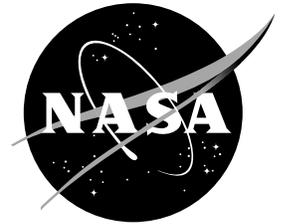


NASA Fact Sheet

National Aeronautics and
Space Administration

Marshall Space Flight Center
Huntsville, Alabama 35812



FS-MSFC-95(08)-010

August 1995



Spacelab Mission Operations Control

All NASA Spacelab science missions are controlled from the agency's Spacelab Mission Operations Control facility at the Marshall Space Flight Center in Huntsville, Alabama.

The Spacelab Mission Operations Control facility provides the science teams the capability to directly interact with their on-orbit experiment operations, influencing the science results. Science teams can also operate from remote facilities through the Spacelab Mission Operations Control facility. This capability offers the science team advantages of using data processing and analysis tools for conducting science operations.

The Spacelab Mission Operations Control team supports the science astronauts in much the same way that the Mission Control Center in Houston supports the Space Shuttle flight crew. Teams of flight controllers and researchers at the Huntsville facility direct all NASA science operations, send commands directly to the spacecraft and payloads, receive and analyze data from experiments onboard the vehicle, adjust mission schedules to take advantage of unexpected science opportunities or unexpected results, and work with crew members to resolve problems with their experiments.

(Continued on Page 2)

There are two air-to-ground communications channels used between a spacecraft and ground control during Spacelab missions. One is dedicated to communications between the Spacelab Mission Operations Control facility and the science crew aboard the Space Shuttle. The other is used by Shuttle Mission Control in Houston to talk with the commander, pilot, and mission specialists about Shuttle flight matters and Spacelab systems operations.

“Huntsville” is the call sign used by astronauts in space to address the control team at the Spacelab Mission Operations Control facility.

Spacelab science operations are a cooperative effort between the science teams and astronaut crew in orbit and their colleagues in the Spacelab Mission Operations Control facility. Though the crew and the instrument science teams will be separated by many miles, they interact with one another to evaluate observations and solve problems in much the same way as they would when working side by side in a ground-based laboratory.

The Spacelab Mission Operations Control team is under the overall direction of the Spacelab mission manager. His office is responsible for design and integration of the mission, for making sure that the mission accomplishes the goals set by the scientists who have experiments on the flight, and the requirements of the scientific payload match the Shuttle/Spacelab resources. The management group coordinates activities with other NASA organizations involved in preparing the Shuttle for launch and performing flight operations.

The Spacelab control facility is located on two floors in Building 4663 at the Marshall Center. Most of the action is centered in two work areas: the payload control area on the upper floor, from which the overall payload is monitored and controlled; and the science operations area on the ground level, where teams of scientists monitor their instruments and direct experiment activities.

The **payload control area** is the hub for payload operations. Communications with the crew, on-orbit and ground computer systems monitoring, science activities, and even television camera operations are marshaled from work stations in the control room. Console operators in this area are referred to as the “cadre”. This cadre supports the science teams by taking science requirements,

developing the appropriate timelines and procedures, coordinating with Johnson Space Center Mission Control, and assuring resources are available when required. The group is made up of three teams under the leadership of the payload operations director. The three teams are listed below.

The **operations control team** is responsible for real-time payload control. They ensure that the pre-planned operations schedule is followed and commands are sent by science teams to the instruments and instructions are provided to the crew. Designated team members stay in voice contact with the on-board science crew members and ground-based science teams to assure smooth, timely science operations.

The **data management team** ensures the science data needed from the payload is scheduled and properly routed to the science teams for data analysis. Their responsibilities range from scheduling the Spacelab data systems, to coordinating the on-board and ground systems configuration, and routing data to all users, including digital and video data.

The **payload activity planning team** is in charge of replanning all payload activities when anything from unexpected science opportunities to equipment problems demands a change. After a science operations planning group (composed of science team leaders) makes rescheduling decisions for upcoming shifts, the planning team works out the many adjustments that will allow those changes to be accomplished.

