



National Aeronautics and  
Space Administration



**AI1-SYS-CDR**

**VERSION 2.00**

**RELEASE DATE JUNE 27, 2008**

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**CRITICAL DESIGN REVIEW (CDR) PLAN  
FOR THE  
ARES I-X MISSION  
DRAFT**

Approved for Public Release; Distribution is Unlimited

*The electronic version is the official approved document.  
Verify this is the correct version before use.*

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### REVISION AND HISTORY PAGE

Status	Revision No.	Change No.	Description	Release Date
Baseline for comments	draft a			7/17/07
Update Draft	draft b		Post Face to Face, GRC	9/19/07
Editorial Review	draft c			11/05/07
Update draft	draft d		Incorporating Chief Engineer, SMA and XCB comments	11/06/07
Update draft	draft e		Baseline review comments	11/19/07
Update draft	draft f		Update comments from XCB	12/3/07
Final Edit for baseline	Version 1.0			12/04/07
Update post CDR	Version 1.01 draft 1		Incorporated CDR phase 2 details	3/27/08
Update draft	Version 1.01 draft 2			4/18/08
DRAFT	V2.00		Modification of version number and header HLDA	4/24/2008
DRAFT	V2.00		Final clean up	5/19/08
Draft	V2.00		Modification of release date and header date-HLDA	5/21/2008
Draft	V2.00		Modification of CDR II dates, data drop information organization	5/28/08
Baseline	2.00		Approved CR AIX-0115	6/27/2008

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**NOTE: Updates to this document, as released by numbered changes (Change XXX), are identified by a black bar on the right margin.**

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## 1.0 REFERENCE DOCUMENTS (FOR THIS PLAN)

A	NPR 7120.5D NASA Program and Project Management Processes and Requirements	March 6, 2007
B	NPR 7123.1A System Engineering Procedural Requirements	March 26, 2007
C	LaRC System Management Office Document 1443.6 "Planning Guidelines and Check List For Developing Review Terms Of Reference"	Version D July 15, 2003
D	LaRC System Management Office Document 1443.7 "Checklist for Project Management and Review Boards"	June 25, 2003
E	Ares I-X Flight Test Plan CxP 70127	
F	Ares 1-X Systems Engineering Management Plan A11-SYS-SEMP	

## 2.0 CHANGE CONTROL

Once approved, this PLAN will be filed in the official records for the Ares I-X Mission and can only be changed by agreement at the Ares I-X Control Board (XCB) through the Change Management process outlined in the Ares I-X Configuration Management Plan.

## 3.0 PURPOSE OF THIS DOCUMENT

The purpose of this document is to establish the PLAN for the Ares I-X Critical Design Review (hereafter referred to as the Review). This document describes the Review roles of the Ares I-X team members and the Review Panel. It also defines the Review execution, products, and deliverables.

## 4.0 PURPOSE OF THE REVIEW

The purpose of the Review is to establish that the detailed designs of the Ares I-X flight and ground systems can meet integrated system functional and performance requirements with acceptable risk (technical performance, safety, cost and schedule) and that these current system requirements have been allocated to the subsystems that are being developed by Integrated Product Teams (IPTs).

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## 5.0 INTRODUCTION / BACKGROUND

The Ares I-X Mission description is described in the referenced document Ares I-X Flight Test Plan CxP 70127.

## 6.0 PROJECT AUTHORITIES AND RESPONSIBILITIES

The Ares I-X Mission Management Office (MMO) provides overall programmatic management for all Ares I-X activities.

The Ares I-X Systems Engineering and Integration (SE&I) Office is responsible to the Ares I-X Mission Manager for Systems Integration. Systems Integration functions include but are not limited to requirements and verification, systems engineering, integrated design and analysis, flight vehicle integration and operations, avionics and software integration requirements, and all other activities required to ensure a successful flight test is accomplished. These activities will be coordinated across participating NASA centers and contractors to foster integrated execution of essential functions and activities.

For this Critical Design Review (CDR), the Ares I-X Mission Team is responsible for:

- 1) Providing copies of the Mission Reference Data to those listed on the Review Distribution List or provide for drops in the Windchill site.
- 2) Providing requested information to the Review Panel, the Mission Manager, CxP Management and CxP S&MA prior to the Review Meeting.
- 3) Delivering presentations at the Review Meeting (along with presentations by contractors and IPT leads)
- 4) Participating in the Panel/Mission interactions and meetings
- 5) Making Mission personnel available for discussion with Panel members
- 6) Providing wrap-up notes and feed back comments to the Chair concerning the Review Findings, the Requests for Action (RFAs), the Review Process, lessons learned, best practices, and suggestions for improving the Review Process.

## 7.0 REVIEW CHAIR: SELECTION, AUTHORITIES, RESPONSIBILITIES

The SE&I Office has the primary responsibility for planning the Ares I-X milestone reviews. The Ares I-X CDR will follow a process similar to the Ares I-X FTV Preliminary Design Review (PDR) and will maintain as many of the PDR panel members as possible. The reuse of panel members as a Standing Review Board is recommended in NPR 7120.5. This Plan will be approved by the following individuals:

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Ares I-X Mission Manager (approves)  
Review Chair (concur)  
Ares I-X SE&I Chief (concur)

The Standing Review Panel Chair (Chair in this document) is suggested to be Mr. John Paulson, who chaired the Flight Test Vehicle PDR, with concurrence by the Chief Engineer for Ares I-X, the Langley Research Center (LaRC) Head of the Systems Management Office and the LaRC Chief Engineer. The Chair has over-all authority, responsibility, and accountability for the conduct of the Review.

