Alpha Magnetic Spectrometer - 02 (AMS-02) Configuration Management Plan

Engineering Directorate

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National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

ALPHA MAGNETIC SPECTROMETER – 02 (AMS-02) CONFIGURATION MANAGEMENT PLAN

Approval Signatures:

Original signed by

TRENT MARTIN
LMSO AMS PROJECT MANAGER

STEVE PORTER
NASA AMS PROJECT MANAGER

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DOCUMENT CHANGE/REVISION LOG

CHANGE/ REVISION	DATE	DESCRIPTION OF CHANGE	PAGES AFFECTED
Baseline	January 1997	Baseline	All
A	August 2004	Updated for AMS-02 and transfer from SA to EA	All

PREFACE

This Configuration Management Plan (CMP) represents the configuration management agreement between the Alpha Magnetic Spectrometer – 02 (AMS-02) Experiment and the Payload Integration Hardware (PIH) for the version of the payload to be operated on the International Space Station (ISS).

A precursor flight (AMS-01) was accomplished on the Space Shuttle during the STS-91 flight and was addressed in the baseline version of this document.

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ACRONYMS AND ABBREVIATIONS

AMS	ALPHA MAGNETIC SPECTROMETER
APO	AMS PROJECT OFFICE
CCB	CONFIGURATION CONTROL BOARD
CDR	CRITICAL DESIGN REVIEW
CIR	CARGO INTEGRATION REVIEW
CM	CONFIGURATION MANAGEMENT
CMP	CONFIGURATION MANAGEMENT PLAN
COFR	CERTIFICATE OF FLIGHT READINESS
CR/DIR	CHANGE REQUEST/DIRECTIVE
CSCI	COMPUTER SOFTWARE CONFIGURATION ITEM
CSR	CUSTOMER SUPPORT ROOM
DCU	DATA CONVERSION UNIT
DOE	DEPARTMENT OF ENERGY
EMC	ELECTROMAGNETIC COMPATIBILITY
EMI	ELECTROMAGNETIC INTERFERENCE
EVA	EXTRAVEHICULAR ACTIVITY
FIAR	FAILURE INVESTIGATION ANOMALY REPORT
FOR	FLIGHT OPERATIONS REVIEW
FPSR	FLIGHT PLANNING AND STOWAGE REVIEW
FRGF	FLIGHT RELEASABLE GRAPPLE FIXTURE
FRR	FLIGHT READINESS REVIEW
GFE	GOVERNMENT FURNISHED EQUIPMENT
GHE	GROUND HANDLING EQUIPMENT
GSE	GROUND SUPPORT EQUIPMENT
ICD	INTERFACE CONTROL DOCUMENT
IDD	INTERFACE DESIGN DOCUMENT
IDRD	INCREMENT DEFINITION AND REQUIREMENTS DOCUMENT
IPT	INTEGRATED PRODUCT TEAM
ISS	INTERNATIONAL SPACE STATION
ISSP	INTERNATIONAL SPACE STATION PROGRAM
JIS	JOINT INTEGRATED SIMULATIONS
JISWG	JOINT INTEGRATED SIMULATIONS WORKING GROUP
JOIP	JOINT OPERATIONS INTERFACE PROCEDURES
JSC	LYNDON B. JOHNSON SPACE CENTER

KSC	JOHN F. KENNEDY SPACE CENTER
LEPS	LOW ENERGY PARTICLE SHIELD
LMSO	LOCKHEED MARTIN SPACE OPERATIONS
MAPTIS	MATERIALS AND PROCESSES TECHNOLOGY INFORMATION SYSTEM
MCC	MISSION CONTROL CENTER
MDL	MASTER DOCUMENT LIST
MIP	MISSION INTEGRATION PLAN
MIT	MASSACHUSETTS INSTITUTE OF TECHNOLOGY
PIB	MISSION MANAGEMENT OFFICE
MUA	MATERIAL USAGE AGREEMENTS
NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NBL	NEUTRAL BUOYANCY LABORATORY
NHB	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION HANDBOOK
NSTS	NATIONAL SPACE TRANSPORTATION SYSTEM
OIU	ORBITER INTERFACE UNIT
OMRSD	OPERATIONS AND MAINTENANCE REQUIREMENTS AND SPECIFICATIONS DOCUMENT
PAS	PAYLOAD ATTACH SYSTEM
PCU	POWER CONVERSION UNIT
PDD	POWER AND DATA LINE DISTRIBUTOR BOX
PDR	PRELIMINARY DESIGN REVIEW
PFR	PORTABLE FOOT RESTRAINT
PIB	JSC PLANNING AND INTEGRATION BRANCH (SF3)
PIH	PAYLOAD INTEGRATION HARDWARE
PMP	PROJECT MANAGEMENT PLAN
POCC	PAYLOAD OPERATIONS CONTROL CENTER
POIC	PAYLOAD OPERATIONS INTEGRATION CENTER
POWG	PAYLOAD OPERATIONS WORKING GROUP
PRD	PROGRAM REQUIREMENTS DOCUMENT
PSRP	PAYLOAD SAFETY REVIEW BOARD
PVGF	POWER VIDEO GRAPPLE FIXTURE
ROEU	REMOTELY OPERATED ELECTRICAL UMBILICAL
SAR	SYSTEMS ACCEPTANCE REVIEW
SDOS	SCIENCE DATA AND OPERATIONS EQUIPMENT

