Space Shuttle Simulation Communication Guidelines

Accurate "ground to space" communication is the critical component to a successful completion of a space flight simulation scenario. To facilitate accurate communications, strict control of who speaks at what time and to whom is critical. To maintain this control NASA has developed a standard communications protocol, which is comprised of three items in a specific order:

1. Who is being addressed, a person (e.g. Mission Commander, Pilot) or group (e.g. Mission Control, Enterprise),
2. Who is speaking, a person (e.g. Pilot, Flight Engineer) or group (e.g. Atlantis, Mission Control),
3. The information.

During shuttle operations, in-flight communications are divided into two main categories which are universally used.

Advise – When the flight personnel or Mission Control needs to tell someone something important. Sometimes the term *"**advised**"* will be used in the statement. This category of communications requires a confirmation from the addressed personnel.

Example:

"*Mission Control, this is Mission Commander; **be advised** we are receiving a caution and warning on the APU system."*

or

"*Mission Control, this is Mission Commander; we are receiving a caution and warning on the APU system. **Do you confirm**?"*

Announce – When flight personnel is relaying information to Mission Control or the Space Shuttle that does not require a confirmation of the information.

Example:

"Atlantis, this is Mission Control, APU pre-start check is underway"

or

"Endeavor, this is Mission Control, External tank cap is retracted"

Additionally, there are standard responses used to relate specific information between the space shuttle and Mission Control:

Report: *"Go"* or *"No Go"* This is used to confirm a system is operational or announce there is a problem with a system.

Confirm: *"Roger"* or *"Copy"* This is used to confirm receipt of a message

Status: "*Nominal"* This is used to identify if a system is operating normally. In the event a system is operating abnormally (off-nominal) the

abnormal system information is identified in the communication.

Example:

"Mission Control, this is Mission Commander; be advised we are receiving a caution and warning on the APU system"

Space Shuttle Crew

The Mission Commander is the flight officer responsible for talking to Mission Control, though occasionally the Pilot will speak to Mission Control in the event the Commander is busy or the information is only seen by the Pilot (status information) or if Mission Control requests status information from the Pilot. Normally the Flight Engineer does not speak to Mission Control, only to the Commander and Pilot. The exception to this is when the Flight Engineer is confirming the switch placements on the Engineering panel before the pre-launch checklist process begins.

When using the flight checklist during shuttle operations the Flight Engineer is responsible for reading off the check list items at the appropriate time. The flight officer who is responsible to turn that system on or off repeats the instruction as they perform the action. The other flight officer confirms that they observed that the action was completed. This system is routinely used by real pilots whether they are flying a passenger jet or the Space Shuttle.

Example:

Flight Engineer: *"APU / HYDRAULICS (1/2/3) to OFF"*
(reads checklist)

Mission Commander: "*APU / HYDRAULICS (1/2/3) to OFF"*
(performs action)

Pilot: "*APU / HYDRAULICS (1/2/3) to OFF Check*
(verifies action completed)

Flight Engineer: *"APU FUEL TK VLV (1/2/3) to CLOSE"*
(reads checklist)

Pilot: *"APU FUEL TK VLV (1/2/3) to CLOSE"*
(performs action)

Mission Commander: *"APU FUEL TK VLV (1/2/3) to CLOSE" Check*
(verifies action completed)

Mission Control Crew

A mission control center (MCC) is an entity that manages aerospace vehicle flights, usually from the vehicle clearing the tower until the landing or the end of the mission. In the FSUS Shuttle simulation system, the two Mission Control flight controllers monitor all aspects of the mission using audio and video telemetry. They support the mission by monitoring the flight checklist to ensure nothing is missed, monitoring telemetry readouts of the shuttle systems and confirming telemetry information with the astronauts. Frequently Mission Control will need to “announce information” during the check list procedures to provide additional information to the shuttle crew. This information is contained in the mission control segment of the checklist.

