ACE-CT-100-31

Configuration Management Plan

for

The Advanced Composition Explorer Payload

California Institute of Technology

October 6, 1993

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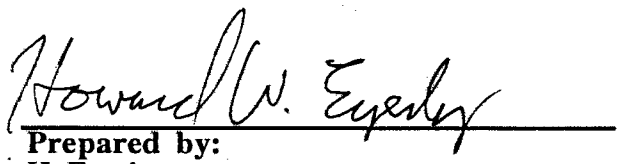

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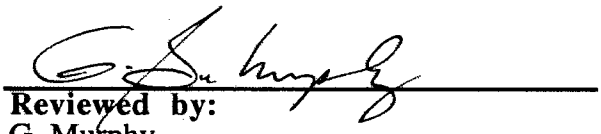

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DOCUMENT CHANGE LOG

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1.0 Introduction and Background

Management of payload development for NASA's Advanced Composition Explorer (ACE) has been assigned to the California Institute of Technology (Caltech) under contract to the Goddard Space Flight Center (GSFC). Caltech is the home institution of Mission Principal Investigator Professor Edward C. Stone. Under terms of its implementation phase contract, the Caltech Payload Management Office (PMO) will establish and maintain a configuration management system appropriate to the development of a payload for the ACE mission.

2.0 Purpose and Scope

This document establishes a Configuration Management (CM) system applicable to all science payload elements developed for use on the Advanced Composition Explorer mission. The purpose of the ACE Science Payload Configuration Management system is to assure that:

a) configured items come under configuration control by the appropriate organization prior to beginning implementation;

b) the as-built condition of flight payload elements and related ground support equipment is properly reflected in the documentation that makes up the acceptance data package at the time of delivery;

c.) changes to elements under Caltech configuration control are processed in a timely and responsible manner.

3.0 Applicable Documents

The Configuration Management (CM) system applicable to the ACE science payload acknowledges prevailing Project requirements documents which specify the technical performance of payload flight elements as well as the qualification, fabrication and acceptance testing requirements for these elements. Foremost among such Project requirements is the **Science Requirements Document (SRD) for the ACE mission, (GSFC-410-ACE-002)**, and the **Performance Assurance Requirements (PAR) for the ACE science payload, (GSFC-410-ACE-008)**. These and other top-level documents come under the configuration management practices of the ACE Project Office, which are described in the **ACE CM procedures document, (GSFC-410-ACE-004)**.

This science payload CM plan is a sub-tier document to Caltech's **ACE Science Payload Management plan, ACE-CT-100-30**, which the Project must approve before instrument development work can begin. The science payload CM plan is consistent with the Project's CM practices. Specific performance assurance requirements which the ACE Science Payload CM system must satisfy are identified in Sections **8.3** and **8.13** of the ACE science payload PAR. Individual instrument development organizations are also bound by these requirements. Their institutionally-unique CM practices are reflected in a set of individual **Instrument Assurance Implementation Plans (IAIPs), ACE-CT-XXX-25**. Each IAIP describes procedures for

ensuring that the effectively of documents and revisions are clearly specified, that revisions are accomplished on the affected products, and that revised end items are appropriately identified.

This payload CM plan therefore focuses on the CM practices of the Caltech PMO. As described in this plan, the Caltech PMO reviews each IAIP to assure that hardware developer provisions are adequate for keeping documents current and to ensure that all fabrications, inspections and tests are performed according to the most recent drawings and revisions.

4.0 Configuration Management Process

The Caltech ACE Payload configuration management process shall consist of:

1.) identification of those items which require configuration management (generation of configured articles list);

2.) association of each configured item whether it be hardware or software with specific drawings and specifications, and the establishment of a process that assures products are built to those drawings, and specifications;

3.) creation of a CM baseline through the use on functional, interface, and process control documents;

4.) implementation of configuration control on the configured items that will assure that any changes to the established baseline are appropriate, and that such changes are appropriately implemented, recorded and distributed.

It is important to note that the SIISs which are under APL configuration control govern the interfaces between the Spacecraft and the Instruments. In order to assure that Caltech, who is responsible for the instrument development, participates in changes to these interfaces, Caltech is in the concurrence loop for CRs against the SIISs. Caltech will be working with APL to develop a process which assures that those items under Caltech configuration control and those under APL configuration control are mutually managed so that all parties are informed of, and participate in, those changes which affect them.

5.0 Configured Items

The ACE science payload CM system identifies those Caltech-controlled documents and deliverable items whose configuration must be controlled in order to assure that the governing Project requirements are met. This identification is accomplished through the use of a Configured Articles List (CAL). The science payload CAL is developed by the ACE experiment development groups and by the Caltech PMO. It is approved by the Caltech PMO. Each item in the CAL will be associated with a drawing or document which controls and specifies its configuration. It is anticipated that the CAL will be available electronically and can be related to any CR's which have been approved or are pending.

Payload documents coming under Caltech PMO configuration control are those which:

a) specify experiment environmental and functional performance requirements as well as the verification approach to be followed;

b) define functional and performance requirements for deliverable hardware and software;

c) document interface agreements as well as system safety hazards.

Those documents, drawings and specifications which describe the design, manufacturing process, test, or configuration of instrument assemblies and subassemblies and do not affect the interface with the spacecraft or impact directly the instrument performance requirements will be under the configuration management authority of the instrument developer.

6.0 Hardware/Software Identification

Flight hardware components, assemblies and subassemblies will be labeled with a part number (and serial number for duplicate items) wherever possible and practical. The extent of, and approach to, such labeling will be reviewed and approved by the Caltech PMO as part of the individual instrument procedures described in the IAIPs. In the course of this review, consideration will be given to the size, shape and materials used in the items to be serialized, and to the experiment's contamination control requirements. Piece parts utilized in flight boards will be kept in the Caltech parts database. Electrical, electronic and electromechanical (EEE) parts will be tracked by serial and/or lot numbers.

Engineering drawings, parts and materials lists, and manufacturing process specifications will come under configuration control at the start of the manufacturing process for the instrument's subassemblies. Change Requests for those items under Caltech, APL, or GSFC configuration control (Section 8) will then be generated and processed as appropriate during flight hardware development so as to properly reflect each instrument's "as-built" configuration. In this way, delivery of completed payload flight hardware will include final versions of documentation which show the true configuration as well as EEE parts traceability.

The configuration of flight software will be identified by revision number and date, along with the appropriate annotation to the source code listing. The ACE Payload Change Request form (see section 8) will also be used by Caltech to disposition software-related requests once the flight software is placed under configuration control at the start of full-up instrument performance and acceptance testing. A duplicate of all configured code will be kept as a back-up

6.1. Numbering System for Engineering Drawings and Specifications

Developers of deliverable ACE payload flight and ground elements will each establish an institutionally-unique numbering system to identify their engineering drawings and process specifications. The system chosen by each investigator group for identifying their engineering drawings will be hierarchical. The Caltech PMO will review the approach selected by each group and make comments or recommendations as appropriate. The portion of an instrument's "drawing tree" under Caltech configuration control (typically including block diagrams and interfaces) and the identification of CRs applicable to a specific drawing will be maintained in a configuration management data base at Caltech and available for review at any time.

