092	Ordnance Installation Procedure	REBachtell	Jun-98
7363-9093	Ordnance Stray/No Voltage and Arming Procedure	REBachtell	Jun-98
7363-9094	Operations Requirements Document (OR)	JJohnson	Jul-99
7363-9095	Mission Requirements Document (TBD)	JJohnson	TBS
7363-9096	Specification, TIMED Ni-H battery Cell 50 Ah (Rabbit Ear Configuration)	MButler	Jun-97
7363-9097	Specification, Solar Cell Lay Down for the TIMED Solar Array Panels	MButler	Aug-97

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Documentation (Cont'd)

NUMBER	DOCUMENT TITLE	WRITTEN BY	DATE
7363-9098	Specification, Solar Cell Laydown for the TIMED Sun Sensors	MButler	Aug-97
7363-9101	TIMED Software Quality Assurance Plan	HKUtterback	Sep-97
7363-9102	TIMED Mission Data Center Software Development Plan	KHeeres	Oct-96
7363-9103	TIMED Attitude S/W Development Plan	SHutton	Dec-96
7363-9104	TIMED Attitude Boot Program Requirements	SHutton	Nov-97
7363-9105	TASTIE Requirements	SHutton	Aug-97
7363-9106	TASTIE Functional Configuration	SHutton	Aug-97
7363-9110	TIMED Command & Data Handling Computer Software Requirements Specification	SWilliams	Jul-97
7363-9111	TIMED C & DH 1553 Bus Specification	SWilliams	Jul-97
7363-9112	TIMED C & DH PCI Bus Specification	SWilliams	
7363-9113	TIMED C & DH Functional Design Document	SWilliams	
7363-9114	TIMED C & DH Software Independent Verification and Validation Test	JHueber	Aug-98
7363-9115	TIMED C & DH Command Specification Document	RFPLatte	TBS
7363-9300	TIMED Command & Data Handling Computer Software Development Plan	SWilliams	Jan-97
7363-9316	TIMED Solar Array Drive Accuator Purchase Spec	TSholar	
7363-9317	End-to-End Data System Developer's Guide	HWinters	Sep-97
7363-9318	TIMED Ground Requirements Document	SGemeny	Jul-97
7363-9319	TIMED Purge System Operation Procedure	ACSadilek	TBS 1998
7363-9320	TIMED Spacecraft Transportation Plan	SKozuch	
7363-9321	Mission Operations Readiness Demonstration (MORD)	RNordeen	draft in 1998
7363-9323	TIMED S/C Modal Survey Procedure	ESchaefer	TBS 1998
7363-9324	TIMED Payload Attach Fitting (PAF) Separation Test	SRVernon	TBS 1998
7363-9325	POC-to-Instrument End-to-End Simulation Data Requirements Document	TLefevere	Sep-97
7363-9326	IEM Testbed Requirements Document	TLefevere	Sep-97

Documentation (Cont'd)

NUMBER	DOCUMENT TITLE	WRITTEN BY	DATE
7363-9327	TIMED Mission Data Center Software Requirements Document	KHeeres	Oct-97
7363-9330	TIMED Project Data Management Plan	RDeMajistre	Nov-97
7363-9331	S/W Development Plan for the GPS Navigation Subsystem	AChacos	Mar-97
7363-9333	Software Requirements Specification for the GPS Navigation Subsystem	AChacos	Sep-97
7363-9348	GPS, Software-Hardware Interfaces for the GPS Navigation System (GNS)	WDevereux	Sep-97

Conclusions and Assertions

- All but two Action Items from the Preliminary Design Review (PDR) have been addressed
- The TIMED Mission Requirements are well understood and documented in 7363-9001 Rev. B
- A partitioned Mission System design has evolved that flows down requirements to the system elements
- Margins are being managed and are under control
- All requirements are being met by the TIMED instruments, spacecraft, and ground system
- This review will demonstrate that TIMED is ready to proceed into the fabrication phase