

Radiation Team Mission Day Instructions

Overview

The health and safety of astronauts is always NASA's top priority. Outside of the earth's protective atmosphere, astronauts are exposed to the hostile environment of space. Because of the extended stay of the astronauts in the space station, radiation levels are constantly monitored.

You will receive real-time radiation exposure data from the Tissue Equivalent Proportional Counter (TEPC). There are two TEPCs on board the station, one that is stationary, located in the Destiny Module and a portable TEPC which the astronauts carry with them when radiation levels are a concern.

Mission Day Materials

- One computer for real-time data
- Radiation Reference Guide
- Mission Day Materials (one per team member):
 - o Mission Day Instructions
 - o Radiation Data Graphs and Instructions
 - o Radiation Data Tracking Tables

- 15 Blank Report Forms on colored paper to deliver to the Communications Team
- Rulers for plotting data on graphs, calculators

Your Task

- By the time the mission starts, the Radiation Team should be able to:
- Analyze real-time data, record it, graph it, and make calculations.
- Monitor radiation levels and astronaut exposure. If the exposure is dangerously high, recommend a course of action to Mission Control.
- Use the Radiation Reference Guide to understand radiation and its effects on the human body.
- Review the ALARA guidelines and how they may be applied on the space station. Learn the names and locations of the station's various modules and what shielding options are available on board if emergency measures need to be take.

Team Tasks

These tasks are listed in priority order. Next to each task, assign a team member. Depending on the size of your team, you may need to assign two tasks to one person.

 Crisis Management : Makes sure all data is analyzed every five minutes. Determines priority level, whether there are any concerns, and helps team decide on any recommendations.
 Data Graphing : Records real-time data on graphs and predicts which way the trend is moving. Uses ruler to make predictions. May be combined with Data Analysis tasks.
 Data Analysis (TEPC1) : Records real-time data in Data Tracking Tables and conducts analyses. Completes Report Forms about every five minutes or as needed.
 Data Analysis (TEPC2) : Records real-time data in Data Tracking Tables and conducts analyses. Completes Report Forms about every five minutes or as needed.
 Crisis Management Helper/ Data Runner : Gathers report forms every five to six minutes. Prioritizes any urgent recommendations. Writes down all questions from Mission Control and responds with written notes given to the Comm Data Officer. This may be combined with Crisis Management tasks.
 Data Recording : Records real-time data from the computer. The data will be accessed and downloaded after the start of the mission. May be combined with other tasks
 (optional) Research and Reference: Reads and understands information provided in the Reference Guide to make recommendations to Mission Control. May be combined with other tasks above.
 (optional) Reporter/ Graphic Organizer: Takes notes during the mission like a reporter from a newspaper. Writes down all the emergencies, recommendations, choices, and successes. May want to use a "graphic organizer" like a white board or chalkboard posted on the wall that is visible to all teams.



Radiation Team Graphs and Instructions

Instructions for Graphing the Data

The Radiation Team will be responsible for creating four graphs, two for each TEPC. For the first graph, use the data from **Column C** on each Data Tracking Table for the y-axis values and plot them along the x-axis according to the correct UTC time.

For the second graph, use the data from **Column F**on each Data Tracking Table for the y-axis values and plot them along the x-axis according to the correct UTC time.





Radiation Team Data Analysis Instructions

You will be receiving readings about every five minutes from the TEPCs. The data relates to current radiation levels on board the station Your team should be able to analyze this data quickly. **It is strongly recommended that you complete the practice worksheets and practice graphs before mission day.** Use the instructions below and the attached Data Tracking Table. You will need two sets of tracking sheets, one for each TEPC.

First, find the spreadsheet labeled "Radiation Team- Data Tracking Table". For your calculations, make one copy for the TEPC1 and one for the TEPC2.

<u>Column A</u>: Coordinated Universal Time (UTC)

UTC is a universal standard in which time is given on a 24-hour clock with no "am" or "pm". For example, one o'clock in the morning is 01:00. Four-twenty in the afternoon is 16:20. Eleven-fifteen at night is 23:15, etc.

Column B: 20 Minute Dose Total

Record the real-time dose rate data in Column B. "Rems" are a unit of measure scientists and health workers use to describe radiation exposure.

<u>Column C</u>: Cumulative Dose

C = Column B + Previous Column C

Use this calculation in conjunction with the graph to monitor the cumulative exposure every reading. This is the actual exposure the crew has received since 15:00.

To calculate the cumulative dose, add the cumulative dose from the previous reading with the current 20minute dose, and record this value.

For the first reading, assume a previous dose of zero.

Cohmn	A	в	C (Graph fluis column)	D	E	F (Graph fitis column a compare to tables in t Reference Guide)	
Table Headings	UTC	20 min Dose Total	Cumulative Dose	Dose Rate	Time to Criticality	24 hour Project Total	
Units	24 Hour Clock rems		rems	rem/hr	ho urs	rems	
alculations	From Data	From Data	C= B+ Previous C	D= <u>B</u> 0.33	E= <u>100 · C</u> D	F = (D X 24) + C	
ų	15:00	0.43	(provious dose assume 0 zems) 0.43	1.30	76.59	31.63	
E B	15:20	0.58	1.01	1.76	56.49	43.25	

Column D: Dose Rate

Column D = Column B divided by 0.33 hour

To determine how fast things are changing, you will need to find the rate of change. To do this, you need to take the current reading from Column B and divide by the amount of time that has elapsed between the two readings (.33 hour is equal to 20 minutes. This is the rate of change in rems/hr.

