

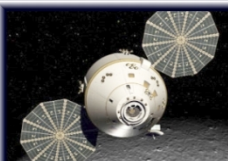


Some Aspects Related to the Assessment of Space System Materials Flammability

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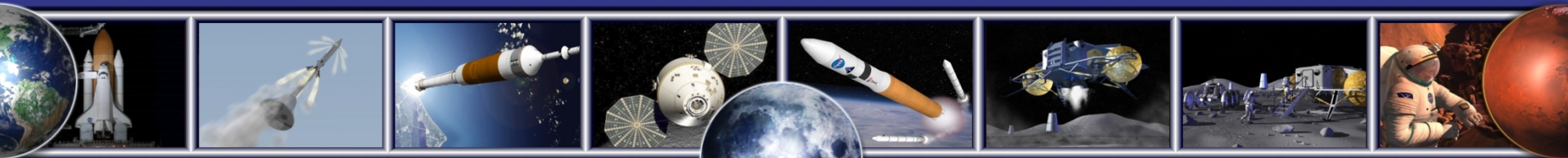
Third IAASS Conference: Space Safety in a Global World
Rome, Italy
October 2008



Agenda



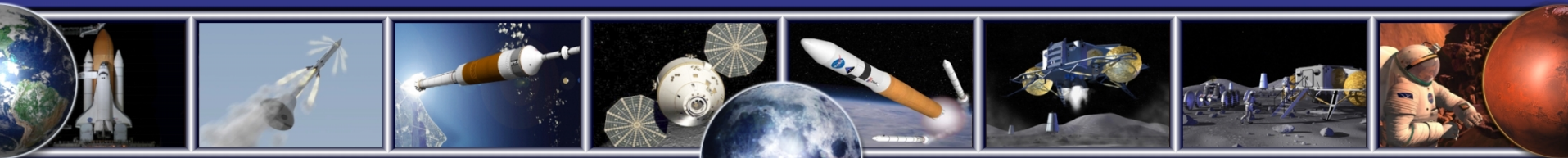
- Current approach to spacecraft fire safety
- Constellation Program fire safety challenges
- Current trends in evaluation of Constellation materials flammability
- Conclusions and Recommendations





General Strategy: Prevent Fires

- Controlling materials
- Minimizing potential ignition sources and materials that can propagate a fire
- Controlling the quantity and configuration of flammable materials to eliminate fire propagation paths





- Major flammability tests – NASA STD 6001.A Tests 1 and 4
- Upward flame propagation
- Conducted under worst expected spacecraft conditions, usually in 30% oxygen at 10.2 psia
- Pass/fail test logic



