Outline

♦ Goals/Objectives
♦ Vision
♦ Concept of Operations
♦ Architecture
  • EVA System Description
  • EVA Systems Reference Configuration

♦ Note: Limited Content due to current Competitive NASA Procurement
Complete the International Space Station
Safely fly the Space Shuttle until 2010
Develop and fly the Crew Exploration Vehicle no later than 2014 (goal of 2012)
Return to the Moon no later than 2020
Extend human presence across the solar system and beyond
Implement a sustained and affordable human and robotic program
Develop supporting innovative technologies, knowledge, and infrastructures
Promote international and commercial participation in exploration

NASA Authorization Act of 2005

The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.
EVA Project Manager’s Vision

- Robotic missions are amazing and extremely important to our Agency, but Robots discover, Human beings **Explore**. Exploration is a personal experience and a capable and innovative EVA System will enable that experience.

- Meeting this vision will require Humans to operate outside the pressurized spacecraft environment and explore other planetary bodies. The EVA Systems Project office will protect the crew in these mission phases and allow for exploration of our solar system in a safe, efficient and cost effective manner.
Success
Operations
Operational Scenarios

- **Launch**
  - Nominal launch ops
  - Emergency Pad Egress

- **Orbit**
  - Survival in an unpressurized cabin
  - Unscheduled/Contingency EVA

- **Lunar Surface**

- **Landing**
  - Nominal & Off-nominal

- Note: Photos borrowed from all legacy and current programs
Nominal Launch Ops

- **Crew dons their suits in the O&C Building “Suit-up room”**
  - Some checkout of the suit will be performed using GSE
- **Crew transfers (with closeout crew) to the pad in the Astrovan**
  - Provisions for cooling will be available
- **Crew rides elevator to the access level (~280’ level)**
- **Crew finishes suit-up process and ingresses CEV with assistance**
Emergency Pad Egress

- System must allow for unassisted emergency egress
  - Closeout crew and rescue crews assist if situation warrants
- Emergency escape system under review by Ground Systems
- Bunker at base of current slidewire system will provide services
- Use of emergency escape vehicle (M-113) needs to be assessed
Survival in an Unpressurized Cabin

- Requirement at the Constellation Architecture level
  - Allocated to CEV, Altair, & EVA Systems
- Reference concept is that CEV feeds leak while crew dons suits
- Cabin eventually bleeds down and crew survives in their suits for the trip home
  - Suit pressure under evaluation but may limit mobility at least during the ‘prebreathe’ timeframe.
  - Worst case (for a single vehicle) involves survival for ~120 hours
  - Details for hydration, nutrition, and mobility need to be worked
Unscheduled / Contingency EVA

- Unscheduled / Contingency EVA requirement levied on the Constellation Architecture (Microgravity)
  - Currently allocated to CEV, Altair, and EVA
  - Unscheduled – Mission Success
  - Contingency – Crew Safety

- 2 EVAs of 4 hours (TBR)
  - Independent of other vehicles
- EV1 performs task
- EV2 SEVA, ready to assist
- Currently no tasks ID’d by CEV project other than Altair – CEV transfer
Apollo EVA on Service Module

**Protection:** Spacesuit TMG and helmet visor provide protection from the space environment.

**Life Support:** Umbilical connection to spacecraft ECLSS for breathing gas supply, CO2 scrubbing, thermal control, and bi-directional data/voice.

**Stabilization:** Handrails give EVA crewmember the means to stabilize himself at the worksite.

**Translation Path:** Handrails leading from the hatch allow EVA crewmember safely reach worksites.
Lunar Surface Exploration

• “...One small step for man, ...”
Nominal & Off-Nominal Landing

- Nominal landing scenario is on land with full assistance by ground ops recovery forces
  - Crew would likely stay suited through transport (cooling services provided)

- Off-nominal scenarios:
  - Land-landing not at the designated site
  - Water-landing
  - In either case, the crew has the option of staying with or leaving the vehicle (appropriate survival gear will be provided by EVA & FCE)
Suit Architecture
EVA Single Suit System Architecture

Since Cx PBS, conducted ‘Architecture Assessment’ that focused on mitigation of occupant protection and mass/volume issues associated with first EVA System Reference (ESR 1)* — resulted in ESR 2 (shown below)

LEA/Microgravity EVA Suit (Configuration 1)
- Change to soft rear entry design
- Shoulder bearing retained for mobility
- Removed Body Seal Closure
- IVA Gloves
- Removed Hip Bearings
- Thigh Disconnect Retained for modularity

Lunar Surface EVA Suit (Configuration 2)
- Two 'shortie' cores
- Common helmet
- Common lower arms
- Common legs/boots
- PLSS (8 Hr EVA)
- Enhanced shoulder mobility
- Waist Bearing
- EVA Gloves
- Multi-hip Bearing
- Rear entry hatch
- TMG/MLI for relevant environment — incl. boot covers

Key features of Lunar config remain unchanged in ESR 2

* Overall EVA System architecture approach retained - modular, reconfigurable, component - based architecture that meets various mission objectives