W March 19, 1999

TO: S/Associate Administrator for Space Science

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Report on Hubble Space Telescope Cost Saving Initiatives
Assignment Number A-HA-98-047
Report Number IG-99-013

The subject final report is provided for your use. Please refer to the Results in Brief section for the overall audit survey results.

If you have questions concerning the report please contact Mr. Daniel Samoviski, Program Director for Earth and Space Science Audits, at 301-286-0497, or Ms. Nora Thompson, Auditor-in-Charge, at 757-864-3268. We appreciate the courtesies extended to the audit staff. The final report distribution is in Appendix C.

[original signed by]
Russell A. Rau

Enclosure

cc:
B/Chief Financial Officer
G/General Counsel
H/Acting Associate Administrator for Procurement
JM/Director, Management Assessment Division
GSFC/100/Center Director

IG-99-013

AUDIT REPORT

Hubble Space Telescope Cost Saving Initiatives

March 19, 1999

National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

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Acronyms

FY	Fiscal Year
HST	Hubble Space Telescope
STScI	Space Telescope Science Institute

HUBBLE SPACE TELESCOPE COST SAVING INITIATIVES

Introduction

The NASA Office of Inspector General completed an audit of the Hubble Space Telescope (HST) Cost Saving Initiatives. The overall objective was to determine whether the HST Program Office is reducing costs for science and satellite operations in line with anticipated budget reductions. The HST program budgeted about $187 million for contractor support of science and satellite operations for fiscal years (FY's) 1998 and 1999 (see Appendix A). From FY's 2000 through 2007, the HST program anticipates about a $134 million budget reduction.[1] Accordingly, science and satellite operations costs must significantly decrease to absorb the reduction.

Specific audit objectives were to determine whether:

- Actions have been initiated or planned to significantly reduce HST program costs by the year 2000.
- Other organizations benefiting from the HST equitably share in the program cost.
- Program planning for HST servicing missions scheduled for 1999 and 2002 considers the full NASA cost of operations and servicing as compared to replacement cost.[2]

To satisfy our objectives, we reviewed program plans and actions that have been implemented; interviewed management and HST program staff; analyzed planned contractor staff reductions; assessed pertinent documentation; and, performed specific assessments as detailed in the discussion below.

We performed fieldwork from August 1998 to January 1999. We performed the audit in accordance with generally accepted government auditing standards.

[1] The $134 million budget reduction results from (1) eliminating two servicing missions that will save $104 million and (2) implementing a new operating system, Vision 2000, that will save $30 million. From FY's 2008 through 2010, the HST program plans a $19 million budget increase to retrieve the telescope from orbit. Therefore, the program plans a net reduction of $115 million ($134 million less $19 million).

[2] When originally planned in 1979, the HST program called for return to Earth, refurbishment, and relaunch every 5 years, with on-orbit servicing every 2.5 years. Hardware lifetime and reliability requirements were based on that 2.5-year interval between servicing missions. In 1985, contamination and structural loading concerns associated with return to Earth aboard the Shuttle eliminated the concept of ground refurbishment from the program. NASA decided that on-orbit servicing might be adequate to maintain HST for its 15-year design life and adopted a 3-year cycle of on-orbit servicing.

Results in Brief

The HST Program Office is reducing costs for science and satellite operations in line with anticipated budget reductions. Management initiated and planned specific actions to significantly reduce program costs by 2000. First, management has eliminated two planned servicing missions after 2003. The initiative will save about $104 million. Second, management plans to implement a new operating system that will reduce contractor and civil service staff. The initiative will save about $30 million. Third, management plans to hold operating costs constant through Vision 2000 efficiencies and reduced civil service staff levels. Management has also initiated continuous improvement initiatives and developed performance metric data for the initiatives. (See Appendix B for a list of continuous improvement initiatives and performance metric data.) Also, grant researchers using the telescope are competitively selected and funded by NASA; therefore, sharing of program costs is not appropriate. Finally, program planning for HST servicing missions currently considers the full NASA cost of operations and savings.

Background

The HST program, a cooperative program between NASA and the European Space Agency, operates a long-lived, space-based observatory for the benefit of the international astronomical community. NASA designed and built the HST in the 1970's and 1980's. The HST became operational in 1990, when NASA deployed it in low-Earth orbit on Space Shuttle mission STS-31. The HST observes celestial objects at ultraviolet, visible, and near-infrared wavelengths.