Constellation Program Fire Safety Challenges



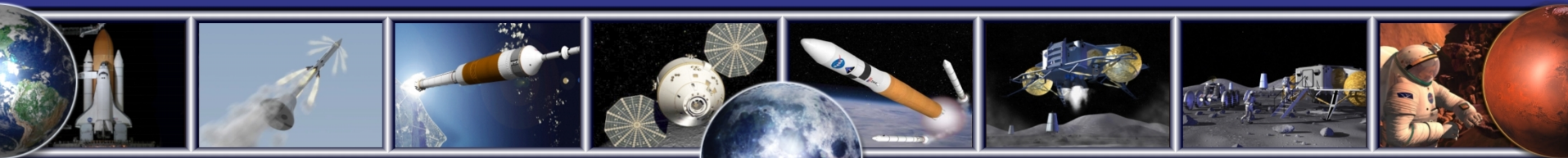
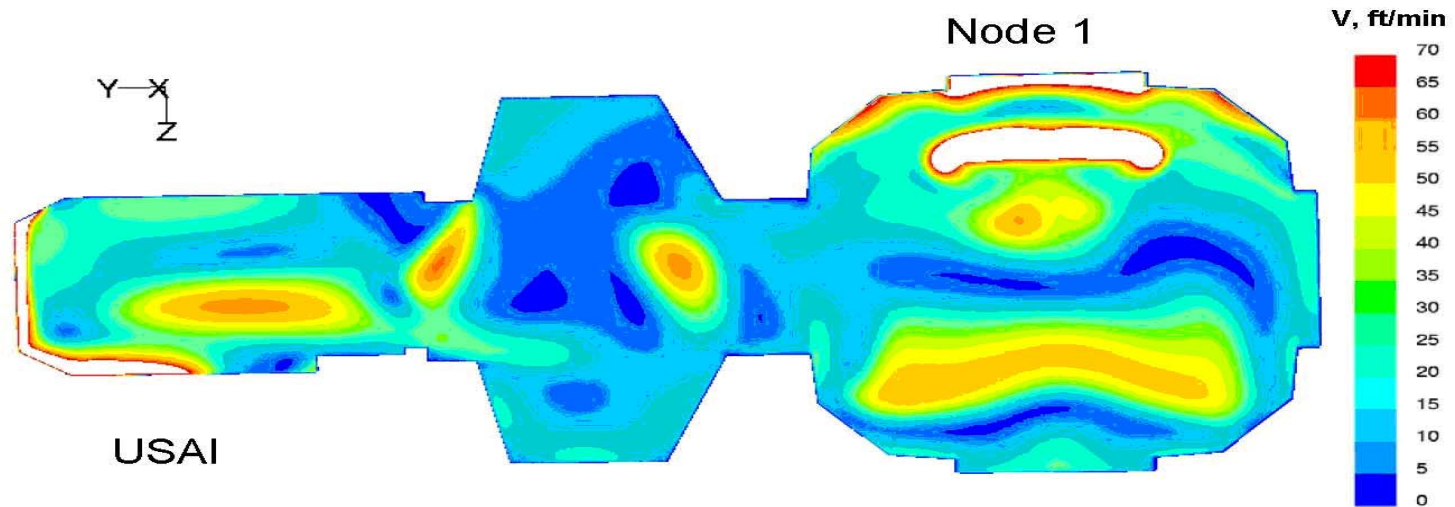
- Long duration; unplanned events more likely
- Limited options for mission termination
- Variety of spacecraft, surface habitats, planetary landers
- Spacecraft environment and its leading importance
- Flexibility and adaptability critical for success



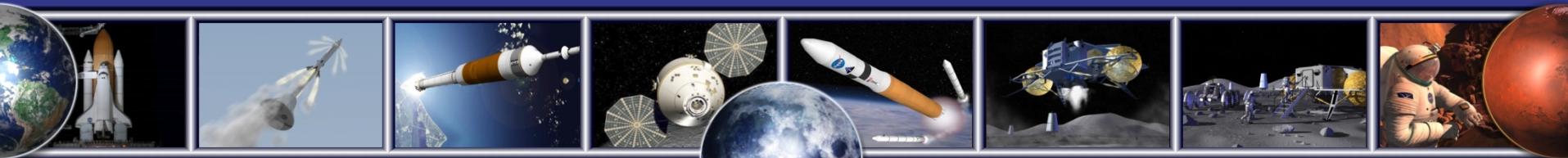
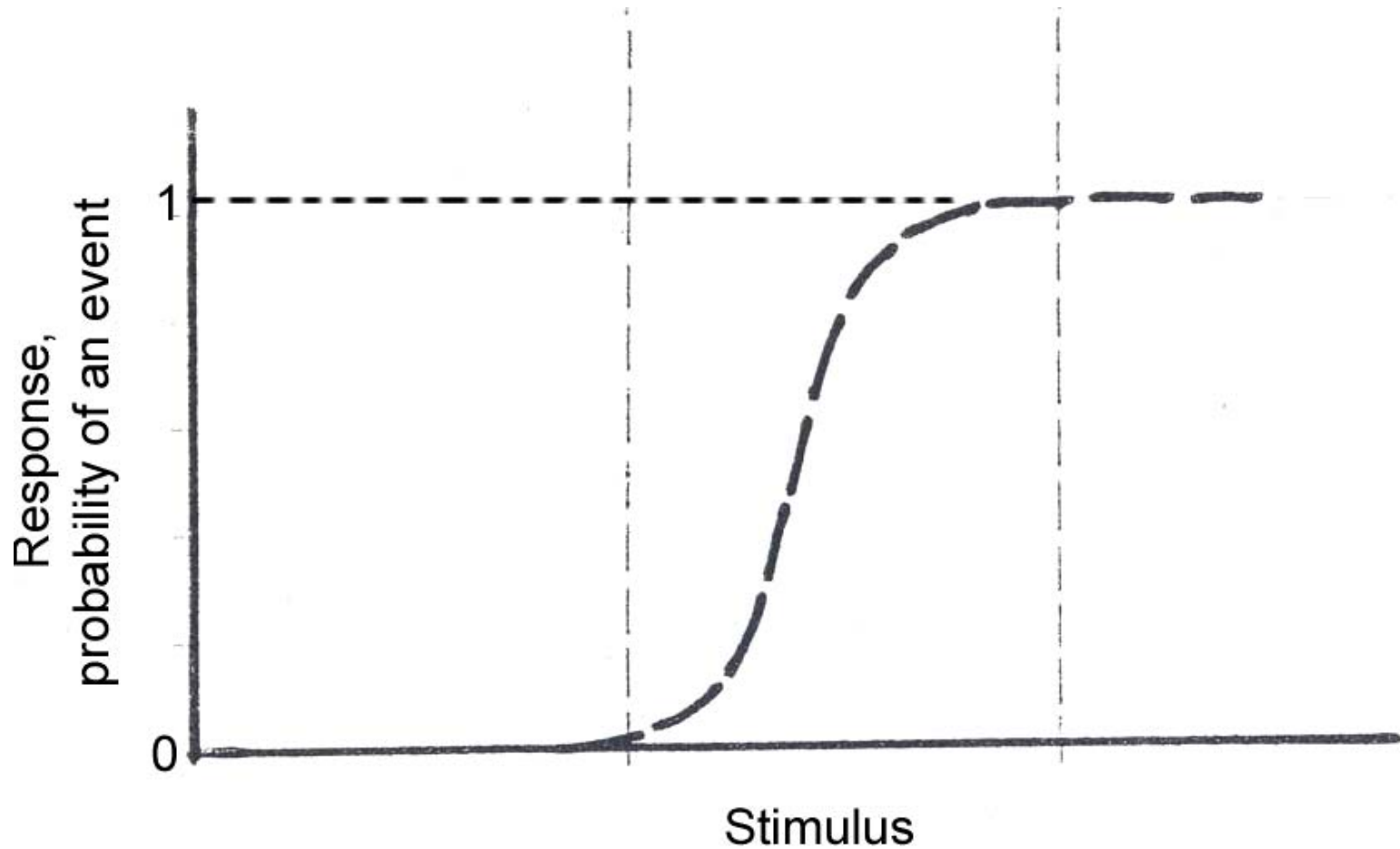
Space System Environments