The Chair is responsible for:

- 1) Concurring on the Ares I-X CDR Plan
- 2) Leading selection and assembly of the Review Panel (The SE&I Office to arrange for travel of outside Panel Members as required)
- 3) Assigning primary areas of review responsibility to individual Panel members
- 4) Conducting the Review (calling and running meetings)
- 5) Compiling a preliminary Presentation of Findings for the mission.
- 6) Compiling and submitting a written Final Report to the distribution list included in section 23 of this document
- 7) Developing a Close-out Package for the Ares I-X Mission Archives to include Review Findings, the Review Process, lessons learned, best practices, and suggestions for improving the Review Process
- 8) Reviewing the list of Reference Data and Documentation to be provided and recommending any changes

Review Secretary - A Review Secretary will be appointed to support the Chair and Review Panel with the mechanics of the Review Process. The Secretary will:

1. Provide notification and distribution of information to the Review Panel
2. Direct Review Panel questions to proper team members
3. Take the official minutes at the Review Meeting
4. Compile official RFAs

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## 8.0 REVIEW PANEL MEMBERS: SELECTION AND RESPONSIBILITIES

An independent panel of technical experts with flight experience will conduct the Review. The Review Panel Members (Panel Members in this document) may consist of selected individuals from NASA, industry, academia, and other Government agencies. Where applicable, Panel Members from the Ares I-X PDR will be asked to return to improve continuity and reduce the up-front learning curve. In addition, panel members from the Constellation Standing Review Board will be invited to attend the review.

Prior to selecting Panel Members, the Chair will consult with the Ares I-X Chief Engineer (CE) and the Ares I-X Lead Systems Engineer (LSE) to determine the proper size and skill mix of the Panel, relative to the nature of the Mission and the scope of the Review. The SE&I Office and the Ares I-X CE will recommend candidates for Panel membership but the final selection of Panel Members is the responsibility of the Review Chair with approval by the Mission Manager. A table of technical disciplines and expertise is included:

### Panel Expertise

Aerodynamics/Flight Mechanics  
Aerodynamics/Flight Vehicles /Systems Engineering  
Systems Engineering  
Systems Engineering/Ground Operations  
Structures/Aerodynamics/Flight Sciences  
Safety and Mission Assurance  
GN&C  
Avionics  
Systems Engineering/Avionics  
Propulsion  
Roll Control Systems  
Materials/Fabrication /QA  
Software Engineering

A table of Panel Members and their assigned area of responsibility will be included in the review report. One panel member will be identified as the technical authority for S&MA, and a member will be identified as the technical authority for Engineering. The panel will operate in accordance with the NASA Governance Model.

Panel Members are responsible for:

- 1) Studying the Reference Data and Documentation relevant to their assigned area of responsibility

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- 2) Formulating questions and topics to be discussed during the Panel/Mission Interaction Phase, prior to the Review Meeting
- 3) Participating in the Panel/Mission interactions and meetings, prior to the Review Meeting
- 4) Supporting development and presentation of RFAs and Preliminary Findings
- 5) Performing as the assigned area point of contact to receive potential RFAs for the technical area and assure proper representation of issue.
- 6) Supporting compilation of the Final Report (review and comment on the draft report)
- 7) Providing wrap-up notes and feed back comments to the Chair concerning the Review Process, lessons learned, best practices, and suggestions for improving the Review Process
- 8) Supporting the RFA disposition and closure in a timely manner.

## **9.0 INDEPENDENCE OF REVIEW PANEL MEMBERS**

To avoid conflict of interest and to preserve the technical integrity of the Review Process, Panel Members must be independent of the Ares I-X Mission. Independence implies no direct involvement with the Mission (excluding service on previous review panels and boards). Exceptions may be granted, although limited to two members, by the Chair on a case-by-case basis and will be noted in the Final Report. The Chair will confirm the independence of Panel Members.

Panel Members should have actual flight hardware experience to the fullest extent possible. Coverage of the technical disciplines with appropriate expertise, experience, and proven judgment will be the primary selection criteria. Panel Member expertise will be sought across broad and diverse sources, but distribution across NASA centers will be a secondary consideration.

## **10.0 TIME COMMITMENT OF REVIEW PANEL MEMBERS**

Phase I Review:

Panel Members are expected to commit approximately, but not limited to, 160 hours on this Review task. These hours are distributed across approximately 8 weeks of elapsed time necessary to complete the review process. Prior to the Review Meeting, a part time level of effort at the member's home office is required for study of the Mission Reference Data. During this phase, some days will require near full-time attendance at Panel/Mission meetings and interaction. Most of this will be conducted by teleconference with web-based computer presentations. The actual Review Meeting

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will require a one-week trip (requiring Sunday travel) and wrap up by mid-day on Friday. During the wrap-up phase, a part-time level of effort at the member's home office is required to support development of the final Review report, tracking and closure of any RFAs, and participating in the wrap-up meeting (teleconference).

#### Phase II Review:

During the second phase of the CDR, the panel members are expected to commit approximately, but not limited to, 120 hours. Hours are distributed across approximately 6 weeks of elapsed time. As was required in Phase I, there will part time level of effort during the data drop phase, a three day on site review phase, and a wrap up phase required to support development of the official RFA list and final review report. There will also be a level of effort to track and support RFA disposition.

### **11.0 CLASSIFIED, CONFIDENTIAL AND PROPRIETARY DATA**

Prior to distribution of the Reference Data and Documentation Package, the Chair will coordinate with the Ares I-X CE and LSE to identify and discuss ITAR, restricted, proprietary, or sensitive data concerns and/or requirements. No National Security classified material will be involved. The Ares I-X Data Manager is responsible for ensuring any data or information that is categorized as ITAR, restricted, proprietary, or sensitive is marked and handled in accordance with Agency policies and procedures. The Ares I-X Data Manager is also responsible for providing necessary measures to protect such information during the Review, such as arranging for appropriate document storage. The Chair is responsible for confirming the appropriateness of Review Panel Members, and if necessary, obtaining non-disclosure agreements. Review Panel Members must be US citizens as ITAR data may be included in the Reference Data and Documentation package.