The cadre also includes: a mission scientist, who leads the science operations planning group and acts as a liaison between the cadre and the teams of scientists; an alternate payload specialist, a backup crew member who helps with air-to-ground communications and assists the mission scientist; and a public affairs commentator and television producer.

The science teams are located primarily in the **science operations area** on the ground floor of the Spacelab Mission Operations Control facility. Some science teams are located at remote sites, such as at their respective home facility or even in their home country. The science teams are responsible for the overall operations of their experiment. This includes experiment command and control, operational procedures, timeline and

operations requirements, data analysis, and contingency resolution. Science teams interact with the Payload Operations Control teams to establish experiment operations requirements, and schedule resources support.

The science teams monitor the data flowing back from each instrument/experiment, evaluate its overall performance, and assess and analyze the science information revealed by the data. The capability is provided for the researcher to talk directly with the crew member operating his or her instrument/experiment to clarify operations or conduct science evaluation. Science teams can also send commands directly to their experiments aboard the spacecraft to adjust or modify the science process.

Engineers on the science teams provide input on instrument performance and if necessary recommend alternate methods to maintain optimal performance. Scientists in each group evaluate the quality of data in light of their scientific objectives. They may also conduct a preliminary analysis of their science data, though a complete study may take months or even years.

SPACELAB MISSION CONTROL POSITION DESCRIPTIONS

Payload Operations Director (POD) — The payload operations director is responsible for all Spacelab payload flight operations and leads the cadre teams. The director approves any changes to payload operations during the mission and serves as prime point of contact with Houston Mission Control. An assistant payload operations director works alongside the director during the mission.

Before the mission, the payload operations director leads the payload operations team and crew as they prepare for the mission through training, science and engineering activities, mission design, and documentation. The POD reports to the payload mission manager.

Mission Scientist (MSCI) — The mission scientist leads the science operations planning group in mission science replanning, approves science changes, and resolves conflicting requirements. An assistant sits alongside the mission scientist during the mission. Before the mission, this mission scientist's role is to lead the investigator's working group in mission-science planning and to assist in

training the principal investigators in payload control area procedures.

Alternate Payload Specialist (APS) — The alternate payload specialist is an additional representative chosen by the science group as a crew member. This individual completes all flight training and serves as a backup for the payload specialist scheduled to work in orbit. During the mission, the alternate payload specialist communicates directly with the science crew. This payload specialist also assists the mission scientist and payload team as necessary and participates in the science operations planning group.

Operations Control Team

Operations Controller (OC) — The operations controller team leader ensures the planned mission timeline is carried out. The controller coordinates short-term operations changes and leads in the resolution of on-board payload malfunctions.

Prior to the mission, the operations controller's team is responsible for preparing the crew procedures and flight software data file, as well as familiarizing the principal investigator teams with the payload operations control procedures.

Crew Interface Coordinator (CIC) — The crew interface communicates directly with the science crew in orbit via the Spacelab Mission Operations Control facility air-to-ground communications loop. The CIC is the control group's link with the crew for resolving problems as they arise. This individual also coordinates direct communication between the crew and the science teams in the science operations area, when required. Prior to the mission, the crew interface coordinator consults with Mission Control in Houston on guidelines for air-to-ground conversations and trains the cadre and science teams on these procedures.

Crew Procedures Engineer (CPE) — Prior to the mission, the crew procedures engineer works with the science teams to prepare step-by-step procedures for the payload crew to operate all experiments, then maintains and updates these procedures known as the payload flight data file as the mission is in progress.

Payload Command Controller (PAYCOM) — The payload command controller manages the

schedule for sending commands up to Spacelab, including enabling and disabling the command system and its users. Prior to the mission, this operations control team member assists in command training for the cadre and science teams.

