Description Of Mission Day Events

I. Introduction

On Mission Day, the students should be prepared with solid background information about the overall mission and more specific training in their particular team or "area of expertise." Prior to the official beginning of the mission, the Mission Commander will review communication protocol with the communication team. This will help facilitate a smooth exchange of information, both verbally and through the chat window. Once the mission begins, the Mission Commander at Mission Control will provide the students with a brief overview and introduction to their task. They will receive a brief introduction to the crew prior to liftoff and then the mission will get under way.

II. General Story Line

The Space Shuttle Discovery is making final preparations for lift-off to transport the Expedition Two crew to Space Station Alpha. The Expedition Two crew will be the second team of astronauts to make the space station their home for the next three months. Once they rendezvous with the station they will link up and begin the process of a crew change. If all goes well, the Expedition Two crew will take over the duties of running the space station and the Expedition One crew can prepare to return home to Earth.

Unfortunately, all does not go well. Immediately following docking, Mission Control receives an urgent bulletin from the Space Weather Center in Boulder, CO

informing them that another huge solar storm is imminent as the sun makes it's final rotation toward the earth once again and that a solar proton event is highly likely in the next few hours. Therefore, the hatches between the shuttle and the station will need to remain closed and there can be no crew exchange until further notice. The shuttle crew and Expedition Two crew are safer in the shuttle where they are more adequately protected from solar radiation. The focus of the mission will be to first and foremost, protect the Expedition One crew currently on board the space station, and minimize their radiation exposure. The team will also have to maintain power levels, keep the space station on its' proper course in orbit as well as preserve the research experiments that are currently in progress on board the space station.

Each team will be asked to download a URL that will begin the data stream for their team. Every five to seven minutes the teams will receive new data that will require calculations, conversions and subsequent recommendations for the space station crew. They will be responsible for developing an action plan for their area and communicating it to the rest of the teams to ensure that they are taking into consideration how the space station systems are inter-related. Communication among the teams is critical throughout for a successful mission.

III. Individual Team Story Lines

A. Storm Team Story Line

The Storm Team's job is to be the space weather predictor team. They will be looking at space weather and tracking x-ray and proton activity to determine if and when the solar storm will hit the space station. This team serves as the early alert team and

should be prepared to warn and inform the other teams and Mission Control if you see any cause for concern.

Within the first few readings at UTC 15:20 and 15:40, the Storm team will see a spike in the x-ray data. Graphing is critical for this team as it serves as a visual aid as well as helps them to predict when the jump in protons will occur. They should anticipate the jump in protons to come about 2-3 readings later, or 20-50 minutes after the x-ray spike. The proton data reflects this as it begins to spike at UTC 16:40. Anticipating the arrival of protons to the space station is their main concern and has implications for all of the other teams. They should take the initiative to warn the other teams, especially the Radiation Team, but if they don't they will be prompted by Mission Control to do so.

Another more serious x-ray spike occurs at UTC 17:00 and 17:20. This will cause the proton level to remain at critical levels for almost the remainder of the mission. This crisis is the impetus for the Radiation Team to implement shielding procedures.

The Storm Team will also be looking at the severity of the x-ray and proton levels and comparing their data to the descriptors on the space weather scale found in the Reference Guide. They will use this information to inform the other teams of the potential ramifications of a storm of this magnitude. They will also be expected to calculate the time to criticality using a critical value related to the next level of severity. For example, if they are experiencing x-rays that are at an R3 level with a descriptor of "strong", they will have to calculate how long the crew has until it goes up to an R4 level with a descriptor of "severe." They will do the same for protons, using the S1-S5 scale. (See Mission Day Instructions)

B. Radiation Team Story Line

The Radiation Team's job is to monitor the radiation levels from the two TEPC monitors on board the station. TEPC 1 is a portable TEPC that can be moved from place to place with the crew. The stationary TEPC, which we call TEPC 2, is located in the U.S. Destiny Laboratory on one end of the station. They will track the levels of radiation from both TEPCs and alert Mission Control if they see levels approaching the danger zone. This team is also responsible for making any shielding recommendations for the crew.

