

NASA Microgravity Science
Fire and Post-Fire Response
Working Group

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Areas of Limited Knowledge

- Effectiveness of carbon dioxide extinguishers
- Rate of fire spread
- Rate of agent transport
- Adequacy of Russian foam extinguishers
- Types of fires experienced
- Small-to-large fire phenomena

Areas of Limited Knowledge(cont)

- NASA policy on agents
- Fire probabilities/risk assessments
- By-products and toxic hazards from fires
- Effects of partial gravity on extinguishment
- Escape mechanisms for crew

Research Topics

- Experimental Determination of Flow in Compartments
- CFD Representation of Flow in Compartments
- Digital Compartment Configuration Documentation
- Proposal of Fire Scenarios

Research Topics (cont)

- Characterization of Fire Event
- Develop Fire Response Concepts
- Agent Transport in Low Gravity
- Fire-Related Emissions
- Extinguishing Agent Performance in Low Gravity

Research Topics (cont)

- Agent Distribution
- Agent/Fire Interaction
- Post-Fire Sampling/Characterization
- Obscuration Mitigation

Experimental Determination of Flow in Compartments

- Critical element to fire characterization process
- Includes rack, module and inter-module compartments
- Must be obtained in microgravity and reduced gravity environments
- Scalar and momentum data
- General regions and local point sources

CFD Representation of Flow in Compartments

- Numerical equivalent of earlier project
- Interact with and refine each other

Digital Compartment Configuration Documentation

- Engineering data on compartment configurations, dimensions and components
- Operating conditions, fuel sources and states, other pertinent features
- Requested in digital format for integration into CFD and other codes

Proposal of Fire Scenarios

- Determine likely fire locations, size and fire growth/spread phenomena
- Includes smoldering, flaming conditions
- Sooting vs. non-sooting
- Including platform fault tree update

Characterization of Fire Event

- Experimental and numerical verification of fire conditions
- Includes investigation of fire growth/spread phenomena
- Recreate low gravity conditions on realistic scale

Develop Fire Response Concepts

- Assess current baseline systems
- Develop new technologies and approaches to mitigate fire events
- Based upon lessons learned from other program activities and data
- Broad range of opportunities
 - Both passive and active fire mitigation
 - Fire isolation and containment
 - Depressurization and agent discharge

Agent Transport in Low Gravity

- Characterization of transport phenomena from discharge outlets to the fire site
- Includes gaseous and mixed-phase agents
- Experimental and numerical studies

Fire-Related Emissions

- By-products from fire event (including extinguishment)
- Includes fuel and suppressant decomposition
- Including human exposure (toxicity)

Extinguishing Agent Performance in Low Gravity

- Gas phase, liquid/mixed phase and powders
- Efficiency, sustainment of extinguishment, breadth of fire scenarios addressed

Agent Distribution

- Fixed and portable systems
- Optimizing flow rates, transport behavior and states upon discharge
- Includes centralized vs. distributed release sites
- Local application/flood application

Agent/Fire Interaction

- Interaction of suppressant into combustion zone
- Diffusion and other issues addressed
- Unique low gravity-related phenomena

Post-Fire Sampling/Characterization

- Develop means of determining point of safe entry into fire zone
- Includes determination of precise “fire out” condition
- Improved atmospheric sampling technologies and diagnostics

Obscuration Mitigation

- Re-establishment of compartment conditions for visual recognition and function
- Develop data for health-hazard community
- Crew equipment to accommodate obscured environment