Ares I Crew Launch Vehicle
Upper Stage Avionics and Software Overview

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Ares I Upper Stage Element
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“Avionics” refers to the on-board electronics that guide and control the Ares I Crew Launch Vehicle (CLV).

NASA is leading the design of the Avionics System, and The Boeing Company is the Avionics production contractor.

Design lead responsibility builds on the legacy of the Saturn development model (NASA design and IBM production).

NASA Design Team (NDT) can establish an architectural philosophy and system design that provides for a low-risk development through:

- Seeking available component solutions
- Design for production
- Design for obsolescence
- An architecture that economically accommodates change

Approach allows NASA to consider future Constellation vehicles and spacecraft and leverage opportunities.
Ares I US Avionics and Software Development Approach

- NASA designs and maintains design ownership throughout all phases
  - NDT architects and specifies
  - NDT assures a viable system design
  - Instrument Unit Avionics (IUA) contract is awarded prior to US PDR
    - Influences design for manufacturability, producibility, and sustainability
    - Analysis and development plans for the manufacture, assembly, checkout, logistics, and sustaining
    - Provides development hardware
    - Integrates and Tests the Upper Stage Avionics System
    - Specifying the Upper Stage Electrical Ground Support Equipment
    - Providing the Upper Stage Avionics Systems and EGSE for flight tests and production flights
    - Establish the manufacturing and production areas
    - IUAC will transition to sustaining engineering role with NASA performing an insight role after Design Certification Review
  - NDT leads the Flight Software Design Development Test & Evaluation
NDT Responsibilities

♦ The NASA Design Team is responsible for the US Avionics System Design, Development, and Test
  • Analyses, Trades, and establishment of margins and system resource management required to demonstrate Avionics
    System (including software) design meets mission requirements
  • Establishment and management of the system development and test program resulting in design certification

♦ The NASA Design Team is responsible for Avionics System-level requirements and specifications:
  • Upper Stage Element Level Requirements (Element Requirements Document)
  • Upper Stage Avionics System-level Architecture (Hardware and Software)
  • Avionics and Software Subsystem Specification
  • Component End Item Specifications
  • Electrical Ground Support System Requirements

♦ The NASA Design Team is responsible for Avionics System-level development and test plans:
  • Avionics System Development Plan
  • Avionics System Test Plan

♦ The NASA Design Team is responsible for Flight Software development:
  • All Flight Software Design, Development, Test, and Evaluation, through Certification for flight

♦ The NASA Design Team is responsible for development and test facilities:
  • Software Development Facility
  • System Integrated Test Facility
  • System Integrated Laboratory
Ares I Upper Stage Avionics Locations

**Instrumentation Unit**
- Flight Computers
- Command & Telemetry Computers
- Vehicle Flight Software
- Inertial Navigation System
- Data Acquisition & Control Units
- Radio Frequency Communication System
- Power Distribution & Control Unit
- Battery Unit
- Flight Safety System
- Global Positioning System
- Operational Flight Instrumentation (OFI)
- Developmental Flight Instrumentation (DFI)

**Aft Skirt**
- Combined Control System Electronics
- Data Acquisition & Control Unit
- Power Distribution & Control Unit
- Battery Unit
- OFI & DFI

**Interstage**
- Roll Control System Electronics
- Rate Gyro Assemblies
- Pump Motor Inverter Unit
- Power Distribution & Control Unit
- Battery Unit
- OFI & DFI

**First Stage**
- Forward Skirt
- Aft Skirt

**Upper Stage**
- J-2X Upper Stage Engine

**Spacecraft Adapter**
- Orion Crew Exploration Vehicle

**Launch Abort System**
Ares I Overall Avionics & Software Functions

♦ Upper Stage Avionics Primary Functional Responsibilities
  • Pre-flight Checkout
  • Guidance Navigation & Control of Integrated Vehicle
  • Vehicle Management
    – Command and Data Handling
    – Autonomous and Automated Control of Upper Stage Subsystems
    – Ground and Crew command capability
    – Fault Detection, Diagnostics, and Response (including Abort Recommendations)
    – OFI and DFI Telemetry
    – Support Range Tracking
    – Flight Termination Implementation
Overall Dimensions:
Diameter 216.5 in.
Length 86 in.
The NASA Design Team (NDT) has planned a development approach that implements within the larger Constellation framework.

NASA-owned and led design has already resulted in cost savings through competition, and provides the mechanisms to further reduce cost through early design influence for production.

NASA and Boeing personnel work are working together in a “One Team” approach.

This strategy leverages opportunities for NASA’s future Constellation developments.

Competition, system architecture, and design philosophy all contribute to the Avionics team objectives: (1) Successfully deliver a certified Upper Stage Avionics System to the Project, and (2) Maintain lower life-cycle cost.