7.0 Document Baseline

The Phase C/D configuration baseline is established with those documents shown in Table 7-1. Once this baseline is established, it will be maintained and updated by Caltech according to the following guidelines:

1) proposed changes will be submitted, systematically reviewed and evaluated for technical, cost and schedule impact prior to disposition according to established processes described in Section 8 of this document;

2) Caltech will process expeditiously any proposed changes to the configuration baseline;

3) Caltech will ensure that changes to the configuration baseline are not made without the appropriate coordination with the Goddard Project Office and/or the APL spacecraft developer;

4) Caltech will track change requests and issue revisions such that all concerned will have easy access to critical information (It is anticipated that most information regarding configuration management will be available on-line over the NASA Science Internet (NSI));

5) Use of electronic systems will be employed where possible to improve information and process flow. (This includes encouraging the use of CAD systems that build CM into their software structure.)

The ACE Payload Document Tree is illustrated in Figure 7-1. Those Documents Shown in orange are under Caltech PMO configuration management and those in yellow are under instrument configuration management.

Table 7-1, Payload Documents

DOCUMENT NAME	Acro-nym	Creator	CM respon-sibility	Approval	Concur-rence	Baselined
Science Requirements Document	SRD	Caltech: PMO	GSFC	GSFC	N/A	Completed
Product Assurance Requirements	PAR	GSFC	GSFC	GSFC	N/A	4/93
Payload Assurance Implementation Plan	PAIP	Caltech: PMO	GSFC	GSFC	N/A	End of Ø B
Payload Safety Plan	PSP	Caltech: PMO	N/A	Caltech: PMO	GSFC 410.0	End of Ø B
Environmental Requirements Document	ERD	Caltech: PMO	Caltech: PMO	Caltech: PMO	APL S/C	End of Ø B
Verification Matrix	N/A	Caltech: PMO	Caltech: PMO	Caltech: PMO	GSFC 410.0	Completed
Contamination Control Plan	CCP	Caltech: PMO	N/A	Caltech: PMO	APL	End of Ø B
CRIS Instrument Assurance Implementation Plan	IAIP	Caltech: CRIS	N/A	Caltech: CRIS; Caltech: PMO	N/A	End of Ø B
SIS Instrument Assurance Implementation Plan	IAIP	Caltech: SIS	N/A	Caltech: SIS; Caltech: PMO	N/A	End of Ø B
ULEIS Instrument Assurance Implementation Plan	IAIP	APL: ULEIS	N/A	U of Md: ULEIS; Caltech: PMO	N/A	End of Ø B
SEPICA Instrument Assurance Implementation Plan	IAIP	UNH: SEPICA	N/A	UND: SEPICA; Caltech: PMO	N/A	End of Ø B
SWIMS Instrument Assurance Implementation Plan	IAIP	U of Md: SWIMS	N/A	U of Md: SWIMS; Caltech: PMO	N/A	End of Ø B
SWICS Instrument Assurance Implementation Plan	IAIP	U of Md: SWICS	N/A	U of Md: SWICS; Caltech: PMO	N/A	End of Ø B
MAG Instrument Assurance Implementation Plan	IAIP	U of D: MAG	N/A	U of D: MAG; Caltech: PMO	N/A	End of Ø B
SWEPAM Instrument Assurance Implementation Plan	IAIP	LANL: SWEPAM	N/A	LANL: SWEPAM; Caltech: PMO	N/A	End of Ø B

Table 7-1, Payload Documents (Continued)

DOCUMENT NAME	Acro-nym	Creator	CM respon-sibility	Approval	Concur-rence	Baselined
EPAM Instrument Assurance Implementation Plan	IAIP	APL: EPAM	N/A	APL: EMPAM; Caltech: PMO	N/A	End of Ø B
Misson Requirements Document	MRD	GSFC	GSFC	N/A	N/A	N/A
General Instrument Interface Specification	GIIS	APL S/C	APL S/C	APL S/C	Caltech: PMO	TBD
CRIS Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; Caltech: CRIS	Caltech: PMO	Instrument PDR
SIS Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; Caltech: SIS	Caltech: PMO	Instrument PDR
ULEIS Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; APL: ULEIS	Caltech: PMO; U of Md: ULEIS	Instrument PDR
SEPICA Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; UNH: SEPICA	Caltech: PMO;	Instrument PDR
S/S/S DPU Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; TUB	Caltech: PMO;	Instrument PDR
SWIMS Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; U of Md: SWIMS	Caltech: PMO	Instrument PDR
SWICS Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; U of Md: SWICS	Caltech: PMO	Instrument PDR
MAG Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; U of D: MAG	Caltech: PMO	Instrument PDR
SWEPAM Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; LANL: SWEPAM	Caltech: PMO	Instrument PDR
EPAM Specific Instrument Interface Specification	SIIS	APL S/C	APL S/C	APL S/C; EPAM	Caltech: PMO	Instrument PDR
Payload Management Plan	PMP	Caltech: PMO	N/A	GSFC 410.0		End of Ø B
Configuration Management Plan	CMP	Caltech: PMO	N/A	Caltech: PMO;	GSFC	End of Ø B
S/W Implementation Plan	SWIP	Caltech: PMO	N/A	Caltech: PMO	N/A	End of Ø B
Mission Operations Concept Document	MOCD	GSFC	GSFC	GSFC	Caltech; ASC Mgr.	Completed

Table 7-1, Payload Documents (Continued)

DOCUMENT NAME	Acronym	Creator	CM responsibility	Approval	Concurrence	Baselined
Mission Requirements Request	MRR	GSFC	GSFC	GSFC	N/A	TBD
Mission Operations Plan	MOP	GSFC	GSFC	GSFC	N/A	TBD
Science Operations and Data Analysis Plan	SODA	Caltech: ASC	N/A	Caltech: PMO	GSFC	TBD
ACE Science Center Control Document	ASCCD	Caltech: ASC	Caltech: ASC	Caltech: PMO	GSFC	Phased starting in 4/96
CRIS Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; Caltech: CRIS	N/A	Phased starting on 3/1/95
SIS Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; Caltech: SIS	N/A	Phased starting on 3/1/95
ULEIS Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; APL: ULEIS	N/A	Phased starting on 3/1/95
SEPICA Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; UNH: SEPICA	N/A	Phased starting on 3/1/95
SWIMS Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; U of Md: SWIMS	N/A	Phased starting on 3/1/95
SWICS Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; U of Md: SWICS	N/A	Phased starting on 3/1/95
MAG Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; U of D: MAG	N/A	Phased starting on 3/1/95
SWEPAM Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; LANL: SWEPAM	N/A	Phased starting on 3/1/95
EPAM Instrument/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	Caltech: PMO; APL: EPAM	N/A	Phased starting on 3/1/95
Spacecraft/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	APL S/C; Caltech: PMO	GSFC 410.0	TBD
POCC/Science Center ICD	N/A	Caltech: ASC	Caltech: ASC	GSFC 500.0; Caltech:PMO	GSFC 410.0	TBD

Table 7-1, Payload Documents (Continued)