SFHe	SUPERFLUID HELIUM
SRMS	SHUTTLE REMOTE MANIPULATOR SYSTEM
SSP	SPACE STATION PROGRAM
SSRMS	SPACE STATION REMOTE MANIPULATOR SYSTEM
STA	STRUCTURAL TEST ARTICLE
STE	SPECIAL TEST EQUIPMENT
STS	SPACE TRANSPORTATION SYSTEM
TBD	TO BE DETERMINED
TIM	TECHNICAL INTERCHANGE MEETINGS
UMA	UMBILICAL MECHANISM ASSEMBLY
USS	UNIQUE SUPPORT STRUCTURE
VAR	VERIFICATION ACCEPTANCE REVIEW
VC	VACUUM CASE
WAD	WORK AUTHORIZATION DOCUMENT

1.0 INTRODUCTION

This document defines the JSC Engineering Directorate configuration management (CM) requirements, responsibilities, and change processing procedures for the Alpha Magnetic Spectrometer – 02 (AMS-02) Payload which consists of the AMS-02 Experiment and the related Payload Integration Hardware (PIH) for flights on the Shuttle Orbiter and the International Space Station (ISS).

1.1 GENERAL

In this Configuration Management Plan (CMP) "AMS" will refer to the total complement of activities, hardware, software, test, integration and operation of the Alpha Magnetic Spectrometer – 02 (AMS-02). The flight hardware is referred to as the "AMS Payload" and is comprised of two parts: the "AMS Experiment" provided by the international AMS Experiment Collaboration and the "AMS Payload Integration Hardware (PIH)" provided by the JSC Engineering Directorate AMS Project Office (APO) with the support of Lockheed Martin Space Operations (LMSO).

This CMP pertains only to the version of the AMS (AMS-02) that will be installed and operated on the International Space Station (ISS). The acronym "AMS-01" will be used for references to the precursor flight version that flew on STS-91.

This CMP has been developed in accordance with EA WI-027.

1.2 AMS PAYLOAD DESCRIPTION

The AMS payload is a state-of-the-art particle physics detector containing a large, cryogenic superfluid helium superconducting magnet that will be designed, constructed, tested, and operated by an international team organized under United States Department of Energy (DOE) sponsorship. The AMS Experiment will use the unique environment of space to advance knowledge of the universe and potentially lead to a clearer understanding of the universe's origin. Specifically, the science objectives of the AMS are to search for cosmic sources of antimatter (i.e., anti-helium or heavier elements), dark energy, and dark matter.

Although not considered an AMS goal, the experiment provides the potential benefit of a permanent and accurate measurement of the radiation environment in outer space, which is

needed to access the amount of radioprotection required for extended manned interplanetary flights. In addition, AMS will provide the first operational experience with a superconducting cryogenic magnet in space and greatly extend the knowledge base regarding superfluid cryogenic systems operation in space. These are enabling technologies for the potential use of magnetic shielding as a method of radioprotection during extended manned space flight.

1.3 SCOPE

This document has been developed to control the configuration of NASA/JSC and LMSO Payload Integration Hardware and the interfaces to the AMS Experiment (including AMS Crew Operations Post).

1.4 DOCUMENT PURPOSE

The purpose of this document is to establish and implement a configuration management and control system for the AMS PIH. The configuration management processing procedures established by this plan are applicable to all organizations and personnel involved in the submittal and processing of changes. It encompasses the management of design requirements, specifications, critical milestones, interface agreements, and flight hardware mission requirements. Its application to the AMS PIH will ensure the following:

- Programmatic commitments are met
- Shuttle/Space Station to AMS Payload and Experiment to AMS PIH compatibility is achieved
- Proposed AMS Experiment and Payload interface changes are processed and dispositioned in a formal and controlled coordinated manner such that engineering changes have an audit trail

1.5 CHANGE POLICY

This document is under the control of the AMS Configuration Control Board (CCB) and the changes or revisions shall be approved by the board as described herein.

1.6 REVISIONS AND CHANGES

Changes to this document will be issued as replacement pages or by complete revision of this document.

2.0 RESPONSIBILITIES

The CCB CM activities that support the procedures expressed in this plan are the responsibility of those defined below.

2.1 NASA PROJECT MANAGER (PM)

The NASA AMS PM shall establish policies and provide the overall management direction required to conduct CM for the AMS Project in such a manner as to achieve the objectives as stated in Paragraph 1.4 of this document. These authorities and responsibilities include, but are not limited to, the following:

a. Serve as Chair of the AMS CCB, with approval authority for all matters brought before the board that require AMS project-level approval.
b. Designate an alternate CCB Co-Chair to act in his/her absence with full decision authority.
c. Formalize all CCB decision/actions by signature on AMS Change Request/Directives (see Section 4.0 documenting the CCB actions.)
d. Establish, maintain, and control AMS project baselines and schedules and changes thereto.

2.2 AMS CONFIGURATION CONTROL BOARD (CCB)

The AMS CCB is the controlling authority for establishing the AMS project-level baseline, and reviewing and dispositioning change requests to the AMS baselines.

2.2.1 Authority and Responsibilities

The CCB shall be responsible for formally establishing the initial baseline, making changes to the baseline, and controlling the AMS project-level baseline (which consist of technical, management, and integration requirements), approval of CCB action items, and dispositioning of changes. The current baselined documents can be found in the Project Plan for AMS (JSC 27296).