### **12.0 SCOPE AND DEPTH OF THE REVIEW**

This review is based on the principles of 7123.1a for conducting an independent review.

The Review is strongly focused on the mission's technical design solution and the supporting analyses, in the context of how the functional and performance requirements are met at the integrated mission level. The CDR will be held at the mission level to ensure the entire system design can meet functional and performance requirements with acceptable risk (technical performance and integrated schedule) and that these system requirements are reflected in IPT designs. Due to the complex number of products and the variety of delivery dates, the CDR will be conducted in two phases. An overview and status briefing will be given for the products not covered in detail at first phase of the CDR. The exceptions that will be carried over to the second phase review

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are included in appendix C variances. **The overall review is based on the following Ares I-X programmatic requirements and plans:**

#### Mission Level

- Programmatic Overview- Mission Implementation Plan
- Integrated Master Schedule (overview)
- CM/DM overview & status
- Integrated Risk Management overview; Top Project Risks and mitigations
- Mission Description and Success Criteria (ConOps overview)
- System Flight Certification Plan

#### System Level

- System Architecture
- External Interfaces
- System Performance and Functional Allocations
- SE&I Top Risks
- Closure of PDR RFAs status
- Baselined IRD/ICD's
- Master Verification Plan and Acceptance Criteria
- Traceability of requirements
- (Verification Requirements Data Sheets [VRDS] Status/Scorecard)
- DFI Requirements and traceability to Primary and Secondary Mission objectives
- DFI Critical Parameter List
- Integrated Design and Analysis (ID&A) Team presentations
  - Supporting systems analysis and test results
  - Status of Guidance Navigation and Control System
- Integrated Logistics Plan
- Assembly, Integration, and Test Plan
  - DFI test plans
- Integrated Hazard Analysis and Integrated Fault Tree (Draft. Approval at CSERP after CDR)
  - Supporting Safety analysis
- 
- Range Safety Documentation
- Hardware Disposition Plan

#### IPT Design Review/Status Reports

- Design Solution –Top Level Design descriptions of System and elements
- (Visuals, CAD images, etc.)
- Changes from PDR designs and status of issues and action items
- Baselined Element-level Requirements Documents (ERD) with traceability to A11-SYS-SRD V4.0
- Verification Status and Scorecard
- IPT risk status and mitigations (top 5)

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- Supporting Safety Analyses preparation
- Manufacturing Plans
- DFI Installation/testing plans
- Development/Qualification Testing

### 13.0 REFERENCE DATA AND DOCUMENT PACKAGE (RDDP)

The RDDP defines the set of relevant information and data necessary that help the Review Panel determine the state of the Mission. These data and information are provided prior to the Review so that the Review Panel Members and stakeholders have time to become familiar with the Mission specifics prior to conduct of the actual Review briefings.

Prior to starting the Review Process, SE&I will create a listing of items to be included in the RDDP. SE&I will confirm the source and availability of the data and reference information contained in the RDDP list. SE&I will review this list and identify any additional data/information deemed necessary to support the Review. Prior to the RDDP drop date, the Chair will consult with the SE&I to determine the source and availability of the data and reference information. Panel members will review this list and identify any additional data/information deemed necessary to support the Review. The Mission will provide a copy of the data to the Review Secretary for distribution to the Panel members upon requested. Electronic distribution of the RDDP utilizing the Ares I-X Data Management tool, Windchill, will be the standard. An inclusive list of configuration documents and products that will be provided at the CDR data drops is listed in the Appendix B of this document.

#### Products for Data Drop for Phase I CDR:

The IPTs will provide on November 30, 2007:

- Support for development of SE&I briefings for CDR data drop including; Assembly, Integration, and Test Plan, Safety and Mission Assurance, and Mission Operations planning.
- Technical data to the SE&I ID&A teams to enable final verification assessment of the system level FTV and ground.
  - Assumptions, standards including compliance to SRD.
  - All supporting IPT design verification reports including:
    - Structural Margins of safety for primary and secondary structure; includes joint bolt stress margins.
    - Thermal stress assessment for primary structure
    - Structural designs of primary and secondary structure at the current state including; finite element and CAD models.
    - Stiffness

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- Mass properties and history metrics
  - Supporting test results applied to the design; including but not limited to joint stiffness, component acceptance vs. maximum predicted environments (vibration, thermal, EMI/EMC, etc.) comparisons.
  - Primary Structure stack tolerance build-up analysis
  - Fault tolerance assessment
  - Safety reliability analysis, FMEA, fault tree, that supports integrated hazard development
- Avionics electrical system performance reports, power/load analysis (Avionics IPT), supporting test reports.
  - Grounding and Bonding Designs
  - Interface verification status scorecard (Verification sheet status)

IPT will provide on December 14, 2007:

- For the purpose of MMO assessment of readiness, the status of all entrance criteria as per in Appendix D.

IPT will provide on January 7, 2008:

- Overview package that establishes their design status against their own ERD and a verification matrix, corresponding to Version 4.0 of the FTV SRD (AI1-SYS-SRD) and version 2.0 of the GSRD (AI1-SYS-GSRD) or the AI1-IRD-F2G.
  - Clear communication of the traceability of the designs to requirements is required.
- Report out the results of the IPTs' design reviews with action items closures, risk acceptance or timely closure plan for those remaining open.
- Product designs (Summary of margins and factors of safety).
- Design solution descriptions that include CAD type illustrations and detail design drawings of the hardware. Changes from the PDR design should be noted.
  - It is up to the IPT to determine the level of detail to bring forward and to ensure the documentation is at a sufficient level to describe the design. Top level assemblies and designs, with a drawing tree to enable the panel members to inquire a level down to detail drawings if needed, should be available.