DOCUMENT NAME	Acro-nym	Creator	CM respon-sibility	Approval	Concur-rence	Baselined
CRIS Instrument Functional Requirements Document	IFRD	Caltech: CRIS	Caltech: PMO	Caltech: PMO; Caltech: CRIS	GSFC 661.0; Wash U.	End of Ø B
SIS Instrument Functional Requirements Document	IFRD	Caltech: SIS	Caltech: PMO	Caltech: PMO; Caltech: SIS	GSFC 661.0	End of Ø B
ULEIS Instrument Functional Requirements Document	IFRD	APL: ULEIS	Caltech: PMO	Caltech: PMO; APL: ULEIS	U of Md: ULEIS	End of Ø B
SEPICA Instrument Functional Requirements Document	IFRD	UNH: SEPICA	Caltech: PMO	Caltech: PMO; UNH: SEPICA	TUB	End of Ø B
SWIMS Instrument Functional Requirements Document	IFRD (Optional)	U of Md: SWIMS	Caltech: PMO	Caltech: PMO; U of Md: SWIMS	U of Bern; TUB	End of Ø B
SWICS Instrument Functional Requirements Document	IFRD (Optional)	U of Md: SWICS	Caltech: PMO	Caltech: PMO; U of Md: SWICS	TUB	End of Ø B
MAG Instrument Functional Requirements Document	IFRD (Optional)	U of D: MAG	Caltech: PMO	Caltech: PMO; U of D: MAG	GSFC 695.0	End of Ø
SWEPAM Instrument Functional Requirements Document	IFRD (Optional)	LANL: SWEPAM	Caltech: PMO	Caltech: PMO; LANL: SWEPAM	Sandia Nat'l Labs	End of Ø B
EPAM Instrument Functional Requirements Document	IFRD (Optional)	APL: EPAM	Caltech: PMO	Caltech: PMO; APL: EPAM	N/A	End of Ø B
CRIS Experiment Implementation Plan	EIP	Caltech: CRIS	N/A	Caltech: PMO; Caltech: CRIS	GSFC 661.0; Wash. U.	6/15/93
SIS Experiment Implementation Plan	EIP	Caltech: SIS	N/A	Caltech: PMO; Caltech: SIS	GSFC 661.0	6/15/93
ULEIS Experiment Implementation Plan	EIP	APL: ULEIS	N/A	Caltech: PMO; APL: ULEIS	U of Md: ULEIS	6/15/93
SEPICA Experiment Implementation Plan	EIP	UNH: SEPICA	N/A	Caltech: PMO; APL: SEPICA	TUB; MPE	6/15/93

Table 7-1, Payload Documents (Continued)

DOCUMENT NAME	Acro-nym	Creator	CM respon-sibility	Approval	Concur-rence	Baselined
SWIMS Experiment Implementation Plan	EIP	U of MD: SWIMS	N/A	Caltech: PMO; U of Md: SWIMS	U of Bern; TUB	6/15/93
SWICS Experiment Implementation Plan	EIP	U of Md: SWICS	N/A	Caltech: PMO; U of Md: SWICS	TUB	6/15/93
MAG Experiment Implementation Plan	EIP	U of D: MAG	N/A	Caltech: PMO; U of D: MAG	GSFC 695.0	6/15/93
SWEPAM Experiment Implementation Plan	EIP	LANL: SWEPAM	N/A	Caltech: PMO; LANL: SWEPAM	Sandia Nat'l Labs	6/15/93
EPAM Experiment Implementation Plan	EIP	APL: EPAM	N/A	Caltech: PMO; APL: EPAM	N/A	6/15/93
CRIS Instrument Design & Data package	IDDP	Caltech: CRIS; Wash U.; GSFC 661.0	Caltech: CRIS	Caltech: CRIS; Caltech : PMO	Wash. U.; GSFC 661.0	Instrument PSR
SIS Instrument Design & Data package	IDDP	Caltech: SIS GSFC: 661.0	Caltech: SIS	Caltech: SIS; Caltech : PMO	GSFC 661.0	Instrument PSR
ULEIS Instrument Design & Data package	IDDP	APL: ULEIS; U of Md: ULEIS	APL: ULEIS	APL: ULEIS; Caltech : PMO	U of Md: ULEIS	Instrument PSR
SEPICA Instrument Design & Data package	IDDP	UNH: SEPICA; TUB	UNH: SEPICA	UNH: SEPICA; Caltech : PMO	TUB; MPE	Instrument PSR
TUB Instrument Design & Data package	IDDP	TUB	UNH	UNH: SEPICA; Caltech: PMO	U. of Md: (SWICS SWIMS)	Instrument PSR
SWIMS Instrument Design & Data package	IDDP	U of Md: SWIMS: U of Bern	U of Md: SWIMS	U of Md: SWIMS; Caltech : PMO	U of Bern; TUB	Instrument PSR

Table 7-1, Payload Documents (Continued)

DOCUMENT NAME	Acro-nym	Creator	CM respon-sibility	Approval	Concur-rence	Baselined
SWICS Instrument Design & Data package	IDDP	U of Md: SWICS	U of Md: SWICS	U of Md: SWICS; Caltech : PMO	TUB	Instrument PSR
MAG Instrument Design & Data package	IDDP	U of D: MAG; GSFC 695.0	U of D: MAG	U of D: MAG; Caltech : PMO	GSFC 695.0	Instrument PSR
SWEPAM Instrument Design & Data package	IDDP	LANL: SWEPAM; Sandia	LANL: SWEPAM	LANL: SWEPAM; Caltech : PMO	Sandia Nat'l Labs	Instrument PSR
EPAM Instrument Design & Data package	IDDP	APL: EPAM	APL: EPAM	APL: EPAM; Caltech : PMO	N/A	Instrument PSR