The Radiation Team will have a few readings before they start to see the radiation levels rise dramatically. These increases in both the TEPC 1 and TEPC 2 data will coincide with the warning that should be received from the Storm Team. They will be making projections regarding the total dose that the crew may receive in a 24hour period and comparing that to the "Effects Chart" found in the Reference Guide. This should serve to emphasize the urgency of their role in the mission.

When the TEPCs register their first big jump at UTC 15:40 the team should begin considering recommendations. The first course of action when they are at this level is to suggest re-orienting the space station from a LVLH to an XPOP orientation. This is something that needs to be discussed with the Power Team, as it would be an initial drain on the power supply.

At UTC 17:00 the radiation levels become even more alarming and the differences between the stationary and portable TEPC become more pronounced. This should be the impetus for the team to follow the ALARA principle and make shielding recommendations. Expected recommendations could include placing all astronauts into

the Zvezda module, building an "igloo" of poly shielding and crawling inside and utilizing water containers for additional shielding. Zvezda is probably the safest because of the ability for the polyethylene shielding to "fit" the crew sleeping stations. It is critical to have a shielding plan in place by UTC 17:20. If they are not making recommendations they will prompted to do so by Mission Control.

The Radiation Team should experience some satisfaction as they see the radiation levels begin to drop around UTC 18:20. They should compare the levels of the two TEPCs and note that the portable TEPC that is located with the protected crew is considerably lower than the unshielded TEPC in Destiny. However, they will need to assess the damage that may have occurred to the crew as a result of the radiation exposure when they were not shielded.

C. Life Support Team Story Line

The Life Support Team's job is to monitor the living environment on Space Station Alpha. They will receive readings from sensors on board for oxygen and carbon dioxide as well as for total air pressure. It is critical that all of these readings remain in the normal range so that the astronauts are living and working in as optimal an environment as possible. If a reading is heading toward the danger zone or falls outside of the normal range, they should inform Mission Control and discuss any possible solutions to the problem.

The Life Support Teams data begins fairly quietly since it gives them an opportunity to practice with numbers with a lot of decimal places. They are working with percentages of oxygen and carbon dioxide that are then converted into millimeters of

mercury which is the standard used by most scientists when evaluating atmospheric components.

The carbon dioxide begins to rise around UTC16:00. The carbon dioxide level remains above critical levels and continues to rise from UTC 16:20 to UTC 17:20. During this period, the team needs to consider the effectiveness of the available solutions and make subsequent recommendations. Possible recommendations include activating the Carbon Dioxide Removal Assembly or checking it to make sure that it's working it it's already in use and utilizing Lithium Hydroxide Canisters to clean the air.

Once the carbon dioxide crisis is over, the oxygen level begins to fall. The oxygen levels fall from UTC 17:20 to UTC 18:00 and the team needs to make recommendations to correct the problem. Temporary solutions include utilizing "perchlorate candles" and oxygen masks. When making recommendations they should consider that the astronauts are in the midst of a radiation crisis and will be in the process of shielding themselves from rising radiation levels. This may impact their ability to utilize some of the life support team's recommendations.

Oxygen levels normalize shortly after the crisis at UTC 18:20. The one remaining problem that may surface in the mission is rising water vapor levels. While the team is not tracking this, they should be able to discuss the implications of water vapor that is too high or too low. They can access their Reference Guide to make recommendations if necessary.

D. Power Team Story Line

The Power Team is responsible for monitoring and maintaining an acceptable level of power for Space Station Alpha. The team must maintain energy levels for the life support systems that are needed to keep the crew safe, make sure that power is not drained when the station is in the earth's shadow and insure that there is enough power to sustain invaluable science experiments that are currently in progress. Their job is to keep the station fully functioning in the midst of the solar storm.