The HST program receives support from two NASA contractors, the Association of Universities for Research in Astronomy and Lockheed Missiles and Space Company. The Association operates the Space Telescope Science Institute (STScI) under a cost-plus-award-fee contract with NASA. The STScI, located at the Johns Hopkins University, Homewood Campus, Baltimore, Maryland, conducts and coordinates the science operations of the telescope. Science operations include evaluating grant proposals funded by the HST program, scheduling telescope time for grant researchers, assisting researchers in data collection and interpretation, and archiving data. Satellite operations are performed on-site at the Goddard Space Flight Center under a cost-plus-award-fee contract with Lockheed. Satellite operations include telemetry, flight operations, and initial science data transcription.

The HST has a modular design so that on subsequent Shuttle missions it could be recovered, have faulty or obsolete parts replaced with new and/or improved instruments, and released again. The HST is expected to continue operating through 2010 with scheduled servicing missions. The initial servicing mission occurred in 1993, a second occurred in 1997, a third will occur in 2000, and a fourth and final mission will occur in 2003.

Our review focused on the anticipated $134 million budget reduction for 2000 through 2007 and on the HST Program Office plans to reduce program costs in line with the reduced budgets.

Reducing Science and Satellite Operations Costs

Actions to reduce HST budgets have occurred and continue. HST program actions have reduced science and satellite operations costs, and program plans will continue to reduce costs through FY 2010. We based that conclusion on a review of program plans and implemented actions, interviews with STScI management and HST program managers, and an analysis of planned contractor staff reductions. We assessed progress of the new operating and information system, known as Vision 2000,[3] through interviews with the project manager, system developer, and system users.

Planned actions conform to budget agreements between the HST Program Office and the Office of Space Science, NASA Headquarters. The Program Office plans to (1) eliminate two planned servicing missions after 2003, (2) implement Vision 2000 in 2000, and (3) ensure operating costs remain constant through Vision 2000 efficiencies and reduced civil service staff levels.

Eliminating the two planned servicing missions will reduce the number of contractor positions now supporting the servicing missions. Planned servicing missions are necessary because program risk, mission, and cost justify equipment modifications and replacement. The cost of Servicing Missions 1 and 2 was $378 million and $448 million respectively.[4] Eliminating missions 3 and 4 would significantly degrade the telescope, could result in failure of critical equipment, and may interfere with telescope operation. The cost of replacing equipment or mission failure significantly exceeds any cost benefit of not performing the missions.

Servicing missions are more cost-efficient than return-to-Earth refurbishment or return-to-Earth and return-to-orbit flights because ground refurbishment would require mirror and optics replacement. Ground refurbishment requires NASA to dismantle the telescope to fit it into the cargo bay. Dismantling could damage the mirror and optics and make the telescope inoperable. The mirrors and optics are highly sensitive to dust and extremely fragile and must be maintained in a sterile environment.

Implementing Vision 2000 will streamline manual calculations and enable management to further reduce the number of contractor positions. These actions will save about $104 million and $30 million, respectively. The HST Program Office plans to eliminate about 250 contractor positions through 2001.[5] Although budget agreements do not include the cost of civil servants, the planned actions will also reduce 100 civil service positions by 2003.

[3] The Vision 2000 project is a reengineered flight operations and control system.

[4] The cost of a servicing mission is determined by dividing the total Shuttle budget by the number of launches for the year. The HST Program Director provided us the costs for Servicing Missions 1 and 2.

[5] The savings from the reduction of 250 contractor positions begin in 1996 and accumulate through 2001. Total amount saved is $46 million.

Sharing HST Program Cost

The HST Program Office does not need a billing process that requires telescope users to equitably share telescope cost. We based our conclusion on a review of telescope users, telescope users funded by the HST Program Office, allocated telescope time, and full-cost accounting guidelines.