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- Summaries of the supporting analyses and trades accomplished in support of the design.
- Sample results such as structures and thermal analysis data should be included.
- Plans for procurement, manufacturing and logistics for delivery to KSC should be covered, including a summary of technical and manufacturing standards.
- A brief discussion of the plan for documenting (e.g., photographing) as-built hardware should also be presented.

SE&I will provide on December 14, 2007:

- For the purpose of MMO assessment of readiness, the status of all entrance criteria as per in Appendix D.

SE&I will provide on January 7, 2008:

- Integrated performance and functional analysis results.
- Report of results of integrated verification that prove successful performance of the vehicle and systems.
- Overview briefing of the System (Vehicle and Launch Facilities) Assembly and Integration and Testing Plan.
- Overview briefing report of all Vehicle PDR RFA closures.
- Present compliance matrix that shows overall designs meet system level requirements
- Master Verification Plan and Acceptance Criteria
- Traceability of requirements including Verification Requirements Data Sheets [VRDS] Status/Scorecard
- DFI Requirements and traceability to Primary and Secondary Mission objectives
- DFI Critical Parameter List
- Status brief of the GN&C effort to date
- Overview of the Logistics Plan and Launch Support Plan.
- System Performance and Functional Allocations
- Report of Closure of PDR RFAs status
- Baselined IRD/ICD's
- Range safety implementation and status of supporting analyses and tailored documents.
- Integrated hazards and safety analysis as an overview.
- Summary of top technical issues, open topics and resolution paths.

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## CDR Phase II

### Products for June 20, 2008 Data Drop :

#### Avionics IPT

- Summary Data, Documentation that supports Flight Software and First Stage Avionics Module (FSAM) CDRs
- Updated Avionics Element Requirements Document
- Avionics Verification Plans and Verification Requirements
- System Installation and Integration Test Plan (SIITP)
- IPT CDR action item status
- 

#### Ground Systems IPT

- Summary Data, Documentation that supports GS hardware designs
- IPT CDR Action Item status
- Updated Element Requirements Document
- Element Verification Plans and Requirements
- GS CDR Data and Documents
- VSS CDR materials

#### Ground Operations IPT

- Ares I-X KSC Processing Plan

#### All IPT's

- Assessments of environmental loads including any updated since CDR I and component testing results (provide to SE&I by 6/11/08)
- Vibro-acoustics, Thermal, Structures
- ERD changes since CDR I (provide to SE&I by 6/20/08)
- Drawing status (1 week prior to CDR)

#### SE&I

- Overview briefing report of all Vehicle CDR Phase I RFA closures and action plans for those that remain open.
- Compliance matrix that shows overall designs meet system level requirements
- Stoplight chart showing status of all IPT's in meeting loads and environments
- DFI/OFI Measurement List, version 3.07 with update requested at CDR 1
- Data and Documentation of GN&C architecture and design including margins and Monte Carlo results
- Integrated hazards and safety analysis
- Separation and First Stage recovery analysis
- Range Status (Range documents are not part of CDR)
- Verification Requirements and Data sheets Status, schedule and issues

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- Summary of top technical issues
- Integrated Environments
- Vibro-acoustics Environments Data book - MEFL (including shock), Qualification levels and Standards that will be used
- Stabilization Requirements for Roll Out and Pad Stay with supporting analysis
- Rigid Buffet Analysis results and impact on coupled loads
- Thrust Oscillation Analysis results
- Aerodynamics updates and impacts
- Modal tests Plans

Status Reports of Next Phase Products:

- Operational Test Requirements Status
- Launch Commit Criteria Status
- Post-Flight Data Plans
- Integrated Assembly Drawings

Mission Management / Chief Engineer Office Products

Products for data drop June 20, 2008 CDR II

- Updated Integrated top risks and mitigation plans
- Integrated Master Schedule Status
- Updated Summary Vehicle and Ground Operations Budget (if different from CDR Phase I drop)
- Mission Implementation Plan Update
- Waivers and Deviations

**Products for July 7, 2008 Presentation Drop Date**

IPT:

- Updates on open items raised at CDR I
- Updates on any design changes since CDR I
- Updates and closure plans on any IPT significant issues
  - SE&I will cover environmental related issues
- Open actions from IPT-level reviews
- If you do not have any of these items, then NO presentation is required
- Avionics (additional)
  - Flight Software Overview, recap CDR, outcome, actions.....
  - FSAM Design Overview, recap CDR, outcome, actions
  - Avionics Testing Plans and schedule (DFI/OFI status and testing overview)
    - Address data recorder survivability (suggested by chairman)
  - Architecture for ground systems (Avionics related)
- Ground Systems (additional)
  - Overview of subsystems CDR's – outcome, actions etc.

