3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title:	MR004L In-flight Radiation Monitoring with Dosimeters
Sponsor:	Medical Operations
Discipline:	Radiation
Category:	Medical Requirements
References:	SSP 50260 ISS Medical Operations Requirement Document SSP 50667 Med Vol B, Preflight, In-flight, Postflight Medical Evaluation Document Requirements for Long Duration Crewmembers
Purpose/Objectives:	• To monitor and document crew exposure to radiation and to maintain crew exposures "as low as reasonable achievable". • To perform risk assessment.
Measurement Parameters:	Radiation exposure
Deliverables:	• Record of radiation doses used to document occupational exposure. • Area dosimeters provide spacecraft location-specific information. • High Rate Dosimeters (HRDs) will provide data during contingencies. • Doses from each mission and accumulated doses shall be used for health risk assessment are to be recorded in crewmembers' medical records.
Flight Duration:	≥30 days
Number of Flights:	All flights
Number and Type of Crew Members Required:	ISS crewmembers (Primary and backup will be trained), Shuttle crewmembers that are scheduled operators for dosimetry activities.
Other Flight Characteristics:	N/A

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

<table>
<tr><td>Preflight Training Activity
Description:</td><td colspan="5">Training will be covered in the following Environmental Health System (EHS) lessons and documents:
(ISS):
EHS Radiation Operations

(Shuttle):
Dosimeter Deployment –Shuttle crewmembers that are scheduled operators for dosimetry activities.
These sessions will familiarize the crew with the dosimeters. Use and deployment will be discussed.</td></tr>
<tr><td rowspan="3">Schedule:</td><td colspan="2">Duration:</td><td>Schedule:</td><td>Flexibility:</td><td>Personnel Required:</td></tr>
<tr><td colspan="2">EHS Radiation Operations 90 min</td><td>L-12 months</td><td>N/A</td><td>ECLSS Crew/Instructors</td></tr>
<tr><td colspan="2">Training for Shuttle Crew
Dosimeter Deployment 60 min</td><td>L-3 months</td><td>N/A</td><td>Shuttle operator</td></tr>
<tr><td rowspan="2">Ground Support Requirements Hardware/Software</td><td colspan="2">Preflight Hardware:</td><td>Preflight Software:</td><td colspan="2">Test Location:</td></tr>
<tr><td colspan="2">Passive Dosimetry System (PDS) includes:
Crew Passive Dosimeters (CPDs)
Radiation Area Monitors (RAMs)
High Rate Dosimeters (HRDs)</td><td>N/A</td><td colspan="2">U.S.</td></tr>
<tr><td rowspan="4">Training Facilities</td><td>Minimum Room Dimensions:</td><td>Number of Electrical Outlets:</td><td>Temperature Requirements:</td><td colspan="2">Special Lighting:</td></tr>
<tr><td>Conference Room</td><td>N/A</td><td>Ambient</td><td colspan="2">N/A</td></tr>
<tr><td>Hot or Cold Running Water:</td><td>Privacy Requirements:</td><td colspan="3">Other:</td></tr>
<tr><td>N/A</td><td>N/A</td><td colspan="3">Overhead projector, access to Shuttle and ISS mockups</td></tr>
<tr><td>Constraints/Special Requirements:</td><td colspan="5">A Shuttle or Station (Soyuz) crewmembers will be trained to install/deploy and retrieve RAMs during scheduled docked phases with ISS (every crew rotation).</td></tr>
<tr><td>Launch Delay Requirements:</td><td colspan="5">Training will be repeated if requested by the crewmember. If a launch delay of more than 45 days occurs, the dosimeters will require reprocessing.</td></tr>
<tr><td>Notes:</td><td colspan="5">None</td></tr>
</table>

3.4 Preflight Activities

Preflight Activity	No crew activities			
Description:	**Duration:**	**Schedule:**	**Flexibility:**	**Personnel Required:**
Schedule:	N/A	N/A	N/A	N/A
Ground Support Requirements Hardware/Software	**Preflight Hardware:**	**Preflight Software:**	**Test Location:**	
	N/A	N/A	N/A	
Constraints/Special Requirements:	When transporting hardware to launch location, hardware should not be x-rayed or stowed/shipped with radioactive material.			
Notes:	N/A			
Data Delivery	**Data/Report to Designated Recipients (Nominal/Contingency):**	**Mission Summary Report:**		
	None	None		

3.5 In-Flight Activities

TABLE 3.5.1: IN-FLIGHT ACTIVITIES

In-Flight Activity

Description:

The Crew Passive Dosimeters (CPDs) are preintegrated into the Launch and Entry Suit (LES or ACES, Soyuz launch location is TBD) prior to launch. Once on orbit, crewmember removes the CPDs during the LES Stow. Each crewmember is required to carry his/her CPD continuously, including during EVAs. Prior to descent, crewmembers are to stow the CPDs back in the LES where they will be recovered at landing.

Radiation Area Monitors (RAMs) are deployed at designated locations on ISS during the docked phase. The deployment location is identified and the dosimeter placed in that location. After the initial flight, the RAMs will be exchanged 1 for 1. The dosimeters are color-coded and carry a mission identifier. After all of the dosimeters have been collected that are to be returned, they will be transferred to the Shuttle or Soyuz for stowage.

A set of 2 High Rate Dosimeters (HRDs) will be exchanged at each scheduled Station rotation (approximately twice per year) after initial flight. The exchange is one for one. Radiation monitoring will be performed in a contingency situation using the HRDs. The HRDs will be read in the event of a contingency and called down when communication is available.

