

NASA's Advanced Extra-vehicular Activity Space Suit Pressure Garment 2018 Status and Development Plan

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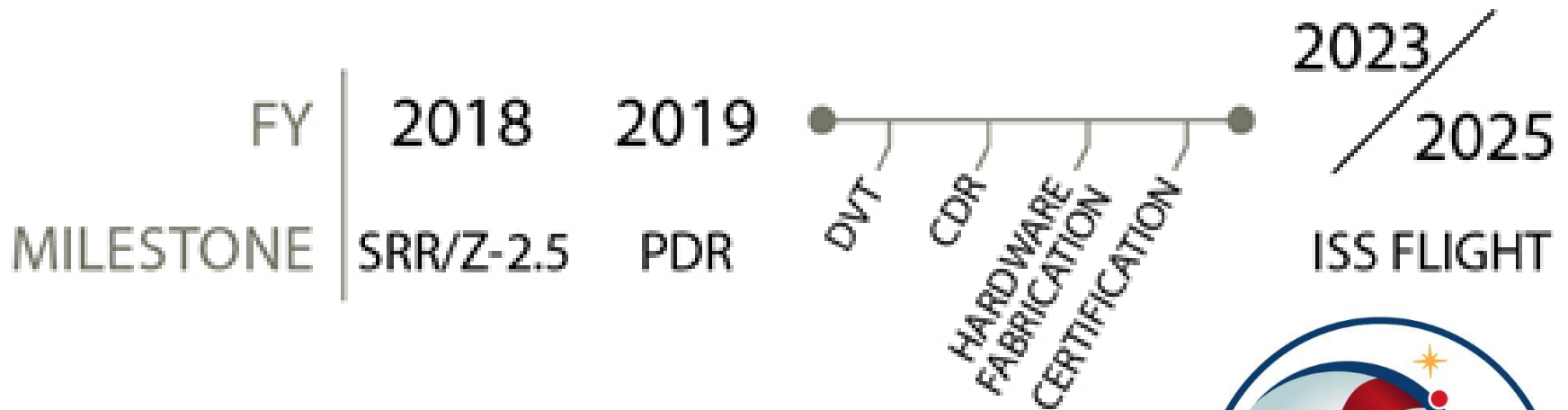


Agenda

- ISS Exploration EMU Demonstration (xEMU Demo) Project
 - Project plan
 - PGS Components
- Exploration EMU (xEMU) efforts
- Mars EMU (mEMU) efforts



xEMU Demo Project Plan Milestones



SRR: System Requirements Review

PDR: Preliminary Design Review

DVT: Design Verification Testing

CDR: Critical Design Review



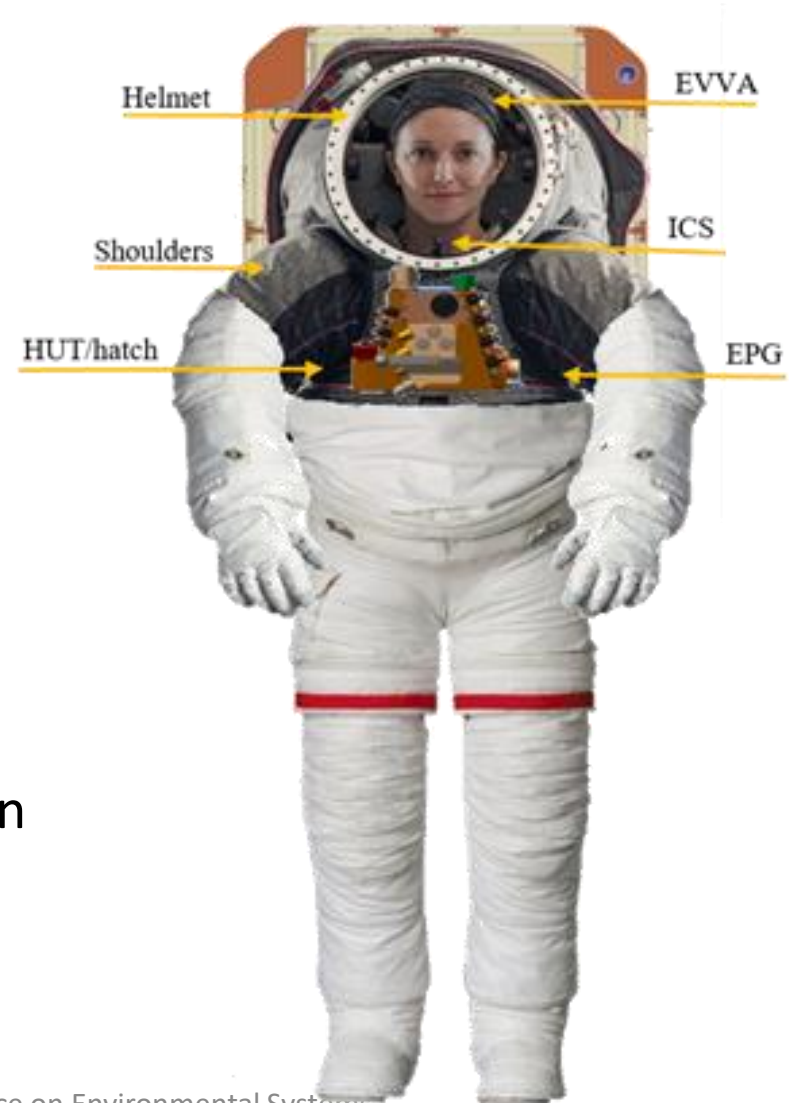
For a view of the broader plan please reference ICES-2018-54, “Methodology for Extravehicular Activity (EVA) Technology Identification, Prioritization, and Maturation,” by Blanco and Aitchison.