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- Launch and Control Center
- VSS design implementation
- Ground Sys Architecture

**SE&I**

- System Engineering and Integration Introduction
  - Updates to DFI requirements
  - SRD/ERD Status and open items
  - IRD/ICD Status and open items
  - Systems Requirements Compliance Matrix
  - Updates to Verification Requirements and Data Sheets, schedule and issues
- Report on CDR Phase I RFA closures and action plans
- Technical issues and changes since CDR I
  - First Stage Reentry analysis
  - Rigid Buffet Status
  - Modal Tests Plans
  - Stabilization Requirements for Roll Out and On-Pad
  - Roll out instrumentation requirements
  - Ground Wind Loads Test, Stage Sep Test status
  - Bending Modes/Frequencies
  - Model CM and verification status
  - Integrated EMI/EMC story
  - Factors of Safety and Margins of Safety
- Integrated Design and Analysis Update .....
  - Integrated Environments Reports
  - Reports on changes since CDR I, testing required...
  - Loads and Environments Stoplight Chart
  - Standards and MEFL and qualification levels
  - Thrust Oscillation Analysis results
- Guidance Navigation and Control System Design .....
- Integrated Hazards and Safety Analysis
- Ground Architecture.....
  - Telemetry Station .....
  - Range Documentation .....
  - Launch and Control Center .....
  - Post Flight Data Analysis Plan and HSOC .....
- Status reports on next phase products - LCC, OTR and Post flight data plan

**Mission Management/Chief Engineer/SM&A**

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- MMO Presentation
  - Introduction - Include scope of the review, mission changes since CDR I, success/exit criteria, changes in budget, schedule, risk etc.
- CE presentation
  - Waivers and Deviations
- S&MA presentation
  - Scope and Overview

•

#### 14.0 REVIEW PROCESS

The Review will be an open process where Panel members are assigned primary areas of review responsibility but are free to review additional areas they deem necessary or of potential concern. The Review process is divided into three phases, Pre-Review Phase, Review Meeting Phase, and Wrap-up Phase.

During the Pre-Review Phase, Panel Members will study the RDDP, engage the Ares I-X mission team with pre-review questions, and formulate a potential list of RFAs for the mission team. The Panel will then proceed to review the RDDP, consistent with the scope and depth of the Review.

During the Review Meeting Phase, the Panel will co-locate at LaRC for presentations of review materials and further questioning of the mission team. The mission team will present materials and be prepared to answer remaining questions for the Review Panel Members. Digital media (DVD or CD) will be provided to the panel members during the review meeting phase. Control of distribution will be required. Panel members and other interested parties shall receive materials via the electronic configuration controlled Ares I-X site on Windchill and may obtain access from the Ares I-X Project Integration Office.

At the conclusion of this phase, Panel Members will submit preliminary RFAs, a Panel Member Report, and the Review Panel will present the Review Outcome and Preliminary Findings to the Ares I-X Mission Management Office for dissemination. The mission team will have an opportunity to discuss the preliminary findings with the Panel. Entrance for the Review Meeting will be controlled due to proprietary technical and programmatic data.

During the Wrap-up Phase (one week following Review Meeting) Panel members will develop and submit their final Panel Member Reports and RFAs assigned by the Chair. The Chair will assemble the final RFAs and Final Findings. The Chair will brief the Final Findings to the Ares I-X Mission Manager and XCB, concluding the wrap-up phase and indicating the conclusion of the CDR. The SE&I Office is responsible for assembly and

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processing of the RFAs and delivering a written response to the Review Panel of RFA disposition plans NLT 30 days after the receipt of the RFAs. The action plans are to be coordinated between SE&I and the IPTs, and both have responsibility for closure or planning of impacts to the actions. RFA action plans that are viewed by the team to be outside the scope of cost and schedule threshold shall be brought forth to the XCB for resolution. The Chair shall file a review panel final written report a least 30 days post CDR review to the Mission Manager.

## **15.0 REVIEW PRODUCTS, DELIVERABLES AND REPORTING PROCESS**

Panel Member Reports - Final reports by each Panel Member are required within one week after the Review Meeting. Preliminary reports may be in draft form and are intended to support development of the Preliminary Findings presented to the Mission Team at the conclusion of the presentations. Preliminary reports will include identification/description of the areas reviewed, summary of the positive findings, summary of the negative findings, and RFAs with recommendations of corrective actions to mitigate the negative findings.

Final Panel Member Reports - Final written reports by each Panel Member, due to the Chair at the conclusion of the Wrap-up Phase (one week after the Review Meeting) to assist the Chair in writing the Final Report. Final Panel Member reports are to be in Microsoft Word and include final versions of the preliminary content. List of RFAs presented that were not considered, rejected or consolidated with other RFAs will be included in the report.

Final Findings and Outcome - A presentation of the preliminary RFAs and a Review Outcome delivered to the mission team as the last act of the Review Meeting.

Presentation of Findings - A presentation by the Chair to the Mission Manager at the end of the Wrap-Up Phase (one week after Review Meeting). The presentation will summarize the Review Findings & final RFAs. In addition, the Chair will also prepare a short summary brief of the Review findings and recommendations to the Constellation Program Manager or his delegates as well as a courtesy briefing to the LaRC Center Management Council (CMC). The Review Chair is responsible for contacting the CMC Executive Secretary and coordinating the date and time of the brief. The SE&I Chief, SE&I S&MA Lead, and SE&I Lead Engineer are expected to be in attendance during the brief.

Final Report - A written report by the Chair delivering the Final Review Findings and Recommendations for the Ares I-X records. Attachments to the Final Report will include any reply from the mission team concerning the Review, due 30 days after Final Findings are briefed.

RFA Report - A consolidation of RFAs shall be documented and collected by SE&I and a representative from the panel.

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Close-Out Package - A collection of Review documentation and information submitted to the Mission, which will archive the official documents. As a minimum, the archived information will include: Review CDR Plan, roster of Review Panel Members (and assigned area of responsibility), copies of the Ares I-X Reference Data and Document Package, Panel Member Reports, and the Final Report, due 45 days after Final Findings are briefed.

## **16.0 REVIEW EXIT/SUCCESS CRITERIA**

Successful completion of the Review requires that the majority of the Review Panel Members concur that the Mission team has appropriately accomplished each of the items listed below. If the Review Panel does not reach consensus on any item then a minority position will be documented and included in the Final Report. Failure of the Mission team to demonstrate that it has appropriately accomplished any of these items requires creation of one or more RFAs.