It is not the responsibility of the flight controllers to read off the flight checklist, this is done by the Flight Engineer. The reason for this is that the checklist is time-sensitive and, because of gaps in radio communication, it is possible to miss items.

In the event of an emergency the flight controllers are responsible for helping the shuttle crew identify the problem by reviewing the telemetry readouts. Once this is accomplished they then walk them through managing the problem using the Emergency Procedure checklist. This is the one time that Mission Control flight controllers take over reading the checklist since it is emergency-specific. Occasionally emergencies occur that are not covered by the checklist, in which case it is the responsibility of Mission Control to work with the flight crew to analyze the problem and come up with a solution so that the mission can continue.

The key to Mission Control is communication, both between the flight controllers and between Mission Control and the space shuttle. The primary purpose of this communication is to ensure that what the astronauts are seeing in their information readouts coincides with what the mission control telemetry is reporting. In the event an abort of the flight is required, the team in Mission Control normally makes the call as they have a more precise knowledge of the orbiter's position than the crew can obtain from onboard systems. However, the Mission Commander, who has full responsibility and authority over the Space Shuttle, makes the final confirmation of the mission abort. Although the Commander cannot override an abort decision from Mission Control, he can initiate a mission abort at any time.

Common Communication/Operational Mistakes

1. No clear operational chain of command during emergencies
2. Understanding the reason or rationale for a system problem as opposed to reacting to the problem.
3. Confirming data in the checklist without actually confirming the data on the information LCD readouts.
4. Not knowing what normal data should be on the LCD screens.

Commonly used abbreviations and meanings

BAT – Battery

CIRC – Circulation

CNTR – Center

CNTRL – Controller

ENG – Engine

FLT – Flight

H_2 – Hydrogen

He - Helium

HYD – Hydraulics

INBRD – Inboard

ISOL – Isolation

LCK - Lock

N_2 - Nitrogen

SHTDWN – Shut down

PWR – Power

SNSR – Sensor

TK VLV – Tank Valve

TRKR – Tracker

Space Simulator Guidelines (Common Mistakes)

General Observations

1. Use data points that are known to each other, if you aren't sure where a data point is, ask your team-mate for its screen location
2. Don't be repetitive on the telemetry data points checked, use many different ones
3. Use the correct data point and switch terms (example: CIRC is circulation, not circular)
4. Don't check non-existent data points (example: don't check SRB fuel status after SRB separation)
5. Some levity and humor is acceptable, but do not go overboard - be "professional"
6. After resolving an emergency, discuss whether to abort/not abort and include rationale for decision
7. Always speak-up if you recognize an error or missing information (don't be tentative)
8. Understand the range of values for systems so if a data point is not nominal, you will know if it is still within an acceptable range

Flight Simulator team

1. Getting ahead of the block or time
2. Uncertain about switch location
3. Did not follow Flight Engineer commands
4. Missed Radar start at T-4:00 minutes
5. Missed Launch command execute at T-00:04
6. Missed T+9:00-11:00 Time gauntlet
7. Missed manual prograde (not at 0,0,0) - Commanders, make sure you know what the zero-up position looks like (see the Landing Manual on the website)
8. Failed to follow De-orbit burn procedure
9. Hard landing
10. Not hitting runway
11. Not ending on the runway
12. One-sided telemetry checking (not verifying telemetry with MC)

Mission Control team

1. Inconsistent on calling T-minus minute marks
2. Missed T-10 second countdown
3. Missed T-4 second Execute confirmation
4. Did not start Mission Elapsed Time clock
5. Getting ahead of the block or time
6. Calling events before they occur
7. Did not confirm "Zero Up" (manual prograde) or called when did not occur
8. Failed to follow De-orbit burn process
9. Failed to call altitude and ground speed on landing
10. "Dead" air
11. Inconsistent communication format
12. Failing to recognize screen prompts
13. Failed to monitor fuel status
14. Verify telemetry data points by pointing them out to other controller