

3.2 Medical Requirements Overview**TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW**

MRID# and Title:	MR004S In-Flight Radiation Monitoring with Passive Dosimeters
Sponsor:	Medical Operations
IPT:	Radiation
Category:	Medical Requirements (MR)
References:	Medical Operations Requirements Document (MORD) for Space Shuttle, Rev G Section 4.5– Radiation Safety
Purpose/Objectives:	To monitor and document crew exposure to radiation in compliance with Federal Regulations. Results from the radiation monitoring serve as the basis for postflight evaluation and documentation of individual cumulative risk from radiation exposure.
Measurement Parameters:	Radiation exposure (exposed dose)
Deliverables:	<p>A record of radiation exposure that will document occupational exposure from various dosimeters.</p> <ul style="list-style-type: none"> • Crew Passive Dosimeter (CPD) provides individual exposure information • Passive Radiation Dosimeter (PRD) provides spacecraft location-specific information. • Pocket Ion Chambers all provide a means to perform onboard evaluation of exposures during contingencies, and are located in the Radiation Dosimeter Assembly (RDA) pouch. These include: <ul style="list-style-type: none"> ❖ Pocket Dosimeter, Low (PDL) – scale range of 0-200 millirads ❖ Pocket Dosimeter, High (PDH) – scale range of 0-20 rads ❖ High Rate Dosimeter (HRD) – scale range of 0-600 rads ❖ Area Passive Dosimeter (APD) – contains different passive radiation sensitive materials that are used to make unique radiation measurements. The sensor material selected varies with each flight. It remains within the kit throughout each mission. <p>The Crew Passive Dosimeter measurements from each mission shall be used for health risk assessment and recorded in crewmembers' medical records.</p>
Flight Duration:	< 30 days
Number of Flights:	All Shuttle flights
Number and Type of Crew Members Required:	All Shuttle crewmembers
Other Flight Characteristics:	N/A

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity	Description: At L-10 days the crew is informed of all projected exposures, ranges for RDA components, as well as current and projected space weather conditions. The Space Radiation Analysis Group (SRAG) conducts a briefing on wearing the CPD and reading the pocket ion chambers.				
	Schedule:		Duration:	Personnel Required:	
	Radiation Familiarization 5 min		Provided during ASCAN training	ASCAN/Trainers	
	Medical Refresher 4101 15 min		L-10 days	Shuttle Crew/Trainers	
Ground Support Requirements Hardware/Software	Preflight Hardware:		Preflight Software:	Test Location:	
	Crew Passive Dosimeter (CPD) Passive Radiation Dosimeter (PRD) Radiation Dosimeter Assembly (RDA) Pouch which contains: Pocket Dosimeter, Low (PDL) Pocket Dosimeter, High (PDH) High Rate Dosimeter (HRD) Area Passive Dosimeter (APD)		N/A	U.S.	
Training Facilities	Minimum Room Dimensions:		Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:
	8' x 10'		None	Ambient	N/A
	Hot or Cold Running Water:		Privacy Requirements:	Other:	
	N/A		N/A	1 table, enough chairs to accommodate crewmembers	
Constraints/Special Requirements:	None				
Launch Delay Requirements:	Refresher training will be provided if requested by crewmember.				
Notes:	None				

3.4 Preflight Activities

TABLE 3.4: PREFLIGHT ACTIVITIES – No Preflight Activities

Preflight Activity	Description:	N/A			
		Duration:	Schedule:	Flexibility:	Personnel Required:
		N/A	N/A	N/A	N/A
Constraints/Special Requirements:	N/A				
Launch Delay Requirements:	If the launch is delayed >45 days, all dosimetry may need to be re-supplied. The Space Radiation Analysis Group (SRAG) should be consulted prior to hardware manifest changes.				
Notes:	At 45 days prior to launch an evaluation by SRAG will be performed to determine whether to replace the dosimeters or allow them to remain. This decision point is addressed in document JSC 17763 Space Shuttle Program Launch Delay Action Requirements Document.				
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):				
	N/A				

3.5 In-Flight Activities

TABLE 3.5.1: IN-FLIGHT ACTIVITIES

In-Flight Activity	Description:	The Crew Passive Dosimeters (CPD) are preintegrated into the Launch and Entry Suit (LES) prior to launch. Once on orbit, crewmembers shall remove the CPD from their LES and transfer it to their on-orbit clothes. Each crewmember is required to carry/wear their CPD continuously, including during EVAs. Prior to re-entry, crewmembers are to stow the CPD back into the LES where they will be recovered at landing. In the event of a contingency, dosimeters (PDL, PDH, HRD) will be available for real-time readings that will be called-down per ground instruction.			
	Schedule:	Activity	Duration	Schedule	Personnel Required
		Personal radiation monitoring using Crew Passive Dosimeter (CPD) – transferred from LES (ascent), to flight suit (on-orbit), to LES (descent).	Continuous monitoring Crew worn dosimeter - 5 min. transfer time	Continuous monitoring during ascent, on-orbit, EVA, descent	Shuttle Crewmembers
		Area radiation monitoring using Passive Radiation Dosimeter (PRD)	Continuous monitoring No crew time	Continuous monitoring	None
		Area monitoring using Area Passive Dosimeter (APD) – remains in RDA Pouch throughout mission.	Continuous monitoring No crew time	Continuous monitoring	None
	Pocket Dosimeters, Low (PDL) Pocket Dosimeters, High (PDH) High Rate Dosimeters (HRD)	As needed	Contingency – to be retrieved from RDA Pouch and read when directed by ground in contingency situations (solar event, etc.)	1 Operator	
Procedures:	Procedure for dosimeter (CPD) transfer for EVA is documented in the EVA Checklist.				
Constraints / Special Requirements:	Scrub turnaround = 45 days CPD - Each crewmember will be supplied with a personal dosimeter (CPD) for continuous wear, even during EVAs. PRD – will be deployed prelaunch in fixed locations inside crew compartments. RDA Pouch – will contain the APD, PDL, PDH, and HRD, and shall be readily available to the crew to support radiation enhancement monitoring.				
Photo / TV Requirements:	N/A				
Notes:	Space environmental monitoring shall be performed from L-3 days through EOM. SRAG will immediately notify the Radiation Health Officer & flight surgeon of conditions that have the potential to increase crew exposure above nominal levels, and will provide recommendations to manage crew’s exposure in accordance with federal regulations, including the ALARA (As Low As Reasonably Achievable) concept.				
Mission Extension Requirements:	The CPD continues to remain with the crewmember at all times.				
Landing Wave-Off Requirements:	See above				
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):				
	N/A				