2.2.2 Membership

The AMS CCB membership shall be as follows:

Chairman:	NASA Project Manager
Member:	NASA Systems Integrator/Deputy Project Manager
Member:	NASA EA2 Representative
Member:	NASA DA Representative
Member:	NASA MA Payload Integration Manager
Member:	NASA NA Representative
Member:	NASA OZ Payload Integration Manager
Member:	NASA KSC Representative
Member:	AMS Experiment Representative
Member:	LMSO Project Manager
Secretary:	LMSO Representative

2.2.3 Members

Members of the CCB are responsible for attending the board meetings (in person or via telecon) or identifying a representative to voice their disposition of a change and/or action item closures. Members also are mandatory evaluators of the change requests (CRs) sent to them by the CCB Secretary. Any CCB member who does not agree with the board's decisions and wishes to appeal to the Engineering Directorate Review Board (EARB) shall notify the CCB Secretary in writing. The CCB Secretary shall coordinate with the EA Rotational engineer to schedule an EARB.

2.2.4 Secretary

The CCB Secretary is responsible for the operational support of the CCB, which includes the following:

a. Receive and process CCB change requests/directives and evaluations
b. Support of the CCB, including the preparation of agendas, minutes, directives, and action item logs.
c. Assuring that follow-ups and close out actions have been taken on the CCB directive.
d. Providing maintenance of the CCB distribution lists, change tracking, and action item closeout system.
e. Providing, as required, status reports of all open Requests and Action Items.

2.2.5 LMSO Contractor

The LMSO contractor will support the AMS Project Manager and the AMS CCB as required.

2.2.6 Other Organizations

Support from other organizations will be solicited when required.

3.0 CONFIGURATION IDENTIFICATION

Configuration identification is the task of determining the manner in which the requirements for the configuration of the AMS hardware is to be described and documented. Configuration identification shall be achieved through the development of formal documentation which will describe the baseline to be used for control and accounting of future changes. This CMP does not address the internal AMS Experiment configuration. It does specifically address the configuration control of the NASA PIH to AMS Experiment interfaces and the AMS payload interfaces to Shuttle and Space Station. In some cases, higher level Shuttle or Space Station board approval may be required.

3.1 BASELINES

Only hardware, software, or documentation changes approved by the CCB are allowed after the AMS baseline is approved. Hardware, software, and documentation that has been specifically designed to be CCB controlled will be baselined by the CCB. Once a document and/or hardware configuration is baselined by the CCB, any changes thereto must be submitted to the AMS CCB for disposition. The current baselined documents can be found in the Project Plan for AMS (JSC 27296). Once released through the Engineering Drawing System, all drawings are considered baselined and must have CCB approval for modification (per the guidelines in section 3.3). For this unique case, where the AMS project has been transferred from SM to EA during the course of the project, all drawings that deviate from the CDR baseline must also be approved by the CCB regardless of whether or not they have been baselined in the Engineering Drawing System.

3.1.1 Document Identification

All configuration management (CM) controlled documents will be identified via a unique document number. For JSC generated documents, a JSC document number will be obtained from the JSC Scientific and Technical Information (STI) center (the JSC library). Refer to http://stic.jsc.nasa.gov/collections/STIC.home/doc3.htm

for the process of obtaining JSC document numbers.

3.1.2 Drawing Identification

The Engineering Drawing System will be used for all drawings that baseline the design. Requirements for drawing identification for JSC developed hardware, firmware and software are defined in JPG 8500.4, "Engineering Drawings System Manual".

3.1.3 Hardware and Firmware Platform Identification

3.1.3.1 Hardware Identification

The need for hardware control is determined on hardware classification and commences with the Design Baseline. Controlled hardware is identified with a nameplate or marking containing the part number (or assembly number), and serial number. A JSC Project Parts Tag (JSC Form 911) is affixed to all controlled hardware in accordance with JPD 5335.1, "Lyndon B. Johnson Space Center Quality Manual". The nameplate and product markings are in accordance with MIL-STD-130, paragraph entitled "General Marking Requirements and Detailed Marking Requirements". Markings must remain legible for the service life of the flight item. Marking techniques must not degrade the structural integrity of the item.

3.1.3.2 Hardware Classification

Hardware is classified per SLP 4.8, " Product Identification and Traceability" into the following:

Class I equipment: Equipment acceptable for space flight use (controlled flight equipment).
Class II equipment: Equipment [of the flight design which are] acceptable for use in ground tests or training in a hazardous environment (controlled non-flight equipment).
Class III equipment: Equipment acceptable for non-hazardous training or display purposes. (Non-flight Equipment)
Class IIIW equipment: Equipment acceptable for use in Water Immersion training in a hazardous environment (controlled non-flight equipment)
Ground Support Equipment (GSE): Non-flight equipment designed and certified with a physical and/or functional interface with flight hardware that is required for the handling, servicing, inspection, testing, maintenance, alignment, adjustment, checkout, repair or overhaul of Class I or Class II products.
Special Test Equipment/Devices (STE/D): STE/D are similar to GSE but have not had design and certification reviews. This equipment may be used in support of class I, II, IIIW and GSE checkout and service but will not directly interface with flight hardware.