Air velocity magnitude contours at aft-forward mid-section of the U.S. Airlock Module; Courtesy: Son, C.H., et al, Integrated Computational Fluid Dynamics Ventilation Model for the International Space Station, SAE Technical Paper 2005-01-2794, Society of Automotive Engineers, 2005



Probability of an Event (i.e., Failure in a Test) for a Monotonic Phenomena





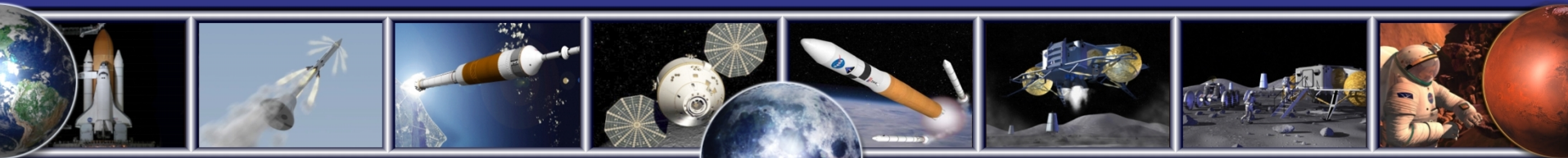
- 1-g Constellation materials flammability qualification tests conducted at NASA WSTF determine the oxygen concentration flammability extinguishment limits
- NASA WSTF also conducted a series of tests to evaluate total pressure effects on the flammability threshold



Conclusions and Recommendations



- Likelihood of fire events with limited options for mission termination will increase with longer duration space missions
- Rigorous correlations between 1-g ground materials flammability qualification test data with data in ventilated microgravity environments of spacecraft will lead to realistic evaluations of proper fire safety factors and spacecraft fire risks.



Conclusions and Recommendations (cont'd)



- Understanding fire risks in transient spacecraft environments will allow flexibility in spacecraft design and operability.
- NASA White Sands Test Facility currently works with NASA Glenn Research Center on ground flammability test qualification data correlation with data in Lunar surface habitation environments.

