SAFETY CHARACTERISTICS IN SYSTEM APPLICATION SOFTWARE FOR HUMAN RATED EXPLORATION

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NASA/KSC
• Develop Human Rated capabilities for exploration class missions into our solar system
• Exploration System Directorate in NASA HQ
• Three separate Programs cross integrated
  • JSC – Orion
  • MSFC – Space Launch
  • KSC – Ground System Development and Operations (GSDO)
    • Command and Control is a project under GSDO
GFAS applications integrate the flight software packages of the Orion, the flight software of the SLS, and the ground control systems through the LCS.

Developing the integrated firing room console applications and displays for pre and post launch activities to support flight and ground processing and integrated ground subsystem processing as required for Orion, Core Stage, Booster and ICPS.
GFAS Structure

- Over 1.5 Million Lines of Code
- 80,000+ measurements
- About 370,000 hours
- About 30% Complete-to-date

- Ten GFAS Teams
- 70+ Software Engineers,
  Operations Engineers,
  Safety and Quality Personnel

- 1200 + Displays

- 500+ Sequencers

- 500+ Routines

- 500+ Sequencers

- 150 + Sequencers

Hundreds of Prerequisite Logic Sequences
GFAST Software Design Lifecycle

- **Initial Software Requirements and Design Specifications – SRDS**
  Includes Systems Hazards controls and operational requirements

- **Final Software Requirements and Design Specifications – SRDS**
  Initial Requirement Verification Test Matrix - RVTM

- **Software Implementation**
  Standardized software displays, sequencers, control logic and data fusions

- **Software Integration**
  Final RVTM Accepted Integration with External Interfaces

- **Verification**
  Software Verified against RVTM

- **Validation**
  Software Validated with User Community
  Launch & Processing Engineers, Test Controllers

- **Doc 45 Software DR**
- **Doc 90 Software DR**

Software Application put under Configuration Control
GFAS Agile Development Process

- Requirements Type Sprint: Two Weeks
- Implementation/Integration Type Sprint: Two Weeks
- Verification/Validation Type Sprint: Two Weeks

A Sprint can be any of these types or a combination.

Sprints 6 per Drop

Drops 1-14
Software Safety Characteristics

• **Five Overarching Software Safety Characteristics**

• Comply with NASA NPR 7150.2B Class A Classification for Human Spaceflight Systems

• GFAS system safety engineers embedded into the GFAS Teams to ensure proper implementation of hazard controls and operational safety requirements are included in the software code

• Software safety engineers concurrence on software displays, sequencers, control logic and data fusions are standardized

• Quality engineering supports the engineering reviews and verification/validation preparations to ensures each step of the SRDS is reflected in the RVTM and in the corresponding Verification and validation processes

• Software configuration control from initial implementation through final TCID Build with clear tractability
Questions?
JOURNEY TO MARS

- Hubble Space Telescope
- International Space Station
- Space Launch System
- Orbiters
- Rovers and Landers
- Deimos
- Phobos
- Mars Transit Habitat
- Orion Crewed Spacecraft
- Deep Space Habitat
- Solar Electric Propulsion
- Asteroid Redirect Mission

Missions: 6-12 months
Return: Hours
Earth Reliant

Missions: 1-12 months
Return: Days
Proving Ground

Missions: 2-3 years
Return: Months
Earth Independent