Once classified, hardware classification changes must be approved per the following:

Change	Approval authority
Changing Class I Flight to any non-flight category	Division Chief/Office Manager (or designee) pre delivery; Program/Project Office post delivery
Changing non-flight to Class I Flight	Concurrence by Division Chief/Office Manager (or designee) Concurrence by PMO Approval by Program/Project Office
All other changes	Project Manager

3.1.3.3 Serializing Hardware

Hardware is serialized if it needs to meet any of the following requirements:

- Ability to track the part or assembly to the work authorization or performance documentation.
- Ability to trace to the source manufacturer.
- Part or assembly contains lower level parts or sub-assemblies that are serialized or lot traceable.
- Need to differentiate one item from the others that are currently the same (i.e., need to incorporate changes or rework on one item versus the rest of the same item; need to process discrepancy reports (DR) or material reports (MR) against the part or assembly with dispositions other than "return to print" or "scrap".
- Ability to locate part or assembly for the purpose of responding to alerts.

Serial numbers will be assigned and certified by NASA/JSC Engineering Drawing Control Center.

3.1.3.4 Firmware Platform Identification

The identification of the firmware platform is performed via engineering drawings, which are produced in accordance with JPG 8500.4, "Engineering Drawings System Manual".

3.1.4 Software and Firmware Code and Tool Identification

Flight software and firmware code identification is documented through the contents of the Version Description Document (VDD) (refer to EA-WI-025, “Flight Project Software and

Firmware Development Work Instruction" for the VDD template, details on the use of the VDD). Refer to EA-WI-025, "Flight Project Software and Firmware Development Work Instruction" for information on the integration of the VDD content with the Engineering Drawing System (for both software and firmware).

3.1.4.1 Software Identification

Software identification uniquely identifies and names all source code files, header files, data files, derived products (e.g., object code, executable, libraries, etc.). Each file contains a version specific name that uniquely identifies it to the user and allows for ease in configuration management of these items. Software identification standards and guidelines are project specific and will be determined (typically by the Software Lead) and documented in the Software Development Plan (refer to EA-WI-025, "Flight Project Software and Firmware Development Work Instruction").

For software, a K-type drawing (document format or "book-form"), per JPG 8500.4, "Engineering Drawings System Manual", is created (if one does not already exist) to document the certified versions of each Computer Software Configuration Item (CSCI) that may be loaded on the end item, by serial number (refer to Table 3.1.4.1-1 for the relationship of VDD to drawings).

The hardware assembly drawing (i.e., top level E-type drawing) for the end item containing the software will include a reference to the K-type drawing for tracking software versions to the end item (refer Table 3.1.4.1-2 for a sample call out). The K-type drawing will reference, in table format, the VDD(s) that describe the configuration of the certified versions(s) of the CSCI(s) for that end item. The K-type drawing also documents, or inventories, the actual configuration of software loaded on individual end items by serial number. The K-type drawing is updated each time a new version of a CSCI is certified and released by pointing to the new VDD.

TABLE 3.1.4.1-1 VDD Relationship to Engineering Drawings

	E-Type Drawing Required	K-Type Drawing Required	VDD Requirement
Software	No	Yes	K-type drawing will reference the software VDD(s) to document certified software and the version(s) of software loaded on end item hardware.
Firmware	Yes	No	Part level E-type drawing will reference the VDD or incorporate the VDD as part of the drawing to document the configuration and function of the firmware.

Table 3.1.4.1-2 Sample of Software K-Drawing Callout on Hardware Assembly Drawing

ITEM	HDW PART/ASSY NUMBER	HDW S/N	DESIGN/CERTIFIED SW VDDS	INSTALLED SW VDD	NOTES
Part; with no subassemblies	Part SEG12345678-3		CSCI XYZ, Version 7 & 8		No preference.
	-3	1004		Version 8	
	-3	1005		Version 7	
	Part SEG12345678-4		CSCI XYZ, Version 8 & 9		V-9 preferred.
	-4	1006		Version 8	
	-4	1007		Version 9	
Assembly; with 2 or more subassemblies	Assy SEG87654321-7	1001	N/A		
	ABC123-4		CSCI ZYX, Version 3 & 4		V-4 preferred.
	-4	1003		Version 3	
	-4	1004		Version 4	
	ABC321-2		CSCI BCA, Version 1		
	-2	1006		Version 1	

3.1.4.2 Firmware Identification

For firmware, the E-type drawing for the firmware component (e.g., chip) is created and annotated with a reference to the VDD (see EA-WI-025, “Flight Project Software and Firmware Development Work Instruction, Appendix D”) or the VDD content is incorporated within the component’s E-type drawing to document the firmware’s configuration (see JPG 8500.4, “JSC Engineering Drawing System Manual”). Note that a programmable memory chip is treated as hardware.

3.1.4.3 Tools Identification

Environment identification uniquely identifies all computers, peripheral hardware, hardware and software tools (e.g., processor probe, compiler, linker, etc.), and makefile/build scripts used in the development, build, test and installation of the flight software. Each item has a version specific name that uniquely identifies it to the user and allows for ease in configuration management of these items.

The configuration of the environment for GFE flight software development, build, test and installation is uniquely identified for each version of the flight software and documented in the VDD (see EA-WI-025, "Flight Project Software and Firmware Development Work Instruction, Appendix D").

3.1.5 Electronic File Identification

Identification of electronic files will be performed by annotating the file with a unique title (can be same as file name) and date.

3.2 CHANGE REQUEST NUMBERS

Change proposals may be submitted by any AMS team member through any AMS CCB board member. If an AMS CCB board member does not sponsor a change proposed by a team member, the AMS team member can appeal to the AMS CCB. Each proposed change received by the CCB will be assigned a change request number by the CCB Secretary prior to distributing the change for evaluation. The change request number shall be composed per the system shown in Table 3.2-1.