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name	P/N	Shuttle Location	Vehicle (Up/Dn)	Category	Late Access / Early Return	Flight Ops	Weights (kg)	Volume (cm ³)	Dimensions LxWxH (cm)	Power (watts)	Resupply	Download / Downlink
Crew Passive Dosimeter (CPD)	SEZ33111519-XXX	Crew Worn	Shuttle	N/A	L-2 days/ R+48 hrs	Yes	0.021	31.6	5.5 x 3.0 x 0.5	N/A	None	N/A
Passive Radiation Dosimeter (PRD)	SEZ3111519-XXX	Fixed locations inside crew compartment	Shuttle	N/A	L-5 days/ R+48 hrs	Deployed prelaunch	0.0085	8.25	5.5 x 3.0 x 0.5	N/A	None	N/A
Radiation Dosimeter Assemble (RDA) Pouch	SED33103036-XXX	Middeck locker w/SOMS Kit	Shuttle	N/A	L-5 days/ R+48 hrs	N/A	0.13	2805	17 x 16.5 x 10	N/A	None	N/A
Area Passive Dosimeter (APD)	SED11100213-XXX	Middeck locker w/SOMS Kit (in RDA Pouch)	Shuttle	N/A	L-5 days/ R+48 hrs	Ground direction only	0.137	530	10 x 10 x 5.3	N/A	None	N/A
High Rate Dosimeter (HRD)	SED33101167-XXX	Middeck locker w/SOMS Kit (in RDA Pouch)	Shuttle	N/A	L-5 days/ R+48 hrs	Ground direction only	0.055	22	12.5 x 1.5Ø	N/A	None	N/A
Pocket Dosimeter, Low (PDL)	SED33101167-XXX	Middeck locker w/SOMS Kit (in RDA Pouch)	Shuttle	N/A	L-5 days/ R+48 hrs	Ground direction only	0.0165	19	10.8 x 1.5Ø	N/A	None	N/A
Pocket Dosimeter, High (PDH)	SED33101167-XXX	Middeck locker w/SOMS Kit (in RDA Pouch)	Shuttle	N/A	L-5 days/ R+48 hrs	Ground direction only	0.035	17	11.3 x 1.4Ø	N/A	None	N/A

3.6 Postflight Activities

TABLE 3.6: POSTFLIGHT ACTIVITIES – Retrieval of Dosimeters & Data delivery

Postflight Activity	Description:	CPDs are retrieved from the crewmembers on R+0 by the Flight Crew Systems (FCS) suit technicians and forwarded to JSC Space Radiation Analysis Group (SRAG) for processing. PRD and the RDA pouch are also collected for postflight analysis. All dosimeters will be retrieved within 48 hours of landing.			
	Schedule:	Duration:	Schedule:	Flexibility:	Personnel Required:
		N/A	N/A	N/A	FCS suit technicians
Ground Support Requirements Hardware/Software	Postflight Hardware:	Postflight Software:		Test Location:	
	N/A	N/A		N/A	
Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):			Data Archives:	
	A final report containing analytical results of PRD and CPD will be delivered to the Space Radiation Health Officer (SRHO) within 35 days of dosimeter receipt. Consultation between flight surgeon and SRAG will be performed as needed.			<p>- The SRHO will submit a mission final report 30 days thereafter to the flight surgeon and Medical Operations. Copies of the report without crew measurements are provided to the Astronaut Office and the Shuttle GFE office.</p> <p>- A report containing crew radiation exposures will be distributed to the individual crewmembers’ medical records and the mission-specific medical record.</p>	

3.7 Summary Schedule**TABLE 3.7: SUMMARY SCHEDULE**

ACTIVITY	DURATION	SCHEDULE	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training				
Radiation Familiarization	5 min	Provided during ASCAN training	ASCAN/Trainers	None
Medical Refresher 4101	15 min	L-10 days	Shuttle Crew/Trainers	
Preflight – N/A				
In-Flight				
Personal radiation monitoring using Crew Passive Dosimeter	5 min. transfer time from LES to on-orbit clothes	Continuous monitoring during ascent, on-orbit, EVA, descent	Shuttle Crewmembers	Crew worn
Area radiation monitoring using Passive Radiation Dosimeter	No crew time	Continuous monitoring	None	Deployed prelaunch Located in fixed location inside crew compartment.
Area radiation monitoring using Area Passive Dosimeter	No crew time	Continuous monitoring	None	Remains in RDA Pouch throughout mission.
Contingency radiation monitoring using Pocket Ion Chambers	As needed	As needed	1 Operator	To be retrieved from RDA Pouch and read when directed by ground in contingency situations (solar event, etc.)
Wheels-Stop – N/A				
Postflight - N/A				
Postflight Debrief				
Debrief	No extra time	~R+30 days	Shuttle Crewmembers/ Radiation Team	Included as part of the Med Ops overall debrief