

Session 5 Summary: Mission Duration: Quantifying the Risks (1 of 2)

- **Duration of Mission is Primary Factor in Risk Management**
 - Mission knowledge beyond six months is limited
 - Public acceptance of mission risk – risk/benefit relationship
- **Acute and Long-Term Physiological Effects from Radiation**
 - Carcinogenesis, chronic & degenerative tissue risks, acute radiation sickness, and acute and late central nervous system risk from primary GCR and secondary particles (vehicle materials, etc.)
 - Galactic Cosmic Rays (GCRs) – shielding options limited (water/hydrogen shielding?)
 - Exposure standard – 3% risk of radiation exposure induced death (REID) at 95% confidence (standard subject to change)
 - Current approximate mission duration limits – 5/7 months (males) & 3/6 months (females) – solar min/max
 - Reducing biological uncertainties *may* significantly extend mission duration or increase in permissible REID
 - Solar Particle Events (SPEs) – shielding easier than GCR
 - Accurate event alert and response is essential for crew safety
 - Storm sheltering results in increased mission mass – major impact is only to EVA opportunities
- **Behavioral Health Support**
 - Stress management
 - Missing Earth (a.k.a. “Pale Blue Dot” problem)
 - No real time communications with family and supporting individuals and impact of events back on Earth (personal and global)
 - Activity to keep the crew engage and productive during transit periods (high stress, short duration activity at NEO)
- **Micro-gravity**
 - Visual Impairment/Increased Intracranial Pressure
 - In- and post-flight changes in vision and anatomy; underlying cause(s) currently unknown
 - Bone mineral density loss, muscle atrophy, cardiovascular atrophy – can be mitigated with adequate exercise if resources are available

Session 5 Summary: Mission Duration: Quantifying the Risks (2 of 2)

- **Habitation & Life Support**
 - Extended confinement in relatively small volumes (standards required) – segmentation, privacy , and personal space is essential
 - Aesthetics of living environment and other factors (e.g., acoustic environment, odors, plants, etc.)
 - Major improvement in reliability of life support system (closed or nearly closed)
- **Human Factors and Group Interactions**
 - Personal hygiene, clothing, food preparation
 - Workload and recreational opportunities
 - Crew selection criteria (modifications needed?)
 - Leadership and proper team composition (male/female mix, multi-national)
 - Remote monitoring of human performance and adjustments and relation with mission control operators
- **Medical Support & Abort Options**
 - Limited abort capability requires sufficient onboard medical capabilities
- **Logistics and Consumables Management**
 - Acceptable, stable food and trash/waste handling; volume requirements; serviceability and adequate spares
- **EVA Approach & Support (risk important by not directly dependant on total mission duration)**
 - Exposure to dust, volatiles, sharp edges, etc.; uncertainties in anchoring techniques
 - Suit integrity and risk of decompression sickness
- **Impact of Space Environment on Materials and Electronics**
 - Radiation effects have to be accounted for (e.g, data corruption, system shutdown, etc.)
 - Micrometeoroid impacts can result in damage to spacecraft and possible decompression (low probability)
- **Synergistic Effects**
 - Stress/radiation effects on brain and endocrine system and subsequent physiological/psychological effects
 - Environmental monotony + social monotony + communications delay + confined space + long duration abort