Table 3.2-1 Change Request Number Composition

CATEGORY	SYMBOL	EXPLANATION
Payload Mission Designation	AMS-01	Precursor Flight On STS-91
	AMS-02	Operational Flight On ISS
Task	D	Documentation
	E	Experiment
	G	Ground Support Equipment (GSE)
	M	Mission Requirements
	P	Payload Integration Hardware
	W	Waivers and Deviations
Request Tracking Number	001	Sequential 3-Digit Tracking Number

Revision Number	A	Assigned Alphabetically

EXAMPLE: AMS-02/P-001A

3.3 CHANGE DEFINITIONS

All Type I hardware, drawings, and documentation changes to the AMS baseline shall be submitted to and changes must be approved by the CCB prior to implementation. Type II changes do not require CCB approval.

3.3.1 Type I Changes

All proposed changes to AMS hardware shall be designated Type “I” whenever one or more of the following are effected:

a. Requirements contained in the AMS baseline
b. Contract cost/provisions
c. Interchangeability
d. Safety
e. Interfaces
f. Any change to baselined documentation under configuration control
g. Waivers and deviations

3.3.2 Type II Changes

Any changes not falling within Type I as defined above shall be designated as Type II. These include corrections to drawing errors, “return to print” hardware modifications, “as built” changes to hardware that do not affect “fit, form, or function” and which do not affect Type I items, and additions of “either/or” items giving choices such as color preference.

4.0 CONFIGURATION CHANGE CONTROL

After an initial baseline is established by the AMS CCB, it is essential that effective, positive control be established which will preclude unauthorized changes to that baseline.

4.1 CHANGE PROCESSING

All proposed changes to the baseline shall be properly documented, evaluated, coordinated, and dispositioned by the CCB. Figure 4.2.1-1 shows the proper change flow. All of the required forms and instructions can be found on the AMS EA Website, and they include:

Form AMS 001	AMS Change Request/Directive
Form AMS 002	AMS Change Evaluation
Form AMS 003	AMS Evaluation Summary
Form AMS 004	Instructions for Preparation of the Presentation to the CCB

The Website also will include a Form Tracking Log that details when the form was created or updated, who approved it, and what was included in the change. The following change request procedures and documentation will be followed.

4.1.1 Change Request Procedures

All change requests shall be developed and written by the responsible technical entity and forwarded to the CCB Secretary for formal processing. The CCB Secretary will disperse each change request to all mandatory evaluators for review. Evaluators have ten working days from the date of CR distribution to return their written comments to the CCB Secretary (by close of business on day ten). The CCB Secretary will compile the evaluators' reviews and forward copies to the CR originator (for inclusion in his/her CCB presentation) and schedule the CR for a future meeting of the CCB. Five working days are allowed for the CCB Secretary to complete this activity. The CR originator must provide the CCB Secretary a reproducible copy of his/her complete presentation package by the close of business two working days prior to the scheduled CCB review date.

4.1.2 Change Request Documentation

4.1.2.1 AMS Changes

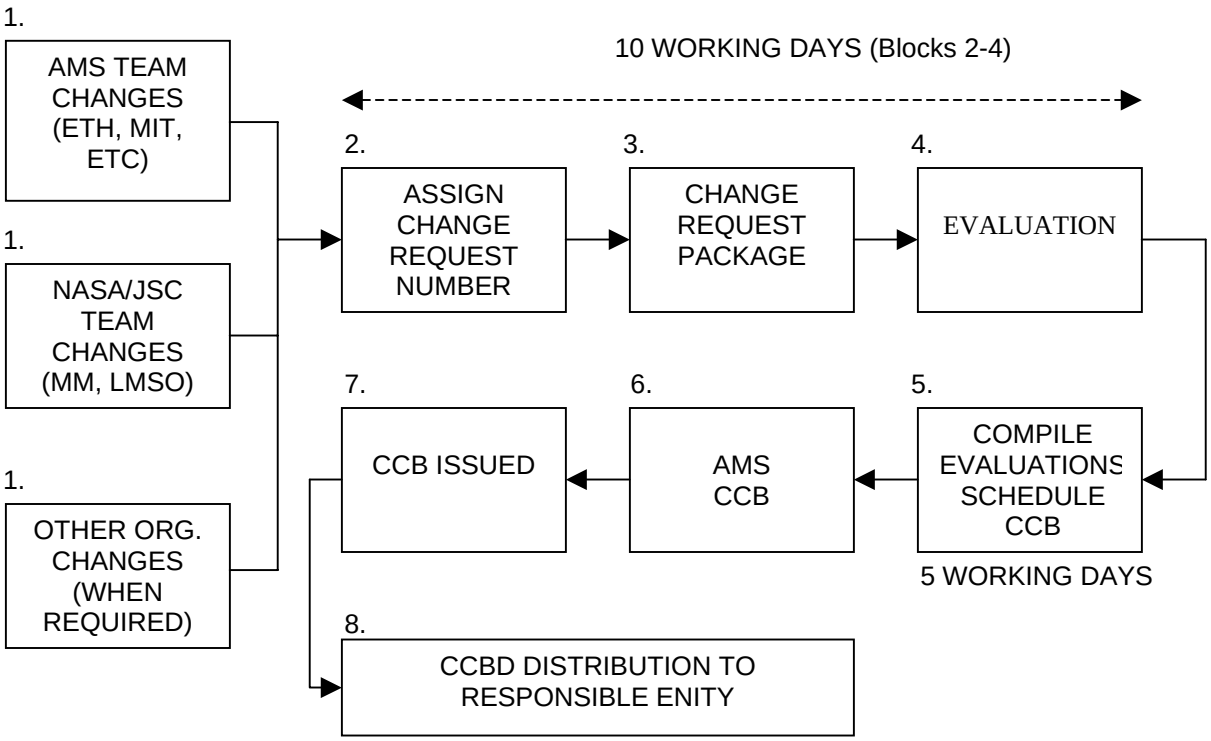
All change requests will be documented on the Change Request/Directive (CR/DIR) form and submitted to the CCB Secretary for processing. Figure 4.1.2-1 shows the change flow processing. Additional data for clarification and/or justification can be attached to the CR/DIR.

