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John H. Glenn Research Center

Workshop on

Research Needs in Fire Safety for the Human Exploration and Utilization of Space

Hosted by

NASA John H. Glenn Research Center
and the
National Center for Microgravity Research in Fluids and Combustion

Sheraton Airport Hotel
Cleveland, Ohio
June 25 - 26, 2001

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Background

- **Last Spacecraft Fire Safety Workshop was held August 20-21, 1986**

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Background

- **Last Spacecraft Fire Safety Workshop was held August 20-21, 1986**
  - Challenger accident 8 months earlier
  - Space Station designs underway
- **107 people, 5 break-out forums**
  - Fire detection and ignition
  - Fire extinguishment
  - Human responses to combustion products and inert atmospheres
  - Spacecraft materials and configurations
  - Selection of spacecraft atmospheres
- **Objectives**
  - Review current knowledge in fire safety
  - Assess the needs relevant to spacecraft

- **Microgravity combustion research conducted since 1986 has impacted fire safety practices on STS and ISS**

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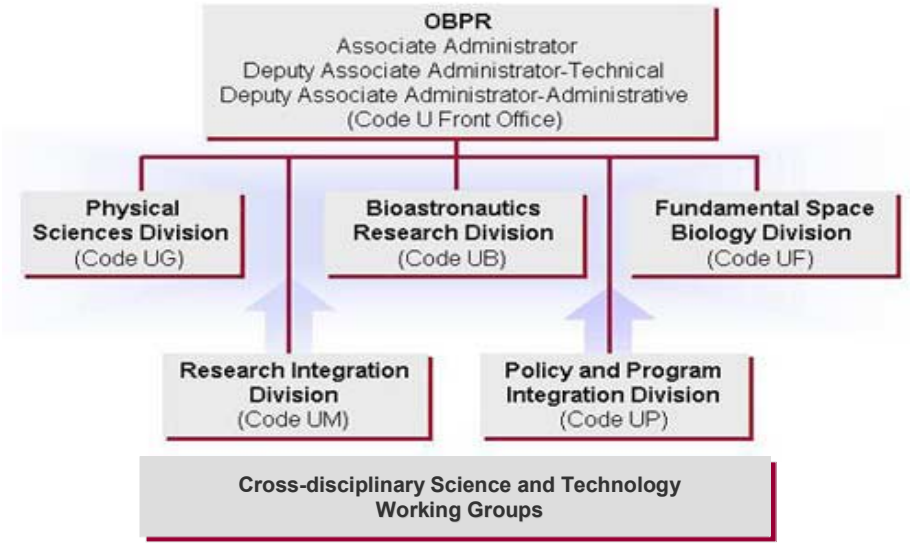
Office of Biological and Physical Research



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Bioastronautics Initiative - History

- **In mid-1999, the Space and Life Sciences Directorate at Johnson Space Center was challenged to develop a new paradigm for NASA human life sciences**
  - Space Medicine
  - Space Biomedical Research and Countermeasures
  - Advanced Human Support Technology
- **A new thrust - *Bioastronautics* - was formulated with a budget augmentation request**
- **Objective:**
  - Expanded extramural community participation through the National Space Biomedical Research Institute
  - Initiated the detailed planning and implementation of Bioastronautics
    - *An Integrated Approach to Ensure Healthy and Safe Human Space Travel*
    - *Assist in the Solution of Earth-based Problems*

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Bioastronautics Initiative

- **Builds upon previous and ongoing work**
  - A significant amount of fundamental knowledge has been created through ground and flight research
  - Apply this knowledge base to applications and solutions which will provide safer human operations in space
- **Utilizes new research resources**
  - ISS/STS research opportunities
  - Ground analogs
- **Leverages new and unique capabilities**
  - Scientific community to focus on NASA issues
  - Transfer knowledge to Earth based problems
  - Cooperate with other Federal Agencies
  - Develop new technologies
    - smart medical systems
    - biologically-inspired technologies
    - fire protection

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NASA Bioastronautics Initiative – Combustion Science

- **Substantially improve spacecraft fire safety within six years**
  - $1M per year for four years (initial funding level)
  - Grant-based through NRAs and directed research
- **Fire safety practices and procedures**
  - ISS and Shuttle operations
  - Prolonged human-crew missions in Earth orbit and beyond
  - Lunar and/or Martian habitats
    - In-situ resource utilization
    - Propellant manufacture and storage

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Workshop Objectives

- **Identify research needed for fire safety of STS, ISS and their payloads**
- **Identify fire safety concerns for prolonged human-crew missions in Earth orbit and beyond**
- **Anticipate research for future Lunar/Martian habitats**