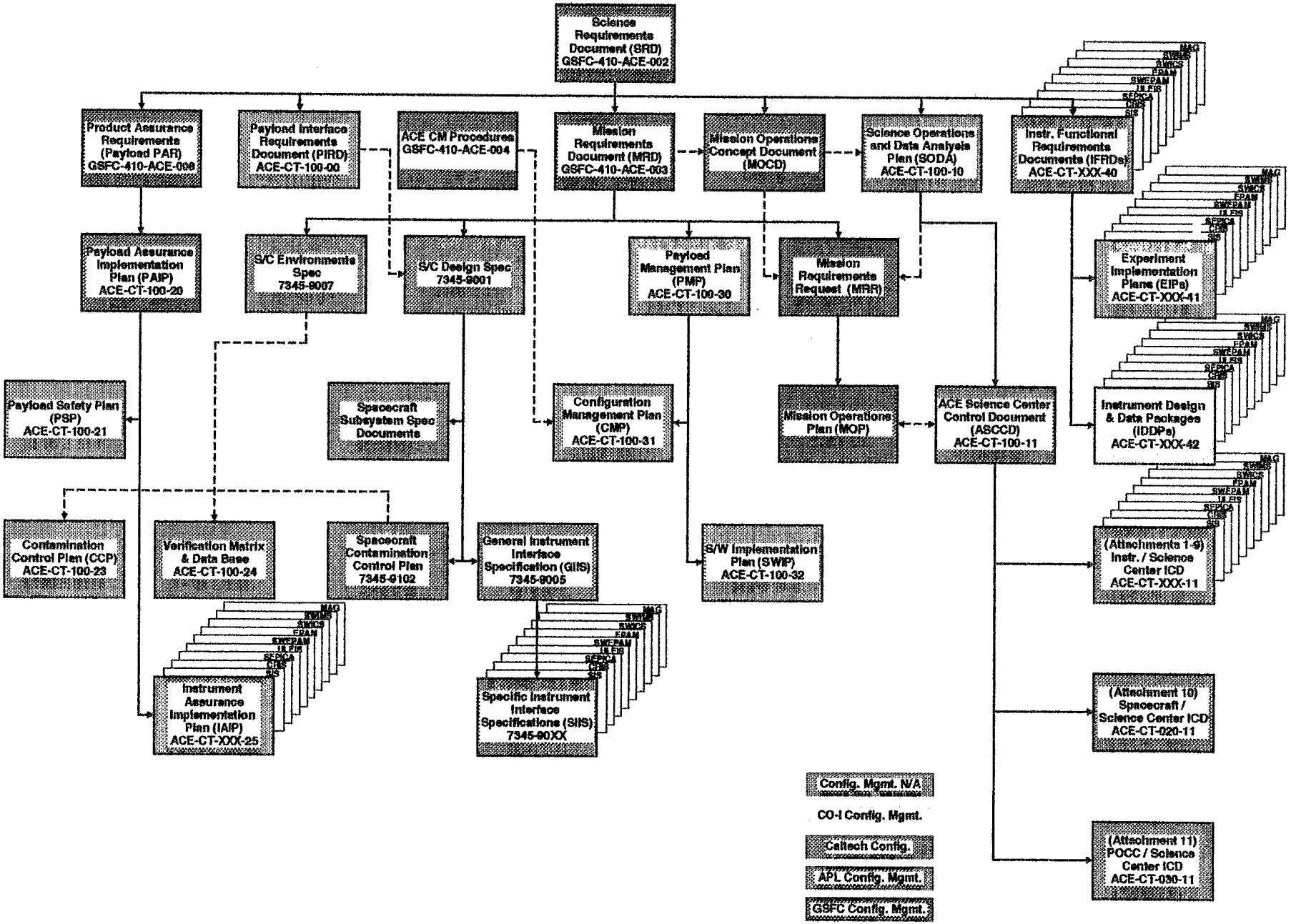

Figure 7-1
Payload Documentation Tree

7.1. Documentation Standards

When accepting drawings or other documents as part of the deliverables for a given instrument and those deliverables are *under the configuration management of the instrument developer*, Caltech will only accept legible, reproducible documentation that has been signed off by the appropriate instrument representative.

Information obtained from instrument developers *that is, or becomes part of, a Caltech configured item* will be provided in a *to be specified electronic format.*

All configuration-controlled documentation produced by Caltech and sent to the GSFC or hardware developers will be in both electronic and print media and one print copy will be left unbound for reproduction. Copies of all documents that are transmitted by Caltech to any other project organizations will be accessible in the Caltech project filing System in both print and electronic form.

7.2. Document Numbering Methodology

Documents that come under the configuration management authority of Caltech will conform to the numbering methodology described below. Once assigned, each document control number having the latest revision letter will remain in force until the document is retired. Minor changes to documents will be clearly marked. The standard way of doing this is through the use of change bars to flag the altered text or tables. By way of contrast, major changes to documents will dictate a complete revision to the document, which will not show change bars, but will carry the next sequential revision letter.

The document number is in the following ten character format:

ACE-CT-XXX-YYZ

where

ACE is the Project;
CT is the lead organization, in this instance Caltech;

$$\left.\begin{matrix} X \\ X \\ X \end{matrix}\right\} = Payload - ID$$

$$\left.\begin{matrix} Y \\ Y \end{matrix}\right\} = Document - ID$$

Z = Revision Letter

The Payload convention follows the same convention as APL, where the three X characters (XXX) designate:

100 = Caltech Payload Document
010 = CRIS

011 = SIS
012 = ULEIS
013 = SEPICA
014 = MAG
015 = SWICS
016 = SWIMS
017 = EPAM
018 = SWEPAM
019 = S/S/SDPU

The Document IDs (YY) identifies the document type (e.g. IAIP, IDDP etc.) by number.

The last designator (Z) are the document revision letters that follow the convention that the first revision will begin with an "A."

Figure 7.1, the Payload Document Tree shows the numbers that have been assigned to the payload documents.

7.3. Distribution of Payload Documents

The right-hand column of Table 7-1 indicates the time by which the indicated documents will be baselined. This occurs after both the approving organization and the concurring organization have signed off the document.

7.4. Released Document Log

The Caltech PMO will maintain a log in which the release of documents under payload configuration control is recorded. This log will be part of the configuration management data base and be on line at all times.

8.0 Payload Change Control

Documents delineating requirements, or describing Hardware or Software configuration, come under change control after they have been approved by all designated personnel. Items under change control cannot be modified unless the changes are accepted by the organization that has the responsibility for configuration control of the affected items.

Column seven in Table 7-1, "Payload Documents," presents the milestones and/or dates by which configuration control is scheduled to be into effect for each document under Caltech control.

Caltech will maintain configuration control on the documents for which the Caltech PMO is responsible. (See highlighted rows in table 7-1.) Caltech will ensure that the Payload Element Managers maintain configuration control of the documents for which they are responsible (refer to column four of Table 7-1).

8.1. Change Classification

8.1.1. Class I Changes

Class I changes are changes that alter items that are under change control, and

a. Affect personnel safety and/or facility or systems safety following delivery to the GSFC, or;

b. Affect more than just Payload costs (i.e. also affects APL or the GSFC operations budgets), and results in an estimated net cost increase that exceeds 20K at any of the institutions, or

c. requires a change or waiver to Governing Project Office imposed requirements, or;

d affects a requirement, document, or component under GSFC configuration management.

8.1.2. Class II Changes

Class II changes are changes that alter items that are under change control which are not class I and:

a. Affects personnel safety and/or facility or systems safety prior to delivery to the GSFC or:

b. requires a change or waiver to Caltech generated requirements, or;

c. affects a requirement, or document for which Caltech has configuration control responsibility, or;

d. if cost impact requires increase in contract value

8.1.3. Class III Changes

Class III changes are changes that alter items *not currently under Caltech change control, and which are not Class I or II changes.* Class III changes affect hardware developer requirements for which the hardware developers have configuration control responsibility. Class III changes have a cost impact that can be absorbed within contractual resources.

8.2. Submittal and Processing of Change Requests/Waivers

The instrument team which wishes to make a change to an item under Caltech CM shall initiate the change process by submittal of the Change Request form described below. This submittal process is anticipated to be via the computer network.

8.2.1. Change Request Form

All Class I and II change requests will be documented on an "ACE Payload Change Request" Form, (Figure 8-1). This form will also be used by Caltech to request Class I change dispositions from the GSFC. In addition to being used for submittal of a change request, Caltech will also use this form as a basis for processing Class II change requests from hardware developers. The steps for completing change request forms are as described below.