Pressure Garment Subsystem (PGS) Components

PGS components being produced for xEMU Demo:

- Hard Upper Torso (HUT)
- Helmet
- Extra-vehicular Visor Assembly (EVA)
- Shoulders
- Auxiliary-loop Liquid Cooling and Ventilation Garment (ALCVG)
- Integrated Communication System (ICS)
- Biomedical monitoring system (Biomed)
- Dust-mitigating Environmental Protection Garment (EPG) integration



Hard Upper Torso

Work has been focused in 3 areas

- Changes to HUT geometry
- Composites development
- Preliminary HUT-focused fleet sizing study

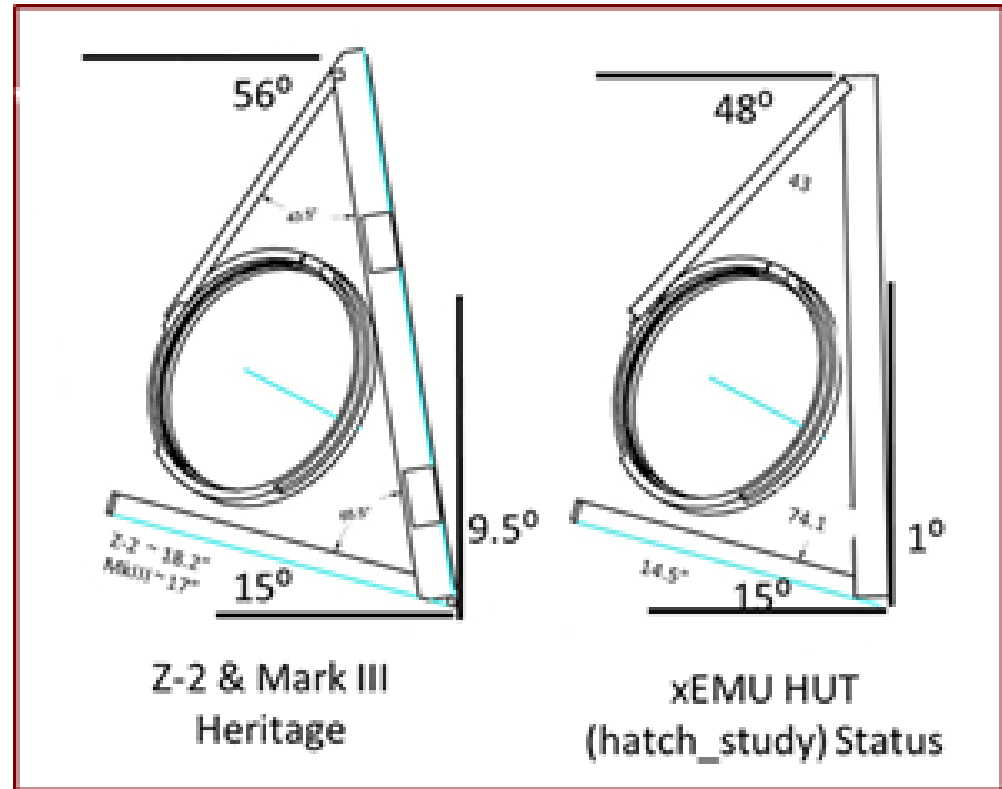
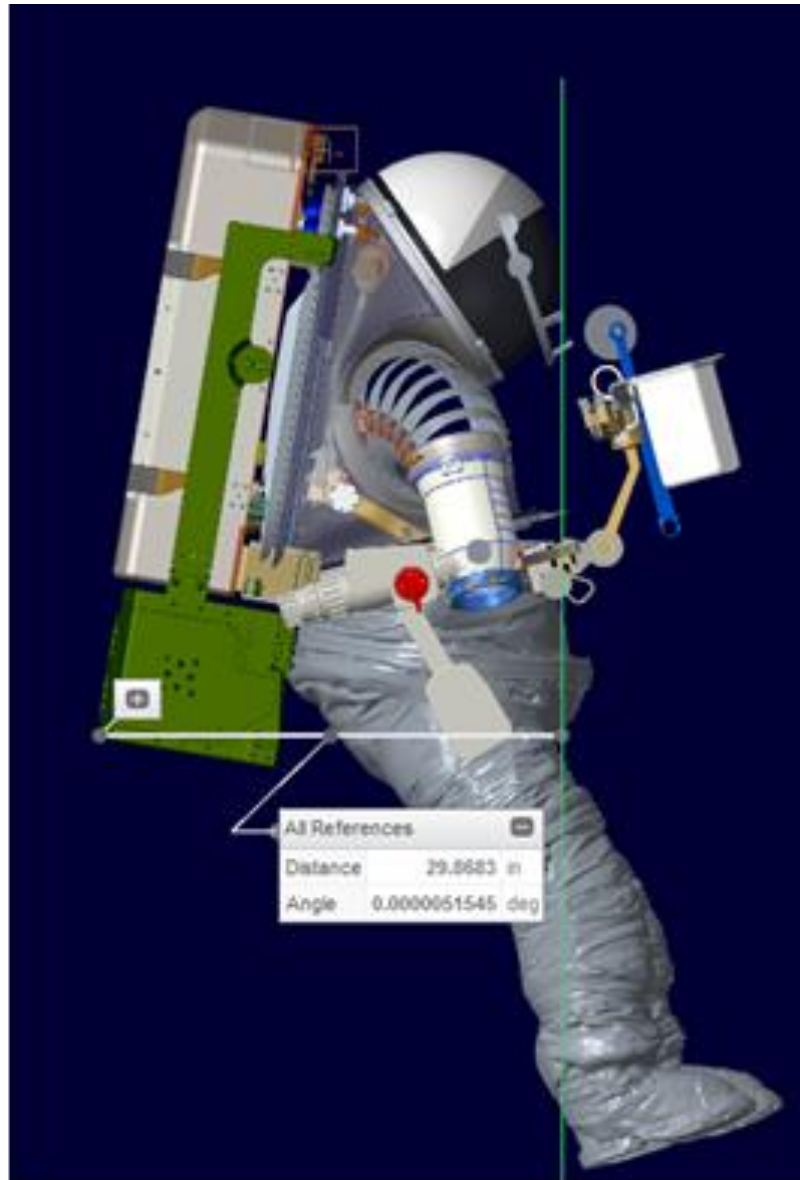


HUT: Geometry

Geometry changes were predicated on the need to reduce the front-to-back dimension of the xEMU Demo. Z-2 NBL testing confirmed the need to address.