Approach

- **Plenary session to overview current operations and issues in fire protection in space**
- **Working groups to review current research and identify needs in the areas of**
  - Fire prevention and material flammability
  - Smoke and fire detection
  - Fire and post-fire response

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Plenary Speakers

- **Dennis Griffin**
  - Group Leader, Chemistry Group
    Materials, Processes, and Manufacturing Department
    NASA Marshall Space Flight Center
- **Michael D. Pedley**
  - ISS Materials and Processes Manager
    NASA Johnson Space Center
- **Alana A. Whitaker**
  - ISS Environmental Control and Life Support Systems
    Fire Detection and Suppression Department
    NASA Johnson Space Center
- **Dale E. Lueck**
  - Systems Engineering and Analysis Branch
    Spaceport Engineering and Technology
    NASA Kennedy Space Center

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Working Groups

- **Fire Prevention and Material Flammability (O'Hare Room)**
  - James T'ien, Case Western Reserve University
  - Dennis Griffin, NASA Marshall Space Flight Center
- **Smoke and Fire Detection (Dulles Room)**
  - David L. Urban, NASA Glenn Research Center
  - Thomas Cleary, National Institute of Standards and Technology
- **Fire and Post-Fire Response (Hartsfield Room)**
  - Robert Friedman, NASA Glenn Research Center
  - J. Michael Bennett, Wright-Patterson Air Force Base
- **Sessions will begin with introductions and short presentations of current research**
  - Begin discussions of mission-driven fire protection systems within these areas
  - Recognize current knowledge and identify unknowns
  - Define research needed to fill gaps
  - Prioritize by short and long term, if applicable

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Schedule

Monday, June 25

Event	7:00 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:15 AM	10:45 AM
Plenary (Grand Ballroom)	Registration/ Continental Breakfast (Grand Ballroom)	**Welcome** Ruff, Ostrach	**Materials Testing and Certification** Griffin NASA MSFC	**Spacecraft Fire Safety: A Human Space Flight Program Perspective** Pedley NASA JSC	**ISS Fire Protection and the ECLSS System** Whitaker NASA JSC	Break (Grand Ballroom)	**In-Situ Propellant Manufacture and Storage** Lueck NASA KSC	**Charge to Working Groups** Ruff
	11:00 AM	12:00 PM	1:30 PM	3:30 PM	4:00 PM	6:00 PM	6:30 PM	
Fire Prevention and Material Flammability (O'Hare Room)	**Moderators: T'ien, Griffin** Presentations: Torero, Fernandez-Pello Olson	Lunch (Lambert Room)	**Working Session**	Break (Grand Ballroom)	**Working Session**	Cash Bar (Lambert Room)	Dinner (Lambert Room)	
Smoke and Fire Detection (Dulles Room)	**Moderators: Urban, Cleary** Presentations: Urban, Hunter, Young		**Working Session**		**Working Session**			
Fire and Post-Fire Response (Hartsfield Room)	**Moderators: Friedman, Bennett** Presentations: Ross, Takahashi, Abbud-Madrid		**Working Session**		**Working Session**			

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Schedule

Tuesday, June 26

Event	7:00 AM	8:00 AM	9:00 AM	9:45 AM	10:30 AM	10:45 AM	11:30 AM	11:45 AM
Plenary (Grand Ballroom)	Continental Breakfast (Grand Ballroom)		Fire Prevention and Materials Summary	Smoke and Fire Detection Summary	Break (Grand Ballroom)	Fire and Post-Fire Summary	**Closing** Ruff	Lunch/Completion of Written Summaries (Working Group Leaders) (Lounge)
Fire Prevention and Material Flammability (O'Hare Room)		Working Session Wrap-up						
Smoke and Fire Detection (Dulles Room)		Working Session Wrap-up						
Fire and Post-Fire Response (Hartsfield Room)		Working Session Wrap-up						

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Summary Presentations

General Topic

- **Current level of understanding**
- **Desired improvement or level of knowledge required**
  - If possible,
  - Near-term
  - Long-term
- **Recommendations for research within this topic**

- **Other Considerations**
  - Enabling technologies
  - Impact on current procedures or future designs
  - Technology transfer/technology teaming opportunities
  - Who is the User?
    - Desired format

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Written Report

- **Introduction**
  - Conduct of the group
  - Decision/discussion process

- **Current Technology Issues**
  - Issue 1
    - Knowns and unknowns
  - Issue 2

- **Research Areas**
  - Major Areas
    - Near-term
    - Mid-term
  - Enabling technologies
  - Technology teaming possibilities
  - Format of information desired by user