The STScI allocates 100 percent of available telescope time to researchers in the Space Sciences Directorate and to astronomers conducting grant research. Researchers within the Space Sciences receive guaranteed time because the Directorate developed the space telescope imaging spectrograph, an instrument on board the HST. At the time of the instrument's development, the HST program guaranteed telescope time to the Directorate researchers without cost. Requiring the Space Sciences Directorate to share telescope cost would be contrary to this agreement. Astronomers conducting grant research are selected through a competitive proposal process and are funded by the HST program. Requiring grant researchers to share in program cost would be equivalent to the HST program billing itself. As a result, NASA would not be reimbursed from external sources by billing current telescope users for HST costs. Additionally, the Program Office has a process for allocating HST costs to users if the information is needed.

Meeting Full-Cost Accounting Principles

Program planning for HST servicing missions scheduled for 1999 and 2002 considers the full NASA cost of operations and servicing as compared to replacement cost. Also, planned servicing missions are necessary and more cost-effective than return-to-Earth refurbishment. We made our determination based on a review of NASA full-cost guidelines, interviews of HST program and financial managers, review of planned equipment modifications on servicing missions 3 and 4, and assessment of an external review report of in-orbit servicing versus ground refurbishment.

In April 1999, HST budget requests are planned to conform to NASA full-cost guidelines. Currently, Goddard recasts budget submissions into full-cost accounting format. The recasting adds the cost of civil servant salaries, general and administrative overhead, and other service costs to the HST budget request. NASA does not require full-cost accounting until 2001. By recasting the April 1999 budget requests, the HST program plans to be in compliance with full-cost accounting guidelines.

Summary

The HST Program Office has three initiatives that will reduce science and satellite operations costs to meet budget reductions for the years after 2000. The initiatives are to: (1) discontinue the servicing missions after 2003, thereby eliminating two servicing missions and reducing costs by $104 million; (2) implement a new operating system, Vision 2000, thereby reducing contractor staffing and related costs by $30 million; and (3) hold operations costs constant through Vision 2000 efficiencies.

Additionally, HST Program Office continuous improvement initiatives have dramatically increased the amount of science data the telescope gathers while reducing cost. For example, new detectors have increased the volume of science data the instrument captures by 1,200 percent. At the same time, productivity improvements have allowed management to hold data capture cost to 80 percent[6] of data capture cost incurred in previous years. The net result has improved science data cost-efficiency by 1,500 percent. (See Appendix B for a description of continuous improvement initiatives and performance metric data.)

For FY 2000 and later, the HST Program Office expects to realize further gains in science data efficiency. The program plans to install new, advanced instruments that will enable the telescope to examine larger areas of the sky with greater resolution. At the same time, Vision 2000 will maintain operating cost reductions. Management estimates the net effect will increase productivity by 3,000 percent.[7]

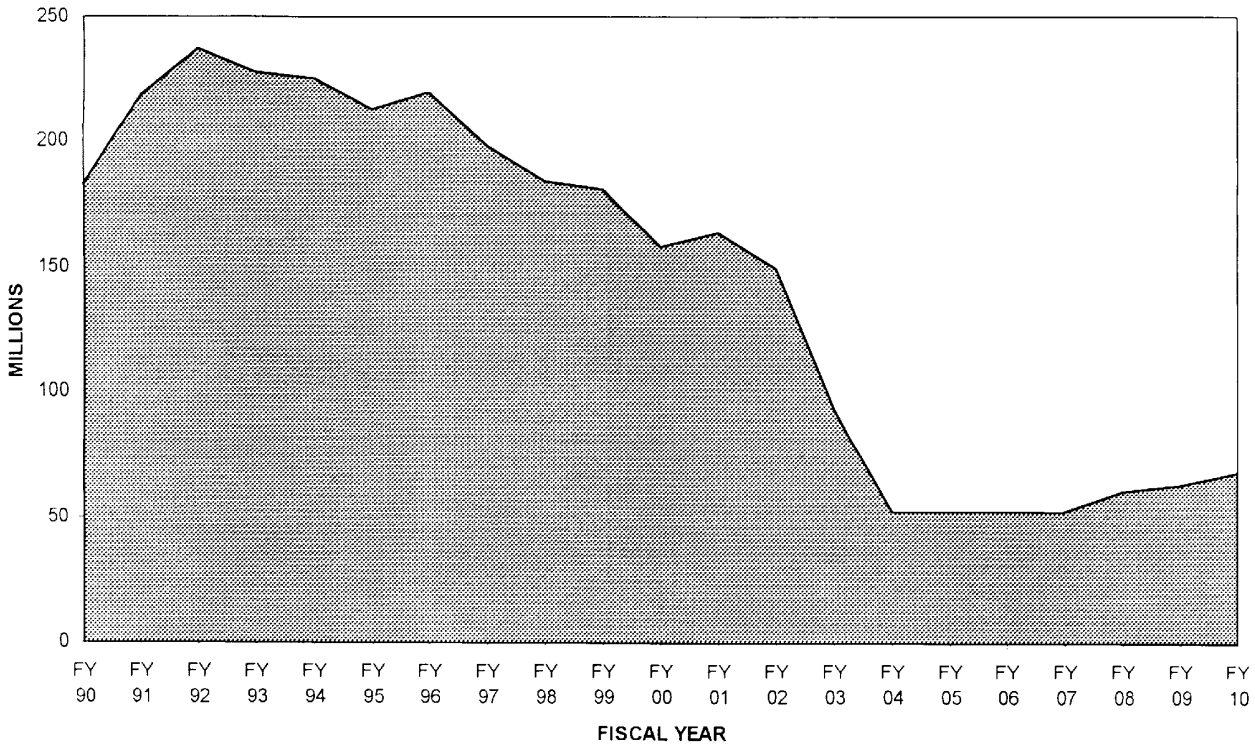
[6] For FY 1998, the budgeted amount was $184 million. For FY 1992, the budgeted amount was $237 million. The ratio of FY 1998 costs to FY 1992 costs is .8 ($184million/$237million).

