

MR0093 In-flight Radiation Monitoring with Intravehicular Tissue Equivalent Proportional Counter (IV-TEPC) for Long Duration Flights

3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title:	MR0093 In-flight Radiation Monitoring with Intravehicular Tissue Equivalent Proportional Counter (IV-TEPC) for Long Duration Flights
Sponsor:	Space and Clinical Operations
Discipline:	Radiation
Category:	Medical Requirements
References:	SSP 50260 ISS Medical Operations Requirements Document
Purpose/Objectives:	The purpose of the activity is to collect radiation environment data that will document crew exposure to radiation, perform risk assessment, and manage crew exposures during flight, especially during radiation contingencies. IV-TEPC collects the surrogate linear energy (y) data for the required linear energy transfer (LET) data and the absorbed dose. The Radiation Health Officer (RHO) will apply physical corrections to convert linear energy (y) spectra obtained with the IV-TEPC to LET –spectra for use in determining crew exposures. These corrections must account for the impact parameter distribution, energy straggling, delta-ray effects, and wall effects from both delta-rays and nuclear reactions.
Measurement Parameters:	Radiation exposures at the tissue-cell level y-spectra data.
Deliverables:	SRAG is responsible for archiving all cyclic telemetry, raw dumped data, and processed data of the IV-TEPC. The cyclic telemetry is stored on the SRAG SQL servers for operational usage and monitoring crew exposures. The processed data is archived on the SRAG internal website. Deliverables include characterization of the radiation environment for updating exposure records for occupational health risk assessments, real-time data for use during radiation contingencies, and onboard crew alarm for contingency radiation events. Elements of the processed data are included in a comprehensive report that is delivered to the NASA Radiation Health Officer (RHO) following a crewmember’s expedition. The archived data is also used for projecting crew mission exposure levels for future expedition flight readiness reviews.
Flight Duration:	≥ 30 days
Number of Flights:	All flights
Number and Type of Crew Members Required:	Designated crewmembers will be assigned as operators. All U.S. crewmembers’ medical records will be updated based on IV-TEPC data.
Other Flight Characteristics:	N/A

MR0093 In-flight Radiation Monitoring with Intravehicular Tissue Equivalent Proportional Counter (IV-TEPC) for Long Duration Flights

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity	Description:	Training will be covered in the following Environmental Health System (EHS) lessons and documents: EHS Radiation Operations		
	Schedule:	Training classes will introduce the EHS radiation hardware & procedures and review the radiation environment in space. The location and function of each piece of hardware is detailed. Hands on training will also be provided.		
		Long-duration crewmembers will be trained to initially deploy and to replace detectors on the IV-TEPC. Relocation procedures will be covered to provide an understanding of what is involved in the monthly relocate activities on ISS.		
		Duration:	Schedule:	Flexibility:
		EHS Radiation Operations 45 min.	NLT L-6 months	N/A
				Personnel Required:
				Crewmember/Instructors
Ground Support Requirements Hardware/Software	Preflight Hardware:	Preflight Software:		Test Location:
	Intravehicular Tissue Equivalent Proportional Counter (IV-TEPC)	IV-TEPC Software on SSC		U.S.
Training Facilities	Minimum Room Dimensions:	Number of Electrical Outlets:	Temperature Requirements:	Special Lighting:
	8' x 10'	2	Ambient	N/A
	Hot or Cold Running Water:	Privacy Requirements:	Other:	
	N/A	N/A	1 Table, 4-6 Chairs	
Constraints/Special Requirements:	N/A			
Launch Delay Requirements:	Training will be repeated if requested by the crewmember.			
Notes:	N/A			

3.4 Preflight Activities - None

MR0093 In-flight Radiation Monitoring with Intravehicular Tissue Equivalent Proportional Counter (IV-TEPC) for Long Duration Flights