The Review Board shall evaluate the Mission using the success criteria indicated below:

1. The detailed design is expected to meet the requirements with adequate margins at an acceptable level of risk.
2. Interface control documents are sufficiently matured to proceed with remaining fabrication, assembly, integration, and test, and plans are in place to manage any open items.
3. High confidence exists in the product baseline, and adequate documentation exists or will exist in a timely manner to allow proceeding with fabrication, assembly, integration, and test.
4. The product verification and product validation requirements and plans are complete.
5. The testing approach is sufficient, and the planning for system assembly, integration, test, and launch site and mission operations is sufficient to progress into the next phase.
6. Adequate technical and programmatic margins and resources exist to complete the development within budget, schedule, and technical constraints.
7. Risks to mission success and top technical issues are understood and credibly assessed, and plans and resources exist to effectively manage them.
8. Safety and mission assurance (e.g., safety, reliability, maintainability, quality, and EEE parts) have been adequately addressed in system and operational designs, and any applicable S&MA products that have been approved.

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9. All appropriate engineering analyses are complete and accurate; the detailed design is based on these results.

10. Integrated safety analysis shows that any outstanding hazards can be controlled and are within an acceptable risk level.

## 17.0 REVIEW OUTCOMES

The principal outcome of the Review is a recommendation to the Mission Manager about the readiness for the Ares I-X Mission to proceed the next phase of the mission. One of the following four recommendations is generally applicable. However, it is recognized that the mission may face some unique circumstances and the Review Panel may tailor the recommendation accordingly.

2) Ares I-X **met** the "Review Exit/Success Criteria." Minor programmatic or technical deficiencies are documented in the RFAs. It is recommended that the mission successfully resolve all RFAs, and proceed to the next Phase without further review.

3) Ares I-X **failed to meet** the "Review Exit/Success Criteria." Critical programmatic or technical deficiencies are documented in the RFAs. It is recommended that the mission remain in the current phase until after the RFAs are successfully resolved, then repeat the Review.

4) Ares I-X **significantly failed to meet** the "Review Exit/Success Criteria." Very serious programmatic or technical deficiencies are documented in the RFAs. It is recommended that the mission stop work and receive immediate executive management attention.

## 18.0 MINORITY REPORTS

In cases where the Review Panel Members do not reach consensus in their findings and recommendations a minority position is documented and included in the Final Report. Any Review Panel Member who believes that the Final Report (including the minority reports) inadequately addresses an important concern should first raise this issue with the Review Chair. If the parties cannot reach a consensus the Review Panel Member may raise the concern to the Ares I-X CEs, Center CEs or to the LaRC CE.

## 19.0 REQUEST FOR ACTION (RFA)

For the purposes of this Review, the term "Request For Action" (RFA) describes a written response to the Ares I-X mission team, documenting individual Review Findings and recommended corrective actions. Standard forms will be provided to the Review Panel Members and collected by the Review Secretary. RFAs may only be submitted officially by a Panel Member. Panel Members may accept a RFA from the broad community during the review, but the individual Panel Member must take ownership and responsibility for working the RFA with the Ares I-X Mission Team. The Panel Member

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may reject an RFA for consideration, but will provide a rationale at the time of the final brief out at the conclusion of the review period. The initiator/s shall have an opportunity to raise this rejection to the panel or to the Chairman. The Chair will have final authority to accept or reject any RFA. In addition, any issue can be elevated via the NASA governance model.

Prior to completion of the Review Meeting, the Review Chair, Review Panel Members, and the Ares I-X SE&I Office and the Ares I-X CE will screen all RFAs to clarify, consolidate, accept, or reject individual findings.

Following the delivery of the final report after the completion of the CDR review, the Ares I-X SE&I Office will then develop an action plan in response to the RFAs and will assign a due date with responsible assignment of individuals to work each RFA within the Ares I-X team.

Once the action plans are developed, the SE&I office will present to the XCB those actions that are rejected, have cost or schedule implications for approval to go forward, approximately 30 days after the final report is released from the review panel.

The mission team will proceed to close the RFAs with concurrence from the originating Panel Member. The mission team is responsible to report results to the Chair who will sign off that the RFA was completed per the action plan. In the event that the original action becomes infeasible or inappropriate, the Ares I-X SE&I Office will develop an alternative action plan in response to the RFA and obtain concurrence of the originating Panel Member or shall raise the issue to the Ares I-X Mission Manager and XCB for disposition. Status of the RFAs will be provided to the Ares I-X Mission Manager and Chair on a weekly basis. Successful completion of the CDR and any open issues will be summarized and reported at the Flight Test Readiness Review (FTRR).

The RFAs will be tracked within the project action tracking tool in Windchill. A RFA closure form will be required for final closure concurrence by signature of the Panel Sponsor and Chair. The Ares I-X Chief Engineer and SE&I Chief will have direct responsibility to have visibility into the responses to all RFAs and access within the Windchill tracking tool. The following is the step by step process:

1. The assignee proposes a resolution, solution or action proposal to the RFA
2. The assignee obtains clarification or negotiates the disposition with the Sponsor
3. If agreed by Sponsor, the assignee will write the resolution into a.) the column labeled "response" in ex. spreadsheet, or b.) in the box labeled "resolution" in Windchill) and collect supporting documentation if applicable.
4. Assignee will send the resolution to the SE&I Office for processing of the official RFA Form .

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5. SE&I Chief, Lead Systems Engineer, Ares I-X SMA Lead and the Ares I-X Chief Engineer review the dispositions via the Windchill action tracking system and deliver a concurrence that there is no conflict to requirements, standards or objectives , if appropriate, within 24 hours to ensure timely movement of the process.