HUT: Geometry



Geometry changes were incorporated into the Z-2.5 design for pre-PDR NBL testing

Helmet and EVVA

Helmet:

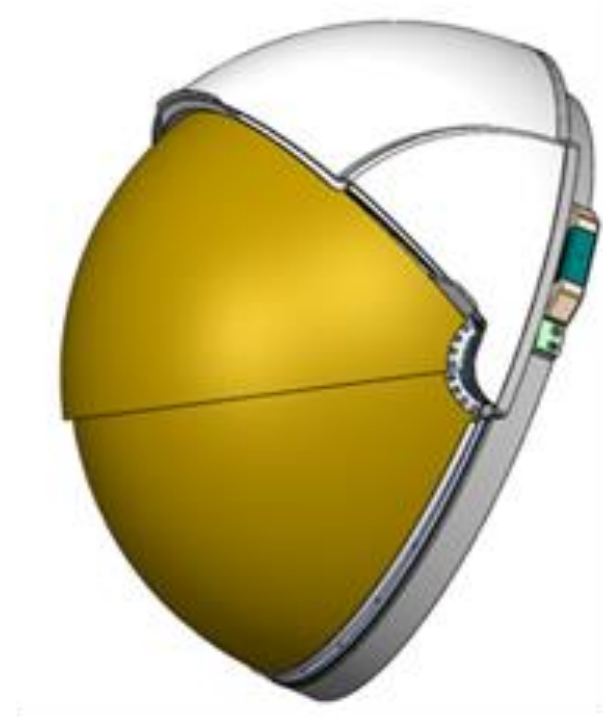
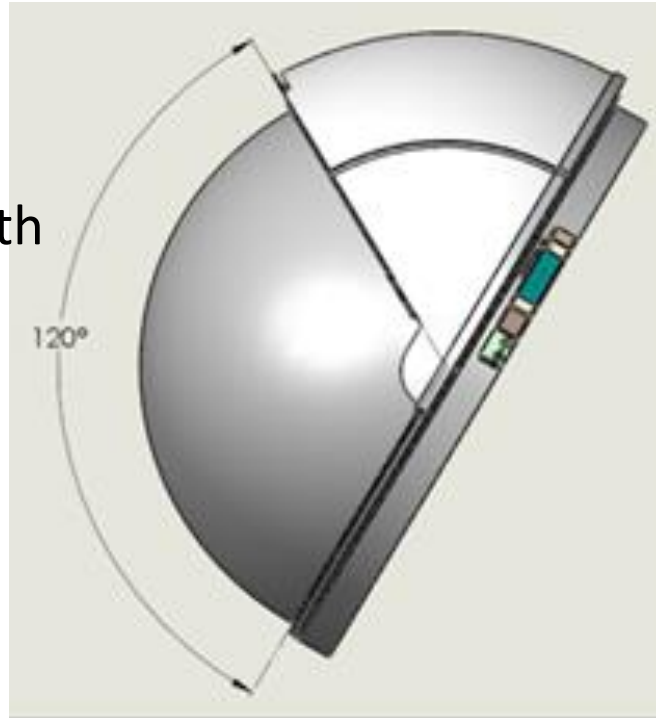
Ellipse 10"X13"

- Z-2 was 11"x13"
- Change made to reduce helmet depth

EVVA:

Mechanical design for xEMU Demo

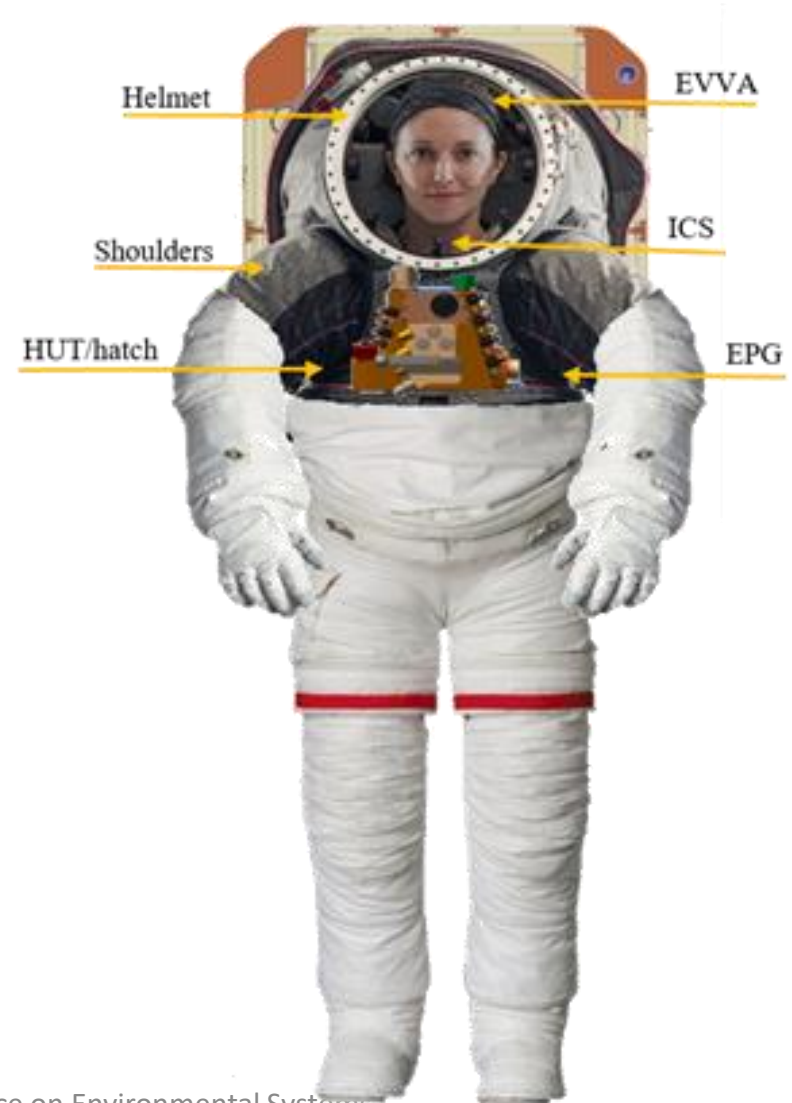
- Effort to maximize visibility
- Z-2.5 EVVA is the first prototype



Shoulders

Shoulder effort focused on design maturation for DVT:

- Address Z-2 NBL feedback
 - Move crewmembers forward in the suit
 - Reduced scye bearing depth
- Incorporate design feature to meet xEMU Demo requirements
 - Redundant seals
 - Modify secondary axial brackets
- Incorporate exploration-forward design features
 - Dust mitigating EPG integration interface



ALCVG

Modifying Constellation ALCVGs for use in Z-2.5 NBL testing

- Removed ventilation system and replaced with EMU vent tubes and plenum
- Adding a layer of mesh for ease of padding integration

Extensive ALCVG design effort to support both xEMU Demo and xEMU configurations

- Water tube material and cross-section selection
- Garment fabric(s)
- Water tube layout
- Aux water tube connector
- Design review completed in June
- Prototype fabrication



ICS

New unit to be tested in Z-2.5 addresses Z-2 testing comments with:

- Improved speakers
 - Addressing comments on 'tinny' sound quality
- Improved digital microphones
 - To improve EMI interference resistance
- Alternate speaker and microphone locations
 - To increase in-helmet space and improve ICS volume
- Design to address potential for feedback
- Fabricating ground-based version of the Space-to-Space Advanced EMU Radio (SSAER)
 - Serves as sign processor for the ICS
 - Interfaces the ICS with ground facility communication systems
 - Used to test the ICS evaluation of proposed audio compression and automatic gain control features



Biomed

The Biomed is being completely redesigned.

- Requirement is to sense heart rate.
- A market survey of commercially-available Biomed sensing hardware options is being performed.
- A prototype unit will be completed for PDR.



EPG Integration

For xEMU Demo baseline:

EMU TMG lay-up

Dust-mitigating EPG interfaces

Performing fit checks with prototypes

Includes: HUT, Shoulder, DCU, PLSS, EVVA (if needed)

For xEMU:

Investigating new material lay-up options



xEMU

- DVT testing will exceed xEMU Demo operation life/cycle requirement (shoulders)
- Self don/doff feature designs are being explored as able
- In discussion with STMD GCD regarding proposed work on composites and EPG
- Phase IIx SBIR following “Contact Stress and Design Parameters for Titanium Bearings” was awarded.
 - Address bearing issues regarding
 - Operational life
 - Dust and other environmental protection
- Overguides funding received to work on anti-shock coating for xEMU Demo
- 2 SBIRs awarded on EVVA sun visor topic
- Efforts continue to obtain funding for a mobile lower torso



mEMU

- Mars 2020 Calibration Target flight hardware fabrication underway
- ARGOS interface hardware design work continues
- EPG work considering all exploration missions
- Determined format for publishing PGS Technology Development Plan



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