ACE PAYLOAD CHANGE REQUEST

C.R. NO:

PRIORITY:

ELEMENT:	ORG:	INITIATOR:	DATE:

☐ ECR ☐ WAIVER

☐ SRD ☐ GIIS ☐ IAIP
☐ PAR ☐ SIIS ☐ EIP
☐ ACCD ☐ IFRD ☐ IDDP
☐ OTHER

REQUESTER'S CLASSIFICATION: I ☐ II ☐

COST (K$)

SCHED. (WEEKS)

EXP. MGR./REP. SIGNATURE:

DATE:

ORIGINAL REQUIREMENT(S) (DOCUMENT, SECTION AND SPECIFIC REQUIREMENTS):

CHANGE/WAIVER REQUESTED:

IMPACT OF CHANGE/WAIVER

REASON FOR CHANGE/WAIVER

PMO CMO CHANGE CLASSIFICATION: I ☐ II ☐ III ☐

TITLE:	SIGNATURE:	APPROVAL YES	APPROVAL NO
TECHNICAL REP:		☐	☐
PROGRAM CONTROL MGR.		☐	☐
PAYLOAD SYS. ENGR:		☐	☐
PAYLOAD P.A. MGR:		☐	☐
MISSION SCIENTIST:		☐	☐
SCIENCE CENTER MGR:		☐	☐
AD HOC CCB MEMBER		☐	☐
PAYLOAD MANAGER		☐	☐

FINAL DISPOSITION:
☐ APPROVED
☐ DISAPPROVED
☐ NOT DISPOSITIONED

PMO CMO SIGNATURE:

DATE:

GSFC CMO SIGNATURE:

DATE:

a. CR NO. The Change Request (CR) Number is assigned by the Caltech ACE Payload Management Office. The initiator should communicate with Caltech as soon as the need for a change is perceived. Contact Howard Eyerly via a phone call at (818) 395-6632, E-Mail at CITSRL::EYERLY or via a FAX transmission at (818) 449-8676 to obtain a CR No.

b. PRIORITY Based on the urgency for obtaining a disposition, the initiator will assign a priority rating of routine, urgent or emergency. In order to expedite dispositions, Caltech is to be immediately contacted via a phone call or FAX transmission whenever the need for a urgent or emergency disposition is perceived.

c. ELEMENT Enter the name of the payload element for which the change is requested, e.g. SEPICA.

d. ORG. (ORGANIZATION) Enter the name of the organization who is requesting the change, e.g. UNH.

e. INITIATOR Enter the name of the individual initiating the change request who can be contacted in order to discuss the change.

f. DATE Enter the date when the change request is submitted.

g. ECR/WAIVER Check the "ECR" box if the requested change is to a controlling document (when a change to a requirement is proposed). Check the "Waiver" box if a relief from a requirement is being requested.

h. WAIVER INVOLVES Check the box that designates the document that contains the requirement that is being addressed in the change request. If the change is contained in a document that is not listed, then check the "Other" box and identify the applicable document in the "Original Requirement(s) Section of the CR.

i. REQUESTER'S CLASSIFICATION Based on the criteria contained in Section 7, check the Class "I" or "II" box.

j. COST (K$) Provide an estimate of additional costs to be incurred throughout all elements of the project, if the proposed change is implemented. If the proposed change would result in a cost savings, then show the amount in brackets, i.e. <TBDK$>.

k. SCHED. IMPACT Provide an estimate of additional development time (in weeks) that would be needed, if the proposed change is implemented. If the proposed change would result in a schedule savings, then show the time in brackets, i.e. <TBD weeks>.

l. EXP. MGR./REP SIGNATURE The experiment manager or his representative will sign and date the CR to authorize the request.

m. ORIGINAL REQUIREMENT(S) Enter the requirement reference and quote the requirement that is being addressed.

n. CHANGE/WAIVER REQUESTED If the change is to a requirement, state what the revised requirement is that is being proposed. If a requirement is being waived, describe what will be done in lieu of adhering to the original requirement.

o. IMPACT OF CHANGE/WAIVER Enter a description of all the impacts associated with the proposed change, examples are: safety, mass, power, data rates, performance and reliability. Financial and/or schedule resource impacts identified in (g) and (h) above, can be expanded upon here in a brief statement.

p. REASON FOR CHANGE/WAIVER Enter the reason(s) for requesting the change. Examples are: a facility limitation, schedule constraints or financial limitations.

Caltech will generate, and if appropriate transmit to GSFC, change requests within five working days following the determination that a change is needed. To ensure that dispositions are processed in a timely manner, Caltech requires that the hardware developers provide change requests within five working days following the determination that a change is needed. Details of the processing of the CRs and Waiver requests are described below.

8.2.2. Makeup Of The Caltech PMO Change Control Board (CCB)

The Caltech Payload Manager will designate at any given time an individual to serve as Configuration Management Officer (CMO). This individual will also serve as Chairman of the Caltech PMO Change Control Board (CCB). Permanent members of the Caltech CCB are the Payload System Engineer, the Payload Performance Assurance Manager, Manager for Program Control and the Mission Scientist. Ad-hoc members will be assigned as needed by the Caltech Payload Manager.

The Caltech Payload Manager will ensure that conflicts of interest do not arise in assigning ad-hoc members to the PMO CCB. Permanent members will excuse themselves if there is a conflict of interest on their part. The CMO will not necessarily always be the same person, depending in part on the travel plans of the several people who serve on the PMO technical staff. Usually, the CMO will be designated from among the permanent CCB members. In addition to being Chairman, responsibilities of the Caltech PMO CMO are to:

a. Record the conclusions reached by the CCB;

b. Expedite Caltech CCB activities;

c. Communicate with GSFC and the hardware developers;

d. Schedule CCB meetings;

e. Ensure that CCB activities are in concert with CM requirements;

f. Obtain technical support from outside the CCB when it is needed;

g. Perform audits of the hardware developers' CM systems at appropriate times;

h. Maintain the CCB electronic data base and information flow.

8.2.3. CR Process flow

Upon receipt, the Caltech CMO will screen each request to verify that it affects an article that is currently under configuration control. If the screening shows that a CR is not required, it will be so noted on the CR, filed, and then returned to the originator. The CMO will also screen the request to determine if the provided information is sufficient in order to permit it's evaluation. He will then log the CR in and ascribe a preliminary classification (Class I or Class II). If in the estimation of the CMO the request is clearly Class III, the CR will be returned to the originator without any further processing. If there is insufficient data provided, the originator will be requested to provide the needed information. If the CMO has any question about how to classify the request during screening (Class I or II or III) he will treat it as a Class II change and allow the CCB to decide. Following the CR screening and acceptance for CCB consideration, the CMO will verify its priority, i. e. routine, urgent or emergency. The CCB will then be convened by the CMO. The CMO will attempt to do so immediately if the proposed change is classified as emergency; within two (2) work days if the change is classified as urgent or within a work week if the change is routine. A quorum will be declared if the CMO and 2 members are present. The PMO CCB will then review the request to concur or change its classification (I, II or III). Class I, II and III changes will be processed as follows:

a. Class I Class I changes will be approved for forwarding to GSFC by the CMO, then forwarded to the GSFC Instrument Manager for disposition, along with a PMO CCB recommendation and rationale for either approval or disapproval. A recommendation for disapproval will be accompanied by (whenever possible), alternative approaches for achieving the indicated effect.

b. Class II Class II changes will be dispositioned by Caltech. A consensus of the CCB is required for approval. One member's disapproval is sufficient to disapprove the request. A board member may however abstain from voting once the case has been heard. In that case, the remaining members will decide the outcome, provided there is still a quorum.

c. Class III If the PMO CCB judges the CR to be Class III, it will be returned to the originator for his disposition.