Note: RFA's that require significant I-X team resources will be summarized to the I-X Mission Manager prior to closure.

6. The action is deemed closed after the form has acquired the CDR Chairman and Sponsor signature.

7. SE&I is required to status disposition metrics at the MMO staff meeting on a weekly basis.

## **20.0 REVIEW LOGISTICS AND RESOURCES**

The Ares I-X SE&I Office is responsible for identifying and providing all the logistics and/or administrative support and resources necessary to conduct the Review.

CDR Phase 1: The Review meeting/presentation will be held over 5 days in a facility large enough to hold at least 150 participants (panel, presenters and attendees). Audio-visual and computer resources must be provided. The Review will also have telecon and computer sharing capability to allow for participants to listen only during the Review remotely. Procedures shall be implemented to protect ITAR and SBU material.

The SE&I Office will help facilitate travel arrangements as requested, which may include recommending local hotels and providing directions to the Review location. Of particular importance is the coordination of visitor badges and passes for the Review participants.

CDR Phase 2: The Review meeting/presentation will be held over 2.5 days in a facility large enough to hold at least 150 participants (panel, presenters and attendees). Audio-visual and computer resources must be provided. The Review will also have telecon and secure computer sharing capability to allow for predetermined locations to join the Review remotely via PBMA.

The SE&I Office will help facilitate travel arrangements as requested, which may include recommending local hotels and providing directions to the Review location. Of particular importance is the coordination of visitor badges and passes for the Review participants.

## **21.0 PROPOSED REVIEW SCHEDULE**

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The Proposed Review Schedule is listed below. Prior to finalizing the schedule, the Ares I-X SE&I Chief and the Panel Chair will confirm milestones relative to the constraints and availability of the mission and key personnel. The final schedule of the Review is the responsibility of the Ares I-X SE&I Office, but requires Chair concurrence. For Phase I of the CDR, the IPTs shall drop data to the SE&I a minimum of 15 working days prior to the final posting of RDDP to enable proper assessment and synchronization of system performance. There will be a second schedule for the CDR Phase II data drop and review. The following is a notional schedule of events during the Review phase:

#### Phase I CDR

10/12/07	Appointment of Panel Chair
11/8/07	Distribution of the Review Notification
12/13/07	Final Selection/Acceptance of Panel Members
1/7/08	Web-site credentials enabled for Electronic Access to Data
11/30/07	Posting of RDDP - Initial Release (IPT to SE&I)
12/14/07	Mission Management Office CDR readiness check point
1/7/08	Posting of RDDP - Original Release
2/6/08	Posting of final RDDP
2/6/08	Distribution of the Review Agenda
2/20/08	CDR dry run and chart review
2/25/08	Posting of final presentation charts

#### Review Meeting Phase

3/2/08	Travel Day to LaRC
3/3/08	Day One of the Review
3/4/08	Day Two of the Review
3/5/08	Day Three of the Review
3/6/08	Day Four of the Review
3/7/08	Day Five of the Review –Panel conclusion brief and wrap up

#### Wrap-Up Phase

3/14/08	Final Findings Briefing to the Mission Manager and final RFAs to the Ares I-X Mission Team
April 14	Briefing to CxP
4/14/08	Final Report
TBD	Briefing to the LaRC CMC
	30 days post final findings delivery
	Delivery of the /Close Out Package (SE&I) to XCB

#### Phase II CDR

5/16/08	Posting of initial RDDP
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6/20/08 Data Drop complete  
6/20/08 Distribution of the Review Agenda  
6/24,26/08 Internal Team Dry Run  
7/7/08 Posting of presentation charts

Review Meeting Phase

7/21/08 Travel Day to LaRC  
7/22/08 Day One of the Review  
7/23/08 Day Two of the Review  
7/24/08 Day Three of the Review (If required)

Wrap-Up Phase

8/01/08 Final Findings Briefing to the Mission Management Office and final RFAs to the Ares I-X Mission Team  
TBD CDR Panel Chair Briefing to CxP Management  
8/25/08 Final Report  
30 days post final findings delivery  
Delivery of the /Close Out Package (SE&I) to XCB  
8/30/08 All RFA action item plans completed with due dates.....

**22.0 REVIEW AGENDA**

The Review Secretary will coordinate with the Chair and the Ares I-X SE&I Chief to develop a Review Agenda. The Agenda will be distributed in accordance with the proposed Review Schedule to the Review Distribution List approximately one week prior to the Review. The Review Chair may adjust the Agenda in real-time as the Review progresses.

**23.0 REVIEW DISTRIBUTION LIST**

The Review Secretary will coordinate with the Review Chair and Ares I-X SE&I Chief to develop an appropriate distribution list for Review related materials. The Review Secretary will forward all Review related materials to this distribution list, as required by the Chair or the Ares I-X SE&I Office. All individuals included in the distribution list may attend the Review. The Directors of the various LaRC organizations identified in the distribution list may designate representatives to attend in their stead. As a minimum, this list will include the following:

Mission Manager and Mission Management Office staff, SE&I Chief, SE&I Deputy  
Chief Ares I-X CEs,  
Ares I-X S&MA Lead  
SE&I LSE

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Review Chair  
Individual Review Panel Members, including the NESC LaRC CE  
CxP Management  
CxP S&MA  
Director, LaRC FPD

Any additional distribution requirements are the responsibility of the Ares I-X Mission Manager.

NOTE: Distributions must take into consideration any constraints imposed on the distribution of classified, restricted, proprietary, or sensitive data.

