



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.

Missions Day Materials

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

- Print and cut 7 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 Team 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 taken.

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 Crises 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, options, 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

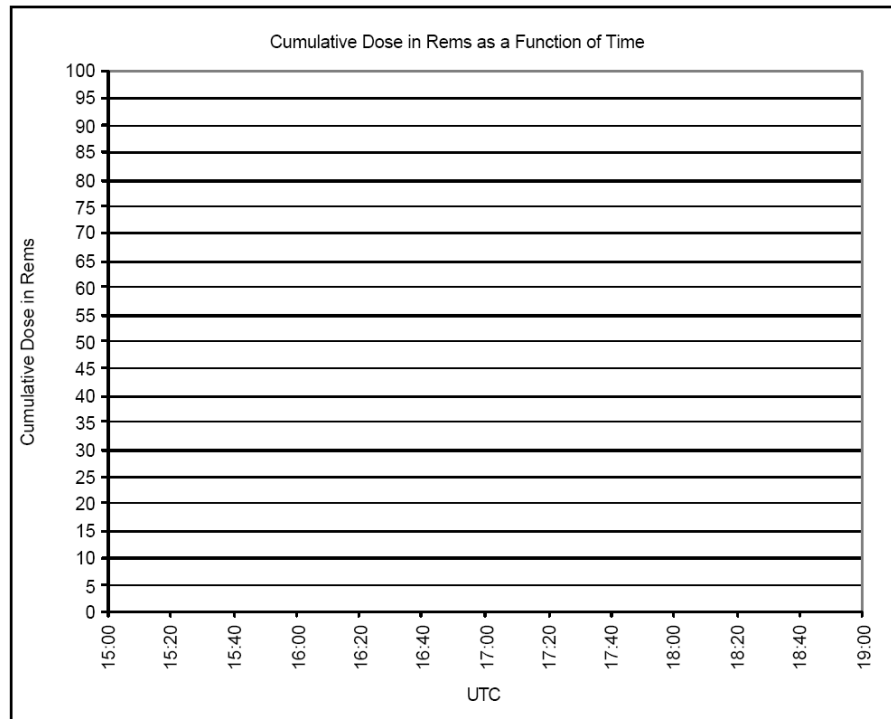
Instructions for Graphing the Data

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.

**Actual Dosage
Received**

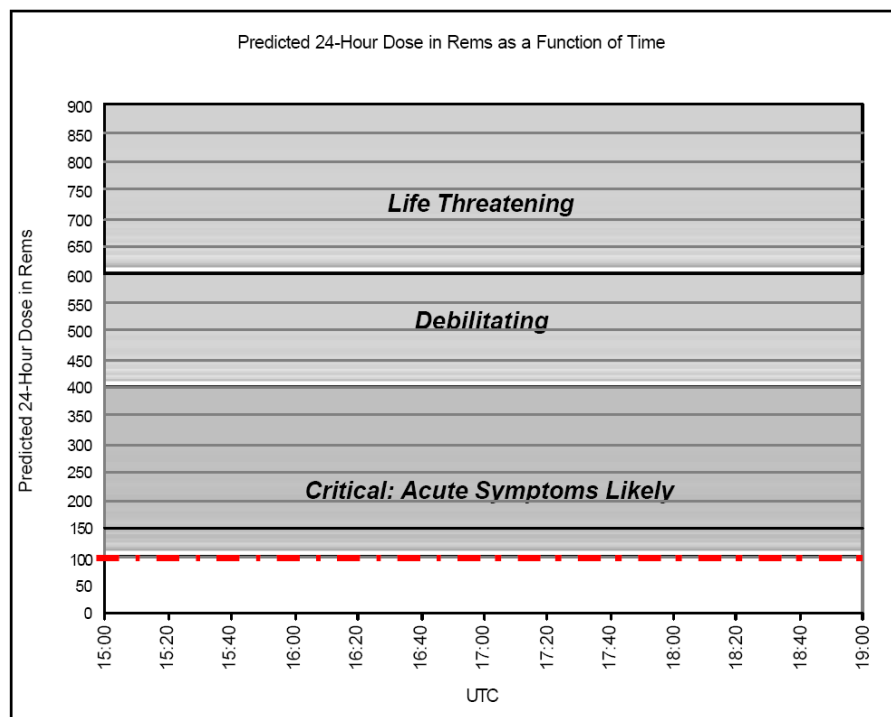
Circle One:
TEPC1
TEPC2



Predicted Dosage

If the storm stays at current levels, then in 24 hours this would be the dosage.

Circle One:
TEPC1
TEPC2





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 two worksheets labeled “Radiation Team - Data Tracking Table.” For your calculations, make one copy for the TEPC1 and one for the TEPC2.

Column A: 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, on o’clock is 01:00. Four-twenty in the afternoon is 16:20. Eleven-fifteen at night is 23:15.

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.

Column C: Cumulative Dose

$$C = \text{Column B} + \text{Previous Column C}$$

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 20-minute dose, and record this value.

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

Column D: Dose Rate

$$\text{Column D} = \text{Column B divided by } 0.33 \text{ hour}$$

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.

Column	A	B (Graph this column)	C	D	E	F	G
Table Headings	UTC	X-Rays	Category	Change	Rate	Projected X-Ray Production in 1 Hour	Category
Units	24 Hour Clock	Amount of X-Rays	From R1 to R5	Amount of X-Rays	X-Rays/min	X-Ray Production	From R1 to R5
Calculations	From Data	From Data	See Reference Guide	B - Previous B	D / 20 min	(E x 60 min) + B	See Reference
Practice	15:00	9	R1·R2·R3·R4·R5	n/a	n/a	n/a	R1·R2·R3·R
	15:20	16	R1·R2·R3·R4·R5	7	0	37	R1·R2·R3·R
	15:40	46	R1·R2·R3·R4·R5	30	2	136	R1·R2·R3·R
	16:00	1250	R1·R2·R3·R4·R5	1204	60	4862	R1·R2·R3·R

Column E: Time to Criticality: Hours

$$\text{Column E} = \frac{100 - \text{Column C}}{\text{Column D}}$$

In order to find the time to criticality, take the critical value (100 rems) 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.

Column F: 24 Hour Projected Total - rems

$$F = \text{Column C} + (\text{Column D} \times 24) \text{ (hrs. in a day)}$$

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. **This information will be plotted on graphs.**



Radiation Team – Data Tracking Table: X-Ray Production



Circle One: **TEPC1 (Portable)** **TECP2 (Stationary)**

Column	A	B	C (Graph this column)	D	E	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	$C = B + \text{Previous } C$	$D = \frac{B}{0.33}$	$E = \frac{100 - C}{D}$	$F = (D \times 24) + C$
Examples and Practice	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	56.24	43.25
	15:40	1.67				
	16:00	3.56				
	16:20	5.01				
	16:40	4.20				
	17:00	1.83				

*Note: Round all calculations to two decimal places.

Column	A	B	C (Graph this column)	D	E	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	$C = B + \text{Previous } C$	$D = \frac{B}{0.33}$	$E = \frac{100 - C}{D}$	$F = (D \times 24) + C$
For the Mission	15:00		(previous dose assume 0 rems)			
	15:20					
	15:40					
	16:00					
	16:20					
	16:40					
	17:00					
	17:20					
	17:40					
	18:00					
18:20						

*Note: Round all calculations to two decimal places.