

IG-98-020

**AUDIT
REPORT**

**CONSOLIDATION DECISION FOR
SECURE SUPERCOMPUTERS**

July 24, 1998



National Aeronautics and
Space Administration

OFFICE OF INSPECTOR GENERAL

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ACRONYMS

ARC	Ames Research Center
ARL	Army Research Laboratory
CoSMO	Consolidated Supercomputing Management Office
LaRC	Langley Research Center
NASA	National Aeronautics and Space Administration
NAVO	Naval Oceanographic Office
OIG	Office of Inspector General
OMB	Office of Management and Budget

W

July 24, 1998

TO: AO/Chief Information Officer

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Report on the Audit of the Consolidation