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## APPENDIX A ACRONYMS AND ABBREVIATIONS

CDR	Critical Design Review
CE	Chief Engineer
CEV	Crew Exploration Vehicle
CFO	Center Financial Office
CLV	Crew Launch Vehicle
CMC	Center Management Council
CoFTRR	Certification of Flight Test Readiness Review
CxP	Constellation Program
DFI	Development Flight Instrumentation
DFI	Development Flight Instrumentation
ELP	Exploration Launch Project
ERD	Element-level Requirements Document
FPD	Flight Projects Directorate
FSB	Five-Segment Booster
FTS	Flight Termination System
FTV	Flight Test Vehicle
ID&A	Integrated Design and Analysis
IPTs	Integrated Product Teams
KSC	Kennedy Space Center
LaRC	Langley Research Center
LSE	Lead Systems Engineer
MMO	Mission Management Office
NASA	National Aeronautics and Space Administration
NESC	NASA Engineering and Safety Center
PDR	Preliminary Design Review
RDDP	Reference Data and Document Package
RFA	Request for Action
RoCS	Roll Control System
RSRM	Reusable Solid Rocket Motor
SBU	Sensitive but Unclassified
S&MA	Safety and Mission Assurance
SE&I	Systems Engineering and Integration
SM&A	Safety, Mission and Assurance
SMO	Systems Management Office
SR&QA	Safety, Reliability and Quality Assurance
USS	Upper Stage Simulator
VRDS	Verification Requirements Data Sheets
XCB	Ares I-X Control Board

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## APPENDIX B CONFIGURATION DOCUMENTATION AND DATA LIST

### RDDP-I Release

Ares I-X Flight Test Plan - Baseline  
 Ares I-X Mission Implementation Plan (MIP) - Baseline  
 Ares I-X Systems Engineering Management Plan (SEMP) - Baseline  
 Ares I-X Risk Management Plan - Baseline  
 Ares I-X Configuration Management Plan – Baseline  
 Ares I-X Data Management Plan - Baseline  
 Ares I-X Assembly, Integration and Test Plan – Baseline  
 Ares I-X Integrated Logistics Support Plan - Baseline  
 Ares I-X FTV Systems Requirements Document - Baseline  
     Ares I-X Mass Allocations- Baseline  
     Ares I-X OML Definitions Document-Baseline  
 Ares I-X Ground Systems Requirements Document - Version X.X-Baseline  
 Ares I-X Safety, Reliability and Mission Assurance Plan (SR&QA) - Baseline  
 Ares I-X Environmental Loads Documents (Structural, Aerodynamic, Thermal) -Baseline  
 Ares I-X Development Flight Instrumentation Measurements List - Baseline  
 Ares I-X FTV Master Verification Plan – Baseline  
 Ares I-X Ground Systems Master Verification Plan - Baseline  
 Ares I-X FTV Verification Requirements Document – Baseline  
 Ares I-X Ground Verification Requirements Document - Baseline  
 Ares I-X ICDs/IRDs – Baseline  
     FTV/GS  
     Avionics/FTV  
     First Stage/USS  
     USS/RoCS  
     CM/LAS/USS  
  
 Ares I-X FTV Integrated Master Schedule - Baseline  
 Ares I-X Operational Test Requirements – Current  
 Ares I-X Launch Commit Criteria –Current  
 Ares I-X Sequencing Document-updated  
 Tailored version of AFSPCMAN 91-710 (Range Safety) current  
 Current Mission Top Risk status  
 Ares I-X Element Requirements Documents –Latest Revision  
     Avionics  
     First Stage  
     Upper Stage Simulator Plan  
     Crew Module/Launch Abort System Simulator Plan  
     Roll Control System  
     Ground Systems

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Ares I-X Element Verification Plans – Latest Baseline Revision  
Ares I-X Element Verification Requirements Document – Updated  
Software Plans  
Ares I-X Software Assurance Plan – Updated  
Avionics FTV System Integration, Installation, and Test Plan -Baseline  
Ares I-X Design Definition Document-Baseline  
Ares I-X Post Flight Data Analysis Management Plan- Preliminary  
Ares I-X Configuration Control Item List-updated  
Subsystem Safety Analyses- Reference  
Engineering Drawing Tree-Baseline  
Range Safety and Mitigation Plan (PRD)- Draft  
Contamination Control Plan-current  
Ares I-X CAP- Baseline  
Integrated Product Team critical design review material

Review Presentation Materials –Final 1 week prior to CDR review

An inclusive list of all documents for drop is contained in the Ares I-X CDR 2 Entry Product Windchill Folder.

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## **APPENDIX C CRITICAL DESIGN REVIEW ENTRY CRITERIA**

The CDR demonstrates that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test. CDR determines that the technical effort is on track to complete the flight and ground system development and mission operations, meeting mission performance requirements within the identified cost and schedule constraints. In addition, to adequately prepare system CDR, IPT final design reviews must be complete.

1. All IPT Subsystems final design reviews completed or sufficient management approved variances in place.

Note: The following variances are approved by the Mission Manager and shall be topics during CDR phase 2:

1. Ground Systems Critical Design Review
  2. Avionics Flight Software and FSAM CDR Critical Design Review
  3. GN&C design
2. Flight Test Vehicle System Level PDR RFA items generated from design reviews closed or timely closure plans in place.
  3. IPT Design reviews RFA items generated are closed or timely closure plans in place.
  4. Integrated analysis complete, drawings and documentation 90% complete or feasible closure plans in place.

The following are expected variances that will be topics for the CDR Phase 2:

1. Guidance Navigation and Control Final Algorithm.
  2. Buffet Loads Model discussion
5. A preliminary CDR agenda, success criteria, and charge to the board have been agreed to by the MMO Chief, SE&I Chief, Chief Engineer and the Review Chair prior to the CDR.