

Lessons Learned from Analogue Mars Surface Suits: Applications for Next Generation Analogue Suits and Moon-Mars Surface Suits

Mr. Paul Graham

OpenLuna Foundation - paul@openluna.org

www.openluna.org

Introduction

Future lunar and Martian exploration requires improved designs for Lunar Surface Suits (LSS) and Mars Surface Suits (MSS). The process of refining suits calls for analogue testing in a relevant environment. Since 2001, the author has been overseeing operations at the Mars Desert Research Station (MDRS) and Flashline Mars Arctic Research Station (FMARS), observing simulations using primitive analogue suits, and gathering data on suit functionality from the perspective of the experienced field scientists and engineers who use them. A next-generation analogue LSS/MSS must be designed.



What went right

- overall size/weight/look
- reduction in audio and tactile capability
- reduced visibility
- lifespan of consumables (power, water)
- Are an acceptable first generation analogue



What went wrong

- size and fit
- ventilation
- durability
- details
- weight and balance
- overall mobility
- no thought given to field operations



MSS/LSS requirements

Sample of requirements for future suits that can easily be reproduced in an analogue suit:

- long duration consumables
- high durability
- ease of use and repair
- Integrated communications, navigation, documentation, telemetry and data systems
- integrated “enhanced” life support
- integrated medical support and telemetry



Analogue MSS/LSS options

easy to apply features for second generation analogue suits include;

MCP or gas bag with heavy coveralls (either armour or dust mitigation)

- Both should be modular for repair or sizing
- Both should go on quickly and easily

long duration power systems (easy to recharge, tetherable)

better easy to clean fluid replacement systems



Analogue MSS/LSS options

easy to apply features for second generation analogue suits include; (cont.)

integrated data systems including communications, video and still cameras. navigation, FDM, medical & suit telemetry and entertainment systems

improved systems survivability and ruggedness, including crew member protection

improved modularity in the PLSS/helmet for ease of maintenance and repair



Future work

University of North Dakota NDX-2 – gas bag suit

Pressurized full isolation life support

Waste handling

Advanced suit-born technologies

OpenLuna suit



Images of NDX-1 courtesy of UND

OpenLuna Suit (preliminary)

with and without Protective Coverall & HUT

- MCP/HUT Hybrid
- Designed to be worn continuously
- Food, water, waste handled in suit.
- Data/comm systems integrated
- Extremely high mobility & balance
- High modularity & durability & Visibility
- Usable tethered



Conclusion

Suit development must take place in a suitable analogue environment,

Current suit designs proved the need for this study, and have given us valuable data in the way people use suits in field analogue conditions.

The time has come to advance to the next level in analogue suit design and take the next step in simulation fidelity. The next generation of suits will be an integral part of this important step.