Schedule:

Activity:	Duration:	Schedule:	Flexibility:	Personnel Required:
Ascent: Radiation monitoring (personal)	Continuous monitoring	Continuous monitoring	N/A	All U.S. crewmembers
On-Orbit: Remove dosimeter from LES during LES stow	1 min	At LES stow	N/A	All U.S. crewmembers
RAMs– deploy/exchange on ISS	60 min for 6 to 18 dosimeters	Every crew rotation flight where the majority of the ISS Crew is changing (see constraints below), during scheduled Shuttle and/or Soyuz docked operations	N/A	Shuttle or ISS Crew
HRD	As needed	Contingency	N/A	1 Crewmember
Photo of RAM deployment	45 min for 6 to 18 dosimeters	Once every crew deployment	N/A	1 Crewmember

Procedures:	Procedures for HRD can be found in the SODF: HRD Contingency Procedures for RAM deployment can be found in the SODF: Radiation Area Monitor Dosimeters – Installation of Dosimeter for ISS
Constraints / Special Requirements:	Scrub turnaround = If a launch delay of more than 45 days occurs, the dosimeters will require reprocessing. Each crewmember will be supplied with a personal dosimeter for continuous use for every mission. Dosimeters shall be worn during EVAs. RAM exchanges will not be required when only 1 crewmember is changing (e.g. 1 CM straddling two increments) RAM dosimeters will be deployed to designated locations during scheduled docked phases. For new deployment sites, the crew will deploy the restraining hardware/site markers. HRDs are also contained within the Passive Dosimetry System Kit. These are stored on ISS as a set. HRDs are self-indicating pocket ion chambers measuring radiation exposure. The HRDs will remain in their stowage location and will be read during radiation contingencies. No crewtime will be scheduled for HRDs.
Photo / TV Requirements:	Photos are required for each RAM deployment (once every crew rotation) to document: a.) The surroundings of each deploy location b.) Any changes that may have occurred since the last deployment (e.g. stowage configuration changes resulting in more or less shielding)
Cold Stowage Requirements:	N/A
Mission Extension Requirements:	N/A
Notes:	Resupply Requirements: At launch each crewmember will be supplied with a crew passive dosimeter (CPD) for continuous wear. Radiation Area Monitors (RAMs) and High Rate Dosimeters (HRDs) will be exchanged 1 for 1 during scheduled docked phases. Nominally, this will occur every crew rotation on a flight dependent schedule determined by the Space Radiation Analysis Group. HRDs will be exchanged in conjunction with the RAMs.
Landing Wave-Off Requirements:	N/A
Data Delivery	**Data/Report to Designated Recipients (Nominal/Contingency):**
	HRDs will be read in the event of a contingency situation and called down when comm is available. A final report containing analytical results of RAMs and CPDs will be delivered to the Radiation Health Officer (RHO) at R+45 days. The RHO will submit a mission final report 30 days thereafter to the Flight Surgeon and Medical Operations.

In-Flight Activities, (cont.)

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name	P/N
Crew Passive Dosimeter (CPD) – CPDs are not launched within the ISS Passive Dosimetry System, crew worn.	SEZ33111519-XXX
Passive Dosimetry System Kit	SEG46116951-XXX
- Ziploc Bag Radiation Area Monitors (RAMs)	SEZ33111519-XXX
- Pouch High Rate Dosimeter (HRD)	WLSF310018 SED33011167-XXX

3.6 Postflight Activities

TABLE 3.6: POSTFLIGHT ACTIVITIES - none

Postflight Activity Description:	CPDs are retrieved from crewmember on R+0 by the flight Crew Systems (FCS) suit technicians and forwarded to JSC SRAG for processing. Crewmembers returning via Soyuz will have their dosimeters returned via flight surgeons.			
Schedule:	**Duration:**	**Schedule:**	**Flexibility:**	**Personnel Required:**
	N/A	R+0	N/A	Flight Crew Systems suit technicians
Ground Support Requirements Hardware/Software	**Postflight Hardware:**	**Postflight Software:**	**Test Location:**	
	N/A	N/A	N/A	
Constraints/Special Requirements:	Upon the return of hardware, hardware should not be x-rayed or stowed/shipped with radioactive material.			
Early Destow / Early Return:	N/A			
Notes:	N/A			
Data Delivery	**Data/Report to Designated Recipients (Nominal/Contingency):**	**Mission Summary Report:**	**Data Archives:**	
	A final report containing analytical results of RAMs and CPDs will be delivered to the Radiation Health Officer (RHO) at R+45 days.	The RHO will submit a mission final report 30 days thereafter to the Flight Surgeon and Medical Operations.		

3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	FLEXIBILITY	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training					
EHS Radiation Operations	90 min	L-12 months	N/A	ECLSS Crew/ Instructors	None
Training for Shuttle Crew Dosimeter Deployment	60 min	L-3 months	N/A	Shuttle operator	None
Preflight – N/A					
In-Flight					
Ascent: Radiation monitoring (personal)	Continuous monitoring	Continuous monitoring	N/A	All U.S. Crewmembers	Continuous monitoring
On-Orbit: Remove dosimeter from LES during LES stow	1 min	At LES stow	N/A	All U.S. Crewmembers	Worn continuously during the mission. Must be worn during EVAs.
RAMS– deploy/exchange on ISS	60 min for 6 to 18 dosimeters	~Every crew rotation flight where the majority of the ISS Crew is changing (see constraints) during scheduled Shuttle and/or Soyuz docking	N/A	Shuttle or ISS Crew	RAM exchanges will not be required when only 1 crewmember is changing (e.g. 1 CM straddling two increments)
HRD	As needed	Contingency	N/A	1 Crewmember	None
Photo of RAM deployment	45 min for 6 to 18 dosimeters	Once every crew deployment	N/A	Crewmember	Photo should include surroundings of deployed location
Wheels-Stop – N/A					
Postflight – N/A					
Postflight Debrief – N/A					