<u>Column E</u>: Time to Criticality: Hours

Col E = 100 - Column CColumn D

In order to find the time to criticality, take the critical value (100rems) and subtract from it the current reading from Column C. Divide this answer by the rate of change you calculated in Column D. This is the amount of time the crew has before they enter into danger levels. Note: At a dosage of 100 rems, you might start to see the first physiological symptoms as well as decreases in performance.

<u>Column F</u>: 24 Hour Projected Total- rems

F = Column C + (Column D x 24) (hrs. in a day)

This column contains your prediction of the total 24-hour dose at each TEPC. To determine this value, start with the current cumulative dose from Column C. Add this to the product of the current dose rate (Column D) and the number of hours in a day. <u>This</u> information will be plotted on graphs.



Radiation Team -**Data Tracking Table**



Circle One:

TEPC1 (Portable) TEPC2 (Stationary)

Α	В	C (Graph this column)	D	Ε	F (Graph this column and compare to tables in the Reference Guide)	
UTC	20 min Dose Total	Cumulative Dose	Dose Rate	Time to Criticality	24 hour Projected Total	
24 Hour Clock	rems	rems	rem/hr	hours	rems	
From Data	From Data	C= B+ Previous C	$\mathbf{D} = \underline{\mathbf{B}}_{0.33}$	$\mathbf{E} = \frac{100 \cdot \mathbf{C}}{\mathbf{D}}$	F = (D X 24) + C	
15:00	0.43	(previous dose assume 0 rems) 0.43	1.30	76.59	31.63	
15:20	0.58	1.01	1.76	56.49	43.25	
15:40	1.67					
16:00	3.56					
16:20	5.01					
16:40	4.20					
17:00	1.83					
	A UTC 24 Hour Clock From Data 15:00 15:20 15:40 16:00 16:20 16:40 17:00	ABUTC20 min Dose Total24 Hour ClockremsFrom DataFrom Data15:000.4315:200.5815:401.6716:003.5616:205.0116:404.2017:001.83	ABC (Graph this column)UTC20 min Dose TotalCumulative Dose24 Hour ClockremsremsFrom DataFrom DataC=B+ Previous C15:000.43(grevious dose assume 0 rems) 0.4315:200.581.0115:401.671.6716:003.561.0116:205.011.6716:404.201.6717:001.831.01	ABC (Graph this column)DUTC20 min Dose TotalCumulative DoseDose Rate24 Hour Clockremsremsrem/nrFrom DataFrom DataC=B+ Previous CD= B 0.3315:000.43(previous dose assume 0 rems) 0.431.3015:200.581.011.7615:401.6716:003.5616:205.0116:404.2017:001.83	AB $\frac{C}{(Graph this column)}$ DEUTC20 min Dose TotalCumulative DoseDose RateTime to Criticality24 Hour Clockremsremsrem/hrhoursFron DataFrom DataC=B+ Previous C $D^{=}_{-0.33}$ $E=\underline{100 \cdot C}_{-D}$ 15:000.43(previous dose assume 0 rems) 0.431.3076.5915:200.581.011.7656.4915:401.671.7656.4916:003.56 </th	

Note: Round all calculations to two decimal places.

Column	Α	В	C (Graph this column)	D	Е	F (Graph this column and compare to tables in the Reference Guide)		
Table Headings	UTC	20 min Dose Total	Cumulative Dose	Dose Rate	Time to Criticality	24 hour Projected Total		
Units	24 Hour Clock	rems	rems	rem/hr	hours	rems		
Calculations	From Data	From Data	C= B+ Previous C	$D = \underline{B}_{-}$	$\mathbf{E} = \frac{100 - \mathbf{C}}{\mathbf{D}}$	F = (D X 24) + C		
	15:00		(previous dose assume 0 rems)					
	15:20							
	15:40							
u	16:00							
ii 0	16:20							
ist	16:40							
Ζ	17:00							
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rt	17:40							
Fo	18:00							
[18:20							
	18:40							
	19:00							
	19:20							

Note: Round all calculations to two decimal places.



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Radiation Team -**Report Form**



criticality is more

riority Level circle one): 1 Urgent – Inform Missie Control Immediately (Time to criticality is less than 24 hours)	2 Potential Danger— Monitor Closely (Time to criticality is between 24 and 48 hours)	3	Maintaining Normal Levels (Time to criticality is more than 48 hours)
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Please fill in ALL blanks in case Mission Control needs the information.

	Α	В	C	D	E	F
TEPC1	UTC	20 minute Dose Total	Cumulative Dose	Dose Rate	Time to Criticality (hours)	24 Hour Projected Total-rems
	Α	В	C	D	E	F
TEPC2	A UTC	B 20 minute Dose Total	C Cumulative Dose	D Dose Rate	E Time to Criticality (hours)	F 24 Hour Projected Total-rems

Communication Team: Please do NOT report the shaded areas to Mission Control.

Recommendations:

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Priority Level (circle one):		1	Urgent – Inform Mi Control Immediate (Time to criticality is les than 24 hours)	ssion y 2	Potential Danger— Monitor Closely (Time to criticality is be 24 and 48 hours)	- 3	Maintaining Norma Levels (Time to criticality is mo than 48 hours)	al ore
Please fill in ALL blanks in case Mission Control needs the information. A B C D E F UTC 20 minute Dose Cumulative Dose Dose Rate Time to Criticality 24 Hour Projected								

TEPC1	010	Total	Cumulative Dose	Dose Male	(hours)	Total-rems
	Α	В	С	D	E	F
TEPC2	UTC	20 minute Dose Total	Cumulative Dose	Dose Rate	Time to Criticality (hours)	24 Hour Projected Total-rems

Communication Team: Please do NOT report the shaded areas to Mission Control.

Recommendations: