



NCRP Review of NASA Radiation Operations

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Astronaut Training on Radiation Issues and Operations

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NCRP Review Items for Training

- Types of Radiation Training
- Training Organization
- Topics of General Knowledge Training
- Procedure Writing and Validation
- Training Schedule
- CHeCs Hardware
- Mission Specific Training

Types of Astronaut Training for Radiation

- General Knowledge of radiation issues
- Generic Flight/Operational Training
 - Shuttle
 - ISS
- Mission-Specific Training
 - Special hazards
 - Payload/Hardware driven
- Updates of Important Issues

Training Organization

- Training for Crewmembers - Mission Operations Directorate, Space Flight Training Division (DT)
- Medical Topic Training by Medical Operations (SD) Training Group integrated with DT
- Training Teams composed of Flight Surgeon (Crew Surgeon assigned to Mission), Biomedical Engineer (Mission Support Contractor), Discipline Expert (for Radiation Issues- from SRAG, RHO)
- Input for Training from Radiation Operations Team
- Radiation IPT provides requirements to Ops Team

General Knowledge Training

- Radiation Component of Medical Briefings
 - Shuttle
 - Medical 3101
 - Medical 3101 EDO
 - ISS
 - ISS Space Medicine Briefing and Study Guide
 - Environmental Health System: Radiation Risks
- Radiation Topic Briefings to Astronaut Office
 - Aviation Safety Meeting

Gen Knowledge:

Medical 3101 Topics

- Amount of exposure based on orbital altitude/inclination
- Astronauts are considered radiation workers - biologic effects as basis for exposure limitations (e.g. 3% excess cancer mortality for career limits)
- Predicted mission exposure vs legal limits
 - +/- EVA activity
- Crew limits (30 day); (annual) (career) quantitative, relative to terrestrial
- Monitoring
 - Stowed active (high rate) dosimeter Readings made by crew and called to crew surgeon in the case of solar or artificial events.
 - Passive dosimeters Required for each crewmember, in vehicle, and in EVA cooling suits.
- Significance of perceived light flashes

Gen Knowledge:

ISS EHS- Radiation Risks Topics

- Radiation Sources
 - Trapped, GCR, Solar
- Radiation Risk and Exposure Limits
 - NCRP recommendations, cancer mortality
- Radiation Interactions
 - Quality factors, dose equivalence, biodosimetry
- Radiation Environment
 - SPE, Geomagnetic Storms, Altitude/Inclination
- References
- Glossary of Radiation Terms

Generic Operations Oriented Training

- Shuttle
 - Refresher: Medical 4101
- ISS
 - ISS Space Medicine Overview
 - ISS Space Med Overview SS
 - EHS Radiation Operations
 - EHS Radiation Operations SS
 - ISS Medical Refresher

In-Flight Procedures

- Written by Radiation Ops team- SRAG, FS and Biomedical Engineer
- Procedures are Validated with flight hardware in operational environment simulator (Bldg. 9- Shuttle, ISS mock-ups)
- Reviewed by several CB office representatives (Not necessarily flown crew)
- Must follow FDF format

Training Duration and Schedule

- **Space Shuttle Crews:**

Medical Procedures 3101A	L-19 weeks	Entire Crew	3.0 hrs
Medical Procedures 4101	L-10 days	Entire Crew	1.0 hrs

- **ISS Crews:**

ISS Space Medicine Overview	L-18 months	Entire Crew	0.5 hrs
ISS Space Med Overview SS	L-18 months	Entire Crew	0.2 hrs
EHS Radiation Operations	L-12 months	Entire Crew	1.0 hrs
EHS Radiation Operations SS	L-12 months	Entire Crew	0.5 hrs
ISS Medical Refresher	L-2 weeks	Entire Crew	1.0 hrs

CHeCS Hardware

(Crew Health Care System)

- HMS (Health Maintenance System)
 - Diagnostic Equipment
 - Medical Kits, etc.
- CMS (Countermeasures System)
 - Treadmill, Ergometer, RED
 - LBNP, Penguin Suits, etc.
- EHS (Environmental Health System)
 - Microbiologic, Air and Water Quality Monitoring
 - Radiation Monitoring

Mission Specific Briefings/Training

- Operational
 - deployment of radiation hardware (may be one time, specific for a flight or increment)
- Payloads
 - may require long duration EVA's (e.g. with passes thru SAA) or high altitude rendezvous, deployment
 - may have radioactive source onboard (poss. specific FR's)
- Education-Exposures higher for specific missions:
 - High Altitude
 - High Inclination
 - Long Duration
 - Interplanetary

Mission Specific- ISS Radiation Operational Training

- EHS: Radiation Operations- Increment 1
- EHS: Radiation Operations- Increment 2
- EHS: Radiation Operations- Increment 3
- EHS: Radiation Operations- Increment 4

Important Issues Updates

- Flight Crew Operations Directors Meetings
- Astronaut Office Management Meetings
- Aviation Safety Meetings
- Crew(CB office) Weekly information tag-ups

Examples: Aerospace Safety Advisory Panel Response Brief
Revisions of dose estimation based on improved data
Deltas to hardware implementation plan

Summary

Crew Training on Radiation Topics:

- Comprehensive
- Systematic
 - Multiple disciplines contribute
 - Generic and Mission Specific
 - General and Operationally-focused topics
- Reviewed periodically/revised appropriately
- Mechanisms for Updates on Important Topics