Immediately following final disposition, the Caltech CMO will note the CR's disposition in the CR log and data base, and then return it to the originator. The PMO logical processing flow is depicted in Figure 8-2.

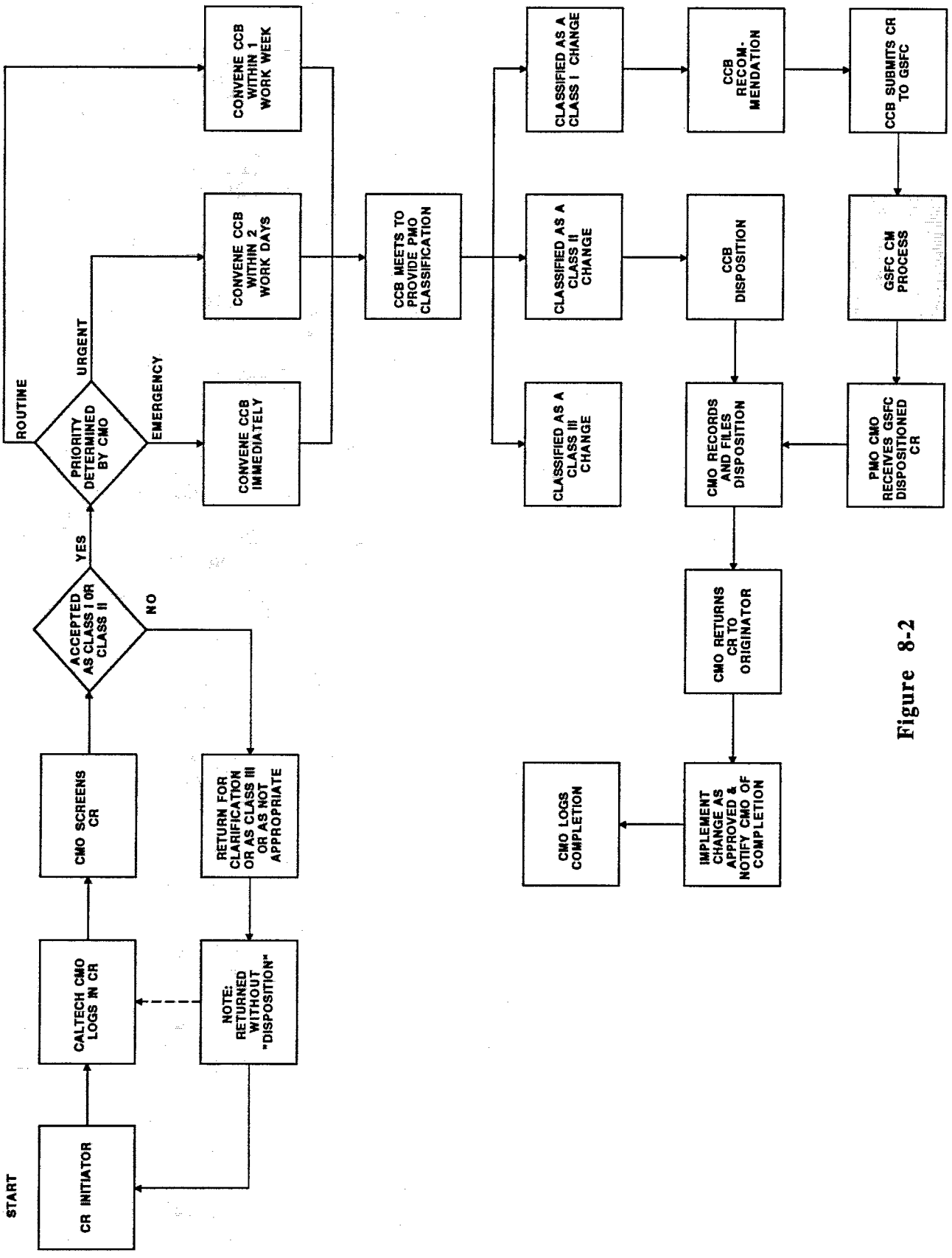
PMO CR PROCESSING FLOW
START
CR INITIATOR
CALTECH CMO LOGS IN CR
NOTE: RETURNED WITHOUT "DISPOSITION"
CMO SCREENS CR
RETURN FOR CLARIFICATION OR AS CLASS III OR AS NOT APPROPRIATE
ACCEPTED AS CLASS I OR CLASS II
NO
YES
PRIORITY DETERMINED BY CMO
ROUTINE
URGENT
EMERGENCY
CONVENE CCB WITHIN 1 WORK WEEK
CONVENE CCB WITHIN 2 WORK DAYS
CONVENE CCB IMMEDIATELY
CCB MEETS TO PROVIDE PMO CLASSIFICATION
CLASSIFIED AS A CLASS I CHANGE
CLASSIFIED AS A CLASS II CHANGE
CLASSIFIED AS A CLASS III CHANGE
CCB RECOM-MENDATION
CCB DISPOSITION
CMO RECORDS AND FILES DISPOSITION
CCB SUBMITS CR TO GSFC
GSFC CM PROCESS
PMO CMO RECEIVES GSFC DISPOSITIONED CR
CMO RETURNS CR TO ORIGINATOR
IMPLEMENT CHANGE AS APPROVED & NOTIFY CMO OF COMPLETION
CMO LOGS COMPLETION

Figure 8-2

8.3. Change Request Record Keeping

The latest version of all ACE Payload Change Requests and their status will be kept in a single, centrally located, electronically accessible database at Caltech. As change requests proceed through the disposition and implementation process, Caltech will maintain an "ACE PAYLOAD CHANGE REQUEST LOG," (Table 8-1) as part of the CM database, which tracks the progress of "in-process" change requests.

Change Requests will remain "open" until the initiating organization notifies the Caltech CMO that the change/waiver implementation has been completed, at which time the CR will be "closed."

8.4. Configuration Status Accounting

The Caltech ACE Science Payload Office will maintain a file of the latest revision of all payload documents listed in Table 7-1. Whenever a change request impacts one of these documents, a copy of the CR will be "attached" to the document until the document is updated per the CR or the CR is disapproved. This file plus the Change Request Status List will specify the current payload configuration. Status of all configured articles (hardware software requirements etc.) are related to approved and in-process CR's and the status is anticipated to be available via query over the NSI.

