NASA Facts

National Aeronautics and
Space Administration

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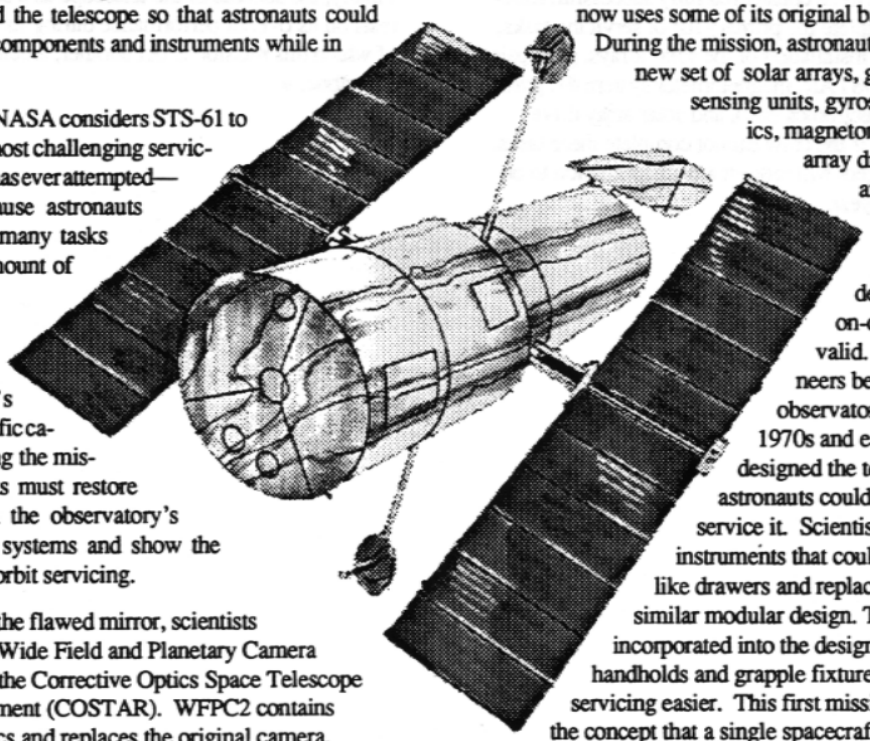
HST Mission Success Criteria

NASA had always intended to service the Hubble Space Telescope, even before engineers and scientists discovered a few months after launch that technicians had incorrectly shaped the observatory's primary mirror. The agency specially designed the telescope so that astronauts could replace parts, components and instruments while in orbit.

Nevertheless, NASA considers STS-61 to be one of the most challenging servicing missions it has ever attempted—primarily because astronauts must perform many tasks in a limited amount of time.



In addition to restoring the observatory's planned scientific capabilities during the mission, astronauts must restore redundancy in the observatory's key operating systems and show the validity of on-orbit servicing.

To correct for the flawed mirror, scientists developed the Wide Field and Planetary Camera (WFPC2) and the Corrective Optics Space Telescope Axial Replacement (COSTAR). WFPC2 contains corrective optics and replaces the original camera. COSTAR, on the other hand, is an assembly of mechanical arms equipped with small corrective mirrors that routes properly focused light to the other three instruments aboard the observatory. It replaces the High-Speed Photometer.

These optical packages will allow scientists to observe both individual objects in crowded fields and very faint, distant objects. For example, scientists may be able to see in greater detail galaxies so far out in distance and time that they appear as they looked when the universe was just one-tenth its current age.

Another objective is making sure that the observatory has sufficient backup in case one of the components fails. So far, the spacecraft has proven quite resilient. The observatory continues to collect data even though the telescope now uses some of its original backup systems. During the mission, astronauts will install a new set of solar arrays, gyroscope sensing units, gyroscope electronics, magnetometers, solar array drive electronics and fuses.

And lastly, NASA wants to demonstrate that on-orbit servicing is valid. When engineers began planning the observatory in the late 1970s and early 1980s, they designed the telescope so that astronauts could regularly service it. Scientists developed instruments that could be pulled out like drawers and replaced by others of a similar modular design. They also incorporated into the design astronaut handholds and grapple fixtures to make servicing easier. This first mission will validate the concept that a single spacecraft can be updated and repaired over a 15-year lifetime, providing the foundation for future servicing missions.

Given the fact that this is the first servicing mission involving a complicated set of tasks, NASA has established a list of objectives that must be met before the agency will consider the mission a success. At the top level, NASA must avoid risk to the flight crew, the Shuttle and telescope; it must ensure that all primary tasks are done; and it must leave the telescope in the best operational state possible.

To accomplish these, all servicing tasks were planned in priority order, consistent with timeline and servicing constraints. Lower priority tasks will be done on a time-available basis. If astronauts complete their servicing tasks faster than expected, the time will be spent attempting to accomplish the lower priority tasks.

With these considerations in mind, NASA has determined that the mission must accomplish these objectives: leave the observatory with at least three reliable gyro systems and either an operational Wide Field and Planetary Camera or a Corrective Optics Space Telescope Axial Replacement. If astronauts accomplish these goals, they will restore the most critical vehicle redundancy, correct part of the science instrument problem and demonstrate on-orbit servicing.

For the mission to be considered fully successful, astronauts must complete the primary list of servicing tasks, which includes installation of the solar arrays, gyro pair #2, WF/PC, COSTAR, magnetometer system #1, gyro pair #3 (with electronics unit), and solar array drive electronics #1. If the crew cannot complete these tasks, program managers will request a backup mission to be flown within a year.

The remaining items on the servicing list, which will be done if time allows, include installation of the Goddard High Resolution Spectrograph Redundancy Kit, the computer co-processor, magnetometer system #2, both gyro fuse plugs and the electronics control unit for gyro pair #1. Installation of these items would give the telescope additional backup capabilities, but they are not considered essential for mission success.

While the success of STS-61 will be judged, in part, on the success of the actual servicing mission, the ultimate success must await on board verification of the flight equipment. Controllers can verify some of the equipment, like the gyros, shortly after Endeavour releases the observatory, but calibration of the optical packages will take up to 7 weeks after the telescope's redeployment.

Finally, the success of the telescope as a scientific program rests on its overall performance during its 15 years in orbit, of which this mission is but another, albeit significant, milestone. ♦