3.5 In-Flight Activities

TABLE 3.5.1: IN-FLIGHT ACTIVITIES

In-Flight Activity	Description:	IV-TEPC will operate continuously to provide radiation measurements of tissue effective dose and dose equivalent. The IV-TEPC will be relocated periodically throughout the habitable modules of the station to analyze the internal radiation environment. Space Radiation Analysis Group (SRAG) will define a relocation plan to determine how long and at which locations the IV-TEPC will be deployed. Nominal deployment sites will be within the cable reach of the CHeCS Power/Data ports. Measured spectra will be telemetered approximately weekly on demand. There may be instances when SRAG defines a specific location that precludes access to a CHeCS Power/Data port, in which case real-time telemetry will not be available, but will either be telemetered the next time IV-TEPC is plugged into a CHeCS Power/Data port, or transferred to an SSC for downlink by the crew.			
	Schedule:	Linear Energy Transfer (LET) spectra data shall be used to provide an estimate of average quality factor for the mission.			
		Activity	Duration	Schedule	Personnel Required
		IV-TEPC Initial Deployment	40 min.	Crew will deploy once in orbit	1 ISS crewmember
	IV-TEPC Relocate	20-25 min. depending on new location	Once every 4 weeks +/-1 week	1 ISS crewmember	
Procedures:	All in-flight procedures are developed in-house and contained within the System Operations Data file (SODF) MedOps book. IV-TEPC Activation and Data Checkout IV-TEPC Alarm IV-TEPC Data Collection IV-TEC Power Down/Power Up IV-TEPC Data Transfer to SSC IV-TEPC Relocate (one-time use procedures for each module relocate)				
Constraints / Special Requirements:	Scrub turnaround = N/A IV-TEPC will be secured within the designated modules via Velcro or seat track interface. The IV-TEPC alarm is tied into the station caution and warning system (class 3 alarm). The IV-TEPC does not contain a local alarm. Deployment locations must not impede rapid egress or block access to any rack.				
Photo / TV Requirements:	Photos of IV-TEPC are required when IV-TEPC is relocated. Photos are necessary to document the position and orientation of the detector heads, surroundings of IV-TEPC, and to ensure the prime detector is not shielded more than expected.				
Cold Stowage Requirements:	N/A				
Mission Extension Requirements:	N/A				
Landing Wave-Off Requirements:	N/A				

MR0093 In-flight Radiation Monitoring with Intravehicular Tissue Equivalent Proportional Counter (IV-TEPC) for Long Duration Flights

Data Delivery	Data/Report to Designated Recipients (Nominal/Contingency):
<p>Notes</p>	<p><u>Cyclic Data (minute-by-minute data)</u>: This data will be obtained via the ISS S-Band telemetry resource. SRAG will use this data and provide weekly summary notes to the Crew Surgeon. This data will also be used to help make real-time risk management, operational decisions to meet the As Low As Reasonably Achievable (ALARA) principle for the protection of the crew from ionizing radiation during space weather events.</p> <p><u>IV-TEPC Dump Data</u>: Ground control will dump data from the IV-TEPC once per week. If the capability to command the IV-TEPC from MCC-H is lost, meaning data dumps cannot be performed, it is advisable that IV-TEPC data be transferred to the SSC approximately once per week to prevent data loss due to the possibility of new data recording over previous data.</p> <p><u>Instrument Health/Status Data</u>: The hardware sustaining organization will review and analyze the engineering data files, and provide a periodic summary of the IV-TEPC's health & status to SRAG. These status reports will not be forwarded to the Crew Surgeon nominally.</p> <p>SRAG is responsible for archiving all cyclic telemetry, raw dumped data, and processed data of the IV-TEPC. The cyclic telemetry is stored on the SRAG SQL servers for operational usage and monitoring crew exposures. The processed data is archived on the SRAG internal website. Elements of the processed data are included in a comprehensive report that is delivered to the NASA Radiation Health Officer (RHO) following a crewmember's expedition.</p>

MR0093 In-flight Radiation Monitoring with Intravehicular Tissue Equivalent Proportional Counter (IV-TEPC) for Long Duration Flights

In-Flight Activities, (cont.)

TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name
Intra-Vehicular Tissue Equivalent Proportional Counter (IV-TEPC) Assembly: Spectrometer Small Detector Large Detector Power Cable

3.6 Postflight Activities

TABLE 3.6: POSTFLIGHT ACTIVITIES

Postflight Activity	Description:	Submittal of final mission expedition report.
Constraints/Special Requirements:		N/A
Early Destow / Early Return:		N/A
Notes:		Crewmember radiation exposure from each mission and their accumulated radiation exposure will be recorded in crewmembers' medical records and will also be used for occupational health risk assessment.
Data Delivery		Elements of the processed data are included in a comprehensive report that is delivered to the NASA Radiation Health Officer (RHO) following a crewmember's expedition.
Mission Summary Report:		Approx. R+90 days
Data Archives:		Approx. R+90 days

MR0093 In-flight Radiation Monitoring with Intravehicular Tissue Equivalent Proportional Counter (IV-TEPC) for Long Duration Flights

3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training:				
EHS Radiation Operations	90 min.	NLT L-6 months	Crewmembers/Instructors	None
Preflight: N/A				
In-Flight Activity:				
IV-TEPC Initial Deployment	40 min.	Crew will deploy once in orbit	1 ISS crewmember	None
IV-TEPC Relocate with Photo-documentation	20-25 min. depending on whether RAM install is required	Once every 4 weeks +/-1 week	1 ISS crewmember	-Payload MDM (Multiplexer and De-multiplexer) is active. -New location must not impede rapid egress or block access to any rack.
Wheels-Stop: N/A				
Postflight:				
Final Mission Expedition Report		~R+90 days	Radiation Team	Report provided to Radiation Health Officer (RHO) to provide to crewmembers postflight.
Postflight Debrief:				
Debrief	No extra time	~R+30 days	Crewmembers/Radiation Team	Included as part of the Med Ops overall debrief.