Detailed procedures for the preparation of a change request and related forms can be found on the AMS EA Website. In addition, these forms will be available on the AMS Website.

4.1.2.2 Field Engineering Changes (FECs)

Field Engineering Changes (FECs) are generated at the Kennedy Space Center (KSC) when baselined hardware integration problems are discovered, or to identify required baseline documentation changes. The following procedures will apply to FECs:

1. The AMS NASA Project Manager representative in residence at KSC will work the FEC in real time.
2. After the approval of an FEC from KSC, a Configuration Control Board Directive (CCBD) is prepared for record purposes.



Notes:

1. AMS team members shall solicit sponsorship of proposed changes from an AMS CCB board member, who will submit the change to the AMS CCB Secretary for processing.
2. All proposed changes will be assigned a Change Request/Directive (CR/DIR) number by the CCB Secretary.
3. CCB Secretary will insure complete change request package distribution to CCB membership/mandatory evaluators.
4. Evaluations must be completed and returned to CCB Secretary by the designated mandatory evaluators by the due date specified. (Normally, ten working days will be allowed for change evaluation – data fax responses by remote evaluators are encouraged).
5. The CCB Secretary will compile evaluations, forward them to CR originator, and schedule CR for a future meeting of the CCB (5 working days).
6. The CCB will disposition all changes per paragraph 4.1.9.
7. A Configuration Control Board decision will be issued for all dispositioned changes and distributed to interested individuals/organizations.
8. The applicable individual or organization responsible for the item is responsible for ensuring that the change is incorporated into the item or for taking action as defined on the CR/DIR. For changes submitted by other organizations, a copy of the dispositioned CR/DIR will be forwarded to that organization.

Figure 4.1.2-1: AMS Change Flow

4.1.3 Change Request Pre-Coordination

All change requests will be reviewed by the change initiator to determine if interface requirements are affected. In those cases where it is determined that interface requirements are affected, the initiator will coordinate the requested change with the applicable organization(s) prior to submittal to the CCB Secretary.

4.1.4 Types of Changes

4.1.4.1 Technical Changes

A technical change includes changes to documentation, requirements, hardware and software controlled configurations.

The steps for processing technical changes are depicted below.

Step 1 (Receipt of Change Package) CCB Secretary assigns Change Request/Directive (CR/DIR) number, packages and reproduces the change package, and distributes the package to evaluators.

Step 2 Change Package transmitted, evaluated, and returned.

Step 3 Initiator and CCB Secretary prepare change package for presentation to the CCB.

Step 4 Proposed change package presented to CCB for disposition. In all cases, change will be dispositioned by formal CCB action.

4.1.4.2 Non-technical Changes

A non-technical change shall be identified based on the following criteria:

a. The change does not effect the AMS Project baseline.
b. The change is required to update or correct AMS Project documentation consistent with the project baseline.

A change conforming to the above criteria shall be identified by the CR/DIR originator as a record change in the “Description of Change” block of the CR/DIR form. Unless an impact is determined, a formal CCB Change Evaluation (CE) is not required. If no adverse response has been received by the end of the designated period, the CR/DIR implementing the change shall be dispositioned outside the formal AMS CCB.

4.1.4.3 Outside the Board (OSB) Changes

Outside the Board CR/DIR’s shall be prepared for those changes to be approved outside the formal CCB. An OSB CR/DIR may only result by direction of the CCB Chair.

4.1.4.4 Emergency Changes

An emergency change is a change required to correct a condition which, if uncorrected, could at any time result in a fatal or serious injury to personnel or extensive damage to valuable property. The board members are delegated the authority to implement emergency implementation, the change will be processed on an expedited basis, through CCB disposition, within 72 hours.

4.1.5 Change Request Packaging

Change request packaging is the integrating and assembling of the total change documentation. Each proposed change and supporting documentation will be packaged under one change number assigned by the CCB Secretary prior to distributing the change for evaluation.

4.1.6 Change Request Evaluation

Change evaluation is required for all proposed change requests. The change request packages will be distributed by the CCB Secretary to all members, and other appropriate individuals, for evaluation. After evaluation, the change evaluation response sheet shall be returned with recommendations to the CCB Secretary. The Secretary will forward a copy of all evaluations to the initiator for his/her technical analysis and coordination with the evaluator, if required.