The Power Team will receive efficiency readings for the solar panels and batteries on board. They will convert these to kilowatts and plug them into equations that will determine whether or not the station is in a period of charging or draining. This team needs to see the natural process of charging and draining as the space station orbits the earth and is in eclipse for 30 minutes of every ninety-minute orbit. Their goal is to make sure that the power load does not drop below 15 kilowatts (what is needed for the station's normal functioning) and that the time to criticality does not fall below thirty minutes (the time that it takes for the station to orbit back into the sunlight). The team may need to cut power to certain systems to keep the Station functioning in the midst of a crisis.

The solar array and battery reserve efficiency are in good shape at the beginning of the mission and readings are in the normal range going into the first eclipse at UTC 16:00. They should be aware that a solar storm is in progress and that has potential to interfere with the functioning of the solar arrays.

The Power team begins to experience problems as the station orbits out of the eclipse and is in sunlight once again. The solar array efficiency should be rising to 100 %

and is instead dropping all the way to 36%. Similarly, the battery reserve is also dropping and is all the way down to 43% as it approaches the second eclipse. Because 35% of the power is drained during the eclipse portion of the orbit this is an extremely dangerous situation to be in.

To address this power crisis the Power Team needs to begin adjusting the power load by using the Power Systems calculator. They need to discuss and make decisions regarding what systems can be cut to lessen the power load and therefore slow the power drain on the station. This reaches it's most critical point at UTC 17:40. The team needs to make recommendations to cut certain systems prior to this time – probably beginning at UTC 17:00. There are no specific answers to what is right and wrong with regard to what systems to cut or by how much, but the team should be able to articulate their reasons behind their recommendations.

Once the space station comes out of the second eclipse the solar storm has passed and the solar array efficiency begins to rise dramatically and consequently the batteries are charged to capacity by UTC 19:00. The team can reallocate power to any systems that were cut in the midst of the crisis.

E. Crisis Management Team Story Line

The Crisis Management Team is responsible for "holding the mission together" and keeping all of the teams informed regarding the current status of Space Station Alpha and the crew on board. They need to be in continual contact with their respective teams and constantly updating the information board and space station diagram. This will provide a visual for the teams as well as an up to the minute status report on the crew.

The action for the Crisis Management Team will coincide with the critical periods that the individual teams are experiencing which is as follows:

Storm Team: UTC 15:40 and 17:00

Radiation Team: UTC 16:40 – 17:40

Power Team: UTC 17:00 – 18:00

Life Support Team: UTC 16:20 – 17:20 (CO2) and UTC 17:20 – 18:00 (O2)

The challenge for the Crisis Management Team is to negotiate the problems that may arise when teams are experiencing a crisis and making recommendations that impact other team's ability to function. For example, at UTC 17:00 the Power Team is beginning to experience problems with the solar arrays and need to begin conserving power. At the same time, the Life Support Team may want to activate the Carbon Dioxide Removal Assembly to solve the problem of rising carbon dioxide levels, which may require additional power. The role of the Crisis Management Team is to help the teams work out a solution that will assist both teams in solving their problems.

Because of the unique nature of every mission there is no hard and fast story line for the Crisis Management Team. What they do is largely dependant upon what the other teams recommend. It is critical, however, that they continue to assert that the space station functions like a body and that all of the systems are inter-related. This alone will go a long way towards helping facilitate a successful mission.

IV. Mission Completion

All data begins to stabilize at UTC 19:00 as the solar storm wears itself out. There will be 2 more readings after that unless the mission is going long and we need to "cut the satellite link." Each team will hopefully be pleased with their action plans and recommendations as they assisted the crew in weathering the worst solar storm in the last 100 years! They will be asked to prepare a brief post-mission report by answering questions sent to them from Mission Control. A representative will be expected to answer the questions orally through the Communications link. This is a great opportunity for all of the students to be able to get a summary of the other team's challenges.

Finally, the mission will end with a visual of the shuttle crew opening the hatches between the shuttle and the space station. This is a momentous occasion as the Expedition One crew turns over the reins to the new crew. The mission ends with the Expedition Two crew beginning another day of living and working in space.