[7] The HST Program Office estimates that science data volume will triple after the installation of the advanced camera instrument on servicing mission 3. Management applied an improvement factor of 2 to the 1,500 science data efficiency factor the program experienced through FY 1998. This calculation yields an estimated improvement of 3,000 percent after servicing mission 3.

Appendix A. HST Budget by Fiscal Year

The figure below depicts the HST Program budget levels from the April FY 1990 launching of the telescope through FY 2010, which is the planned mission completion date. The budget decreases significantly from FY 2002 to FY 2004. From FY 2004 to FY 2010 the program budget assumes a nearly constant operating cost except for a slight increase in FY 2008 for retrieval or reboost of the telescope. HST Program management plans to reduce costs by: (1) discontinuing servicing missions after 2003; (2) implementing the Vision 2000 (a reengineered flight operations and control system), thereby reducing contractor staff levels; and (3) ensuring costs remain constant through Vision 2000 efficiencies and reduced civil service staff levels.

HST BUDGET FOR FY 90 THROUGH FY 10
(IN FY 97 DOLLARS)



Appendix B. HST Program Office Continuous Improvement Initiatives

The HST Program Office, working with the STScI, has implemented continuous improvement initiatives and developed performance metric data as described below.[8]

Continuous Improvement Initiatives

- New detectors with wide formats have improved telescope efficiency and have significantly increased the volume of science data the telescope captures.

- The solid-state data recorder and computer upgrades have improved telescope observation scheduling. As a result, researchers have realized gains in target and science data volume.

- Commercial off-the-shelf software and hardware have significantly advanced technical capability while keeping costs lower. These costs are less than those incurred in developing the first generation of science instruments and spacecraft hardware.

Performance Metric Data

- Science data cost-efficiency has increased by 1,500 percent. Over the last 8 years, the above initiatives have increased science data volume by 1,200 percent. Although data volume has increased dramatically, management reduced data capture costs by 20 percent as compared to previous years.

- The HST program has measured science performance from citations in published journals. In 1996, more than 3 percent of every 30 papers published in refereed astronomy journals was based on HST data. In 1996, more than 14 percent of high-impact journal articles used HST data. High-impact articles are defined as the most cited, refereed journal articles published. In 1997, Science News attributed 1 percent of the most important discoveries to HST. The discoveries applied worldwide, across all fields of science.

[8] The continuous improvement initiatives include the increase in science data produced up through 1997. The initiatives do not consider the effect of instruments installed after 1997. The Hubble Program Director, the Hubble Program Scientist, the STScI Director, and staff described the above continuous improvement initiatives and provided the performance metric data.

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Congressional Member

Honorable Pete Sessions, U.S. House of Representatives

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