CHANGE REQUEST STATUS LIST

WAIVER/ ECR NO.	DATE RECEIVED	ELEMENT	INITIATOR	CLASS	PRIORITY	DISPOSI-TION DATE	DISPOSI-TION	IMPLEMENT-ATION DATE

PAGE ___ of ___

Table 8-1, Ace Payload Change Request Log

9.0 Network Communication Implementation

Implementation of configuration management across several institutional boundaries with a small management team requires rethinking the process flows, asking which steps are really necessary, and determining the most expedient way to do business. *Configuration Management depends of effective communication and dissemination of information.* This process has traditionally involved a great deal of paper flow. In recent years, though the aid of the NASA Science Internet (NSI), all of the investigators as well as GSFC and the Caltech PMO have developed the capability to sent electronic mail including data and documents. This capability will be exploited by the Caltech PMO to the extent practical in development of the communication processes involved in configuration management. It is inappropriate to go into detail in this document exactly how the network communication will be employed, since that involves discussion of operating systems, local software, and interchange standards. We describe below some of the general principals that Caltech anticipates will enhance the CM process, and then follow with an example that illustrates these principles in action.

9.1. General Principles

Careful thought about each CM process will determine where and when network communication and interchange of electronic documents or databases help get the job done and when they become more of a burden than a benefit. In selecting how best to take advantage of the latest communication technology the following principles will be employed:

1) Replacing a paper flow process with an electronic or "paperless" system involves rethinking the process itself *not just converting the paper system to an electronic one*;

2) Serial processes (e.g. those which require successive actions or approvals) must be considered distinct from the parallel ones (e.g. sending data to all those concerned);

3) When an electronic system can increase the reliability and decrease the maintainability of a process it shall be considered as a candidate for use;

4) Wherever possible, forcing people to learn new software shall be avoided--if this is necessary, the benefits must clearly justify the learning curve;

5) Conversion to an electronic process must also take the GSFC and APL CM systems and capabilities into account.

In general, databases for storing information on the status of CRs or documents, bulletin boards for disseminating information, and electronic mail for facilitating communication are anticipated to play a central role in the Caltech CM process. The next section discusses an example.

It is important to note that information stored in databases and electronic files will always be backed-up and a paper copy kept should there be any computer hardware or communications problems that preclude electronic access. One of the jobs of the CMO will be to assure that databases are current, that files are backed up and that any paper copy kept on file reflects the latest version in the computer. As discussed above, all documents when baselined will have paper copies sent to GSFC with at least one left unbound and in reproducible form. The

process of document update and distribution can also be altered if we take full advantage of electronic communication. The extent to which this is possible will be explored with the GSFC ACE project office.

9.2. Examples

Figure 9-1 is an example of a CM process where computer and network communication technology may improve the efficiency, reliability and speed over a traditional paper oriented method. *This is meant to be an example only and is not intended to commit Caltech to the details illustrated in the figure.*

Figure 9-1 parallels the CR process flow illustrated in section 8 (Figure 8-1) but shows instead the associated file creation, database update, and electronic communication that might be involved in a "paperless" system. Note that there are several structures which are the key to facilitation of communication. The first of these are the "mailboxes." The ACE.CR mailbox is used to send CR applications or dispositioned CRs to the Caltech ACE PMO. The GSFC.CR mailbox is used to send Class I CRs to GSFC. The ACE.CR. Comment mailbox is use to receive input and comments on outstanding CRs.

The second structure is the "bulletin board." The CR bulletin board is globally readable but can only be written to by the Caltech CMO and the GSFC CMO. It is used to notify people of impending CRs and of changes that have been approved. This bulletin board can be set up with certain dedicated subscribers that will have the responsibility of reviewing it periodically. Caltech is currently looking for bulletin board software that has the additional advantage of allowing the CMOs to tell who has read the notice and who has not.

The third important structure is the "CR database." The figure shows three databases, the first is a "CR status" file that allows anyone to determine where a CR is in the process and, after completion, acts as a resource to record all CR transactions. The other two database files illustrated are used to record the actual CR (a separate database file is given for Class I and Class II CRs) The whole process is facilitated by use of a standard form (see Figure 8.1) that can be sent between all machines on the network. That form, when completed, is incorporated into the "CR Class I" or "CR Class II" databases. Not shown on this flowchart, but important to the CM process, is the inherent ability to "tie a CR to a specific change in a baseline document." Several methods can be employed, but the result is that, when issuing a new document revision, all CRs approved against that document are automatically picked up for incorporation, and when viewing a given document between major updates, a list of unincorporated but approved CRs is also shown.

The key advantages illustrated by this system are: 1) the ability to tie a CR to a specific document change which makes CR and document change status self-consistent and up to date as well as available to all concerned via an electronic database--this limits the number of revisions required and the constant flow of change pages (which often get lost) that are often part of the process; 2) the ability to cut process time because the time

delay associated with delivery of paper by mail takes about a week out of the Class I CR process flow; and 3) provision for the CR initiator to determine the status of their CR at any time by examining the database and viewing comments that others may have via the CR bulletin board.