4.1.7 Agenda

The CCB Chairman shall schedule board meetings as required to maintain AMS configuration control. Remote board members and presenters may participate live or via teleconference. At the discretion of the CCB Chairman, the CCB Secretary will distribute an agenda prior to each scheduled meeting. The agenda shall identify the items to be presented for disposition and, as a minimum, contain:

a. Date, time, and location of meeting (including teleconference tie-in number)
b. Identification of items to be presented by change request number, title, and name of presenter.
c. List of open actions due or past due

4.1.8 Presentation of Change to the Configuration Control Board

The initiator of the change will present the proposed change to the CCB in a clear, concise format, using viewgraphs and visual aids, where appropriate, to enable the Board to fully understand the proposed change. As a minimum, the following shall be included in the presentation:

a. Description of change
b. Sketches, etc. that fully describe the change
c. Effectivity
d. Impact statement
e. Justification for change
f. Evaluation summary
g. Recommendation

For detailed procedures and forms, refer to the AMS EA Website.

4.1.9 Dispositioning of Change Package

The CCB Secretary will report whether those changes scheduled for presentation to the CCB have been evaluated for impact. The CCB Chairman shall disposition each change according to one of the following:

a. The change request is approved as written.
b. The change request is approved, as revised with specific alterations stated.
c. The change request is disapproved, with reasons explained.
d. The decision is deferred for investigation, with action and responsibility assigned to the designated person(s).

4.1.9.1 Change Request/Directive (CR/DIR)

The directive portion of the CR/DIR form and the continuation sheet (if required) are used to record, report, and disposition all change directions and actions. No changes to the AMS baseline documents will be issued except as instructed by the approved CR/DIR. It shall consist of the bottom portion of the AMS Change Request/Directive submitted by the requester to the CCB. It will become the official record of the action(s) taken by the CCB. The distribution of the Change Request/Directive will be made by the CCB Secretary. Detailed procedures for the preparation of the Change Request/Directive are contained on the AMS EA Website.

4.1.10 Minutes

The CCB Secretary will prepare minutes at the completion of the meeting. The minutes shall document the following:

a. Date, time, and location of meeting
b. Summary of change dispositions including:
    - CR/DIR number
    - CR/DIR title
    - Organization submitting change
    - Disposition of each change; i.e., approved, approved with changes, disapproved, deferred for further rework, or submitted to NASA or other organizations for submittal to their board
    - Actions assigned with actionee and suspense date identified
c. List of attendees
d. Copy of dispositioned Change Request/Directives

The CCB chairman will approve the minutes prior to distribution by the CCB Secretary.

4.1.11 Implementation of Changes

4.1.11.1 Hardware Changes

Approved hardware changes fall into three categories: (1) changes to be implemented by the AMS Team (ETH, MIT, etc.) (2) changes to be implemented by the NASA/JSC Team (PM, IM, OM, LMSO) (3) changes to be implemented by other organizations when required.

a. For changes to be implemented by the AMS Team, the CCB Secretary will submit the CR/DIR to the designated AMS Team leader for appropriate action.
b. For changes to be implemented by the NASA/JSC Team, the CCB Secretary will issue the CR/DIR to the applicable individual responsible for insuring that the change is implemented and documented.
c. For changes to be implemented by other organizations, the approved CR/DIR will be forwarded to the appropriate organization.

4.1.11.2 Baseline Documentation Changes

Approved CCB changes to baseline documentation under configuration control will be implemented as follows: The CCB Secretary will incorporate the change into the document as approved by the CCB, distribute the change, and file the original document.

5.0 CONFIGURATION CHANGE ACCOUNTING

5.1.1 CONTROL, RELEASE, and ACCOUNTING OF DOCUMENTATION

All AMS Project documentation will be tracked using an Open Paper Management Tool that allows for configuration controlled closed loop verification.

All controlled documents initiated by the AMS Project will be developed using JSC approved products in the standard load (typically Microsoft product or approved form). The baseline hard copy master (signed original) of controlled documents will be stored in a CM controlled repository (AMS Library) along with all the approved changes. Three copies of the baseline will be provided to the JSC STI Center upon release.

Once baselined, the non-proprietary controlled documents will be listed and released (distributed) electronically via the AMS Project home page (http://www4.jsc.nasa.gov/eaprojects/ea-projects/flightgfe/ams_02/html/ams_02.htm). If available electronically, all other non-proprietary controlled documents initiated outside the Engineering Directorate will also be posted to the Flight GFE Projects Home page for easy access. In addition, a duplicate website with all export controlled documents removed will be available at CERN so that AMS collaborators will have easy access to non-export controlled documentation and drawings.

5.1.2 CONTROL, RELEASE, AND ACCOUNTING OF DRAWINGS

The control, storage, and release of drawings for JSC developed hardware, firmware and software will be in accordance with the policies and procedures documented in the "Engineering Drawing System Manual", JPG 8500.4. The JSC Engineering Drawing Control Center (EDCC) is responsible for control of drawings, for ensuring that changes to released drawings are documented and approved, and for releasing drawings. Changes to JSC engineering drawings, after original drawing release, are documented using drawing revision or drawing change notice (DCN), per JPG 8500.4, “Engineering Drawing System Manual”.

5.1.3 CONTROL, RELEASE, AND ACCOUNTING OF HARDWARE AND FIRMWARE PLATFORMS

After final fabrication acceptance, in order to preserve historical records and to ensure traceability, items detailed on final approved JSC drawings will be assigned new identifying dash numbers when a part or assembly is changed in such a manner that any of the following conditions occur:

Parts, subassemblies, or complete articles are changed to an extent that previously built parts, or newly designed parts items are not interchangeable.
Notes: 1. If parts are deleted, added, or substituted without the drawing calling out both the old and the substituted part as being acceptable, the items are not interchangeable (by definition). 2. Items will be assigned new identifying dash numbers even though the change is incorporated into all existing units.
Performance or durability is affected to such an extent that previously built items must be discarded or designated “for restricted use” for reasons of safety or malfunction
Use of previously built parts, or newly designed parts, are limited to specific articles and the other part does not have the same limitations.