Payload Systems Engineer (PSE) — The payload systems engineer is the focal point for resolving issues that arise involving the Spacelab subsystems and their interface to the experiments. The PSE is responsible for preparing the crew procedures payload systems handbook, schematics and other systems level documentation prior to the mission.

Mass Memory Unit Manager (MUM) — While Spacelab is in orbit, the mass memory unit manager performs required updates to flight software data files used by the experiments and experiment computer. The MUM also manages and performs commanding for the Spacelab experiment automated timelines. This control team member prepares Spacelab command tools before the mission, including verifying the database, testing command execution by the experiments and on-board computers, and preparing supporting displays required during the mission.

Experiment Computer Operator (ECO) — This operator assists the mass memory unit manager in Spacelab command preparation and replanning, and generates the command timeline that is used by the cadre and science teams to schedule execution of commands required to support on-board experiment operations. The ECO also develops pre-mission and updates during the mission, special software data files, known as master and subordinate timelines, used by the experiment computer to automatically operate on-board experiments.

Payload Activity Planning Team

Payload Activity Planner (PAP) — The payload activity planner leads a team in designing the mission timeline prior to the flight, then altering those plans as required during the mission to accommodate changes requested by the science teams. The payload activity planner also assists the operations controller, in responding to real time changes to the timeline, and is the prime contact with the flight activities and flight dynamics officers in Houston.

Timeline Engineer (TLE) — During the mission, the timeline engineer updates mission timelines to reflect all payload activity changes as a result of anomalies or changes in requirements. During mission preparation, the timeline engineer is charged with assisting the payload activity planner in developing mission timelines with the principal investigators of each the science teams.

Orbital Analysis Engineer (OAE) — In the months before a mission, the orbital analysis engineer develops orbit parameters and attitude timelines based on experiment requirements. The analyst also predicts experiment observation opportunities and satellite communications coverage. After a mission begins, the analyst is responsible for replanning orbiter attitudes and experiment pointing operations, for generating the orbital trajectory, orbiter attitude, and experiment pointing data required for replanning the mission and monitoring its execution.

Payload Replanning Engineer (PRE) — In support of the Payload Activity Planner, the Payload Replanning Engineer directs all replanning-related mission analysis and timeline activities, including support of the Science Operations Planning Group meetings and generation of replanning products.

Data Management Team

Data Management Coordinator (DMC) — The data management coordinator manages the on-board Spacelab data systems and coordinates the routing, recording and downlink transmission of experiment and subsequent telemetry to ensure that the maximum science data possible is received, preserved, and distributed. The coordinator is the prime contact with Mission Control in Houston on all matters dealing with payload data management. Before the mission, the data management coordinator is the payload control center's lead representative for coordinating the communications network resources required to accommodate the data flow activities scheduled for the mission.

Data Flow Analyst (DFA) — The data flow analyst manages the processing of payload data requests, assists the data coordinator in implementing short-term changes, and generally manages the utilization of payload operations control center data systems services.

Data Replanner (DREP) —The data replanner is the data management team’s liaison with the payload activity planning team. The DREP works with the timeline engineer pre-mission to develop the data flow schedule required to support the mission timeline. During the mission, the DREP updates the schedule based on changes requested by the Science Operations Planning Group and assists the DMC plan changes to the realtime data downlink plan.

television Operations (TVOPS) — Television operations coordinates use of the on-board video and still camera to support experiment operations. TVOPS works with the Mission Control Center to ensure that the best camera angles and fields of view are used to accurately capture and document the crew and experiments during the mission. Prior

to the mission, TVOPS works with the science teams and payload crew to determine what type of video and camera equipment will be required to support the mission and how they can best be used. These crew procedures are documented in the TVOPS book and the photo/TV checklist.

Public Affairs Team

Public Affairs Commentator — These public affairs officers provide commentary on science crew and payload operations control center activities for broadcast on NASA Television and Mission Audio.