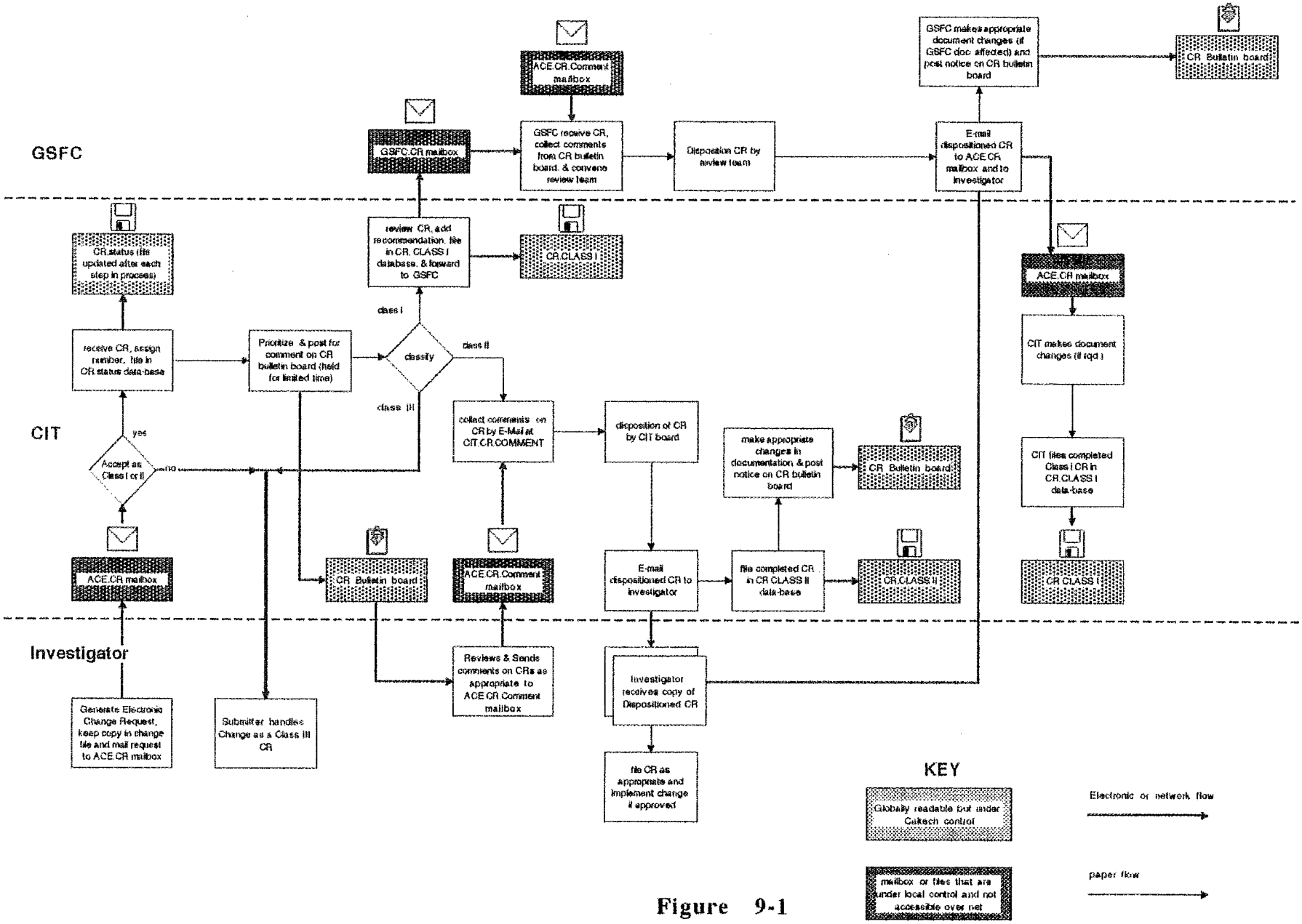
GSFC
CIT
Investigator
ACE.CR.Comment mailbox
GSFC.CR mailbox
GSFC receive CR, collect comments from CR bulletin board, & convene review team
Disposition CR by review team
GSFC makes appropriate document changes (if GSFC doc affected) and post notice on CR bulletin board
CR Bulletin board
E-mail dispositioned CR to ACE.CR mailbox and to investigator
CR.status (file updated after each step in process)
review CR, add recommendation, file in CR.CLASS I database, & forward to GSFC
CR.CLASS I
ACE.CR mailbox
class I
receive CR, assign number, file in CR.status data-base
Prioritize & post for comment on CR bulletin board (held for limited time)
classify
class II
class III
CIT makes document changes (if rqd.)
yes
Accept as Class I or II
no
collect comments on CR by E-Mail at CIT.CR.COMMENT
disposition of CR by CIT board
make appropriate changes in documentation & post notice on CR bulletin board
CR Bulletin board
CIT files completed Class I CR in CR.CLASS I data-base
ACE.CR mailbox
CR Bulletin board
ACE.CR.Comment mailbox
E-mail dispositioned CR to investigator
file completed CR in CR.CLASS II data-base
CR.CLASS II
CR.CLASS I
Reviews & Sends comments on CRs as appropriate to ACE.CR.Comment mailbox
Investigator receives copy of Dispositioned CR
Generate Electronic Change Request, keep copy in change file and mail request to ACE.CR mailbox
Submitter handles Change as a Class III CR
file CR as appropriate and implement change if approved
KEY
Globally readable but under Caltech control
mailbox or files that are under local control and not accessible over net
Electronic or network flow
paper flow

Figure 9-1

APPENDIX A

Applicable Documents

Document Number	Document Identification
ACE-CT-100-30	"ACE Science Payload Management Plan," Version: Draft, Dated: TBD.
GSFC-410-002	"Science Requirements for the ACE Mission," Version: Final, Dated: September 11, 1993.
GSFC-410-004	"Advanced Composition Explorer Configuration Management Procedure," Version: Change Request, Dated: November 3, 1993.
GSFC-410-008	"Performance Assurance Requirements for the Science Payload of the Advanced Composition Explorer (ACE) Mission," Version: Final, Dated: April 1993.

APPENDIX B

ACRONYMS AND TERMS

ACRONYMS AND TERMS	DEFINITION
ACE	Advanced Composition Explorer
ACE.CR	An Electronic Mail Box
ACE.CR Comment	An Electronic Mail Box
APL	Applied Physics Laboratory
ASC	ACE Science Center
ASCCD	ACE Science Center Control Document
ASCII	A machine readable data format
CAD	Computer Aided Design
CAL	Configured Articles List
Caltech	California Institute of Technology
CCB	Change Control Board
CCP	Contamination Control Plan
Class I	Changes that require the approval of affected hardware developers, the Caltech PMO and GSFC
Class II	Changes that require the approval of affected hardware developers and the Caltech PMO
Class III	Changes that only require the approval of the affected hardware developer
CM	Configuration Management
CMO	Configuration Management Officer
CMP	Configuration Management Plan
C.R	Change Request
CRIS	Cosmic Ray Isotope Spectrometer
CT	California Institute of Technology
EEE	Electrical, Electronic and Electromechanical
EIP	Experiment Implementation Plan
ECR	Engineering Change Request
E-Mail	Electronic Mail
ENGR	Engineer
EPAM	Electron, Proton, and Alpha-particle Monitor
ERD	Environmental Requirements Document
FAX	Facsimile
GIIS	General Instrument Interface Specification
GSFC	Goddard Space Flight Center
GSFC.CR	An Electronic Mail Box
IAIP	Instrument Assurance Implementation Plan
ID	Identification
IDDP	Instrument Design & Data Package
IFRD	Instrument Functional Requirements Document
K	Thousand Multiplier
LANL	Los Alamos National Laboratory
MAG	Magnetometer
MGR	Manager
MOCD	Mission Operations Concept Document

MOP	Mission Operations Plan
MPE	Planck-Institute for Extraterrestrial Physics (Germany)
MRD	Mission Requirements Document
MRR	Mission Requirements Request
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NO.	Number
NSI	NASA Science Internet, an Electronic Mail Network
ORG	Organization
PAR	Performance Assurance Requirements
PAIP	Payload Assurance Implementation Plan
PDR	Preliminary Design Review
PSR	Preshipment Review
Ø B	Final planning phase of a development, before the start of the implementation phases
Phase C/D	The implementation phases of a development, that follows the planning phases
PIRD	Payload Interface Requirements Document
PMO	Payload Management Organization
PMP	Payload Management Plan
PSP	Payload Safety Plan
REP	Representative
Sandia	Sandia National Laboratory
SEPICA	Solar Energetic Particle Ionic Charge Analyzer
SIIS	Specific Instrument Interface Specification
SIS	Solar Isotope Spectrometer
SODA	Science Operations and Data Analysis Plan
SPEC	Specification
SRD	Science Requirements Document
SWEPAM	Solar Wind Electron, Proton, and Alpha-particle Monitor
SWICS	Solar Wind Ionic Charge Spectrometer
SWIMS	Solar Wind Ion Mass Spectrometer
SWIP	Software Implementation Plan
S/C	Spacecraft
SYS	System
S/S/SDPU	SWICS/SWIMS/SEPICA Data Processing Unit
TBD	To Be Determined
TUB	Technical University of Braunschweig
ULEIS	Ultra Low Energy Isotope Spectrometer
UNH	University of New Hampshire
U of Bern	University of Bern (Switzerland)
U of D	University of Delaware
U of Md	University of Maryland
Wash U	Washington University
W/O	Without