The physical control, storage, and release of hardware and firmware platform will be in accordance with the policies and procedures documented in the JPD 5335.1, "Lyndon B. Johnson Space Center Quality Manual". Per the requirements of NHB 4200.1, a property custodian controls all property. The property custodian control will be in accordance with the "Equipment Management Manual for Property Custodians", NPG 4200.2.

5.1.4 CONTROL, RELEASE, AND ACCOUNTING OF SOFTWARE AND FIRMWARE CODE

Configuration control and accounting of software configuration items begins no later than the delivery of the Certification Release (part of the Design baseline; refer to EA-WI-025) and continues throughout the operations phase of the project lifecycle. Prior to the Design Baseline, software configuration control is at the discretion of the Software Lead. Changes to software and/or firmware code after the Design Baseline, are identified, tracked, and processed through the AMS Project change process.

After the software is placed under configuration control the following must be performed:

- A minimum of two copies of the software and the environment are maintained in separate locations in order to recover from damage or loss.
- A unique software release or version number is used to identify each version or revision of the software. Copies of each version are maintained throughout the life of the project.
- Any modifications to the flight software are approved by the appropriate controlling authority.

- Changes to baseline will necessitate the creation and tracking of a discrepancy against each production item affected until the disposition of each item is determined (refer to section 5 of this Appendix).

5.1.5 CONTROL, RELEASE, AND ACCOUNTING OF ELECTRONIC FILES

Controlled electronic files will be saved on a file server in an area where only the configuration manager has access to update the file. Release of files will be accomplished by saving the latest approved copy on the web-server. These controlled documents will be listed and released (distributed) electronically via the AMS Project home page (http://www4.jsc.nasa.gov/eaprojects/ea-projects/flightgfe/ams_02/html/ams_02.htm).

6.0 CONFIGURATION VERIFICATION

Configuration verification is the process of ensuring that the baseline requirements are implemented, the documentation is current, and the as-built products meet the design.

The configuration verification is performed for the SAR via verification of the paper trail that shows all the "shalls" have been verified and that the documentation and drawings are current. The verification is performed by the project team and quality assurance (who provide witness and approval of tests/inspections, concurrence with the disposition of any discrepancy reports, and approval of the acceptance data package and GCAR, Form 1296). The results/status of the configuration verification are presented by the SR&QA project personnel and approved by the AMS Project Office sponsor at the SAR.

6.1 NON-CONFORMING PRODUCT

Non-conforming products, as defined in JSC SLP 4.13, "Control of Non-conforming Product", are those that do not conform to specified requirements. Non-conformances against GFE flight project related hardware, software, or firmware are tracked via Discrepancy Reports (DRs, per NT-CWI-003, "Quality Assurance Record Center Discrepancy Reporting and Tracking") whenever there is a problem during Flight Production and Certification, Deployment, and Operations phases. Use of DR's during these phases will cover problems experienced during testing, fabrication, handling or operating the qualification or flight hardware and the certification release or flight release software.

Quality Engineering (QE) or project personnel will generate a DR anytime there is a nonconformance, as defined in NT-CWI-003, "Quality Assurance Record Center Discrepancy Reporting and Tracking". A DR is also used to track end-items (hardware or software) that are out of configuration due to a drawing change that affects a production unit. The Project Manager is responsible for ensuring timely analysis of the DR and providing DR resolution. The resolution will include any required stress and material approval in accordance with NT-CWI-003. Official closure of DR's require signature by the Division Chief/Office Manager (or designated representative - typically the Project Manager) and the quality engineer.

Non-conformity dispositions are actions to be taken to resolve the non-conformity. They are uniquely defined for hardware and software in JSC SLP 4.13. The outcome of a disposition may result in the following:

a. A design change: A “design change” DR disposition that affects the baseline will require changes to the appropriate documents and drawings through the CM processes described above. Examples:
    - Baselined requirements (specifications, ICDs, contract)
    - Interchangeability of an item
    - Certification
b. A waiver or deviation request.
c. A Materials Review Board (MRB) disposition. The MRB dispositions discrepancies that do not affect baselined requirements (specifications, ICDs, life cycle, or life requirement), interchangeability of an item, or certification. Note: A formal meeting of the MRB is not required as long as the signatures of all MRB functions are obtained (as defined per NT-CWI-003, “Quality Assurance Record Center Discrepancy Reporting and Tracking”).
d. A "return to print" or "retest" or “scrap” disposition requires only project manager disposition.

In addition to DRs, a FIAR (Form 2174) is generated to document failures that meet the criteria of JSC 28035, “JSC GFE Problem Reporting and Correction Action (PRACA) Requirements”. All FIARs are tracked in the JSC Problem Reporting and Corrective Action (PRACA) center. Quality Engineering submits FIARs to the PRACA system. The process for closing FIARs is dependent on the criticality of the GFE and failure modes. If acceptance procedures for an end item must be changed to verify discrepant condition is not present in other items, any items requiring retest will be tracked on a FIAR. The FIAR will be used to assure correct procedures are used and to indicate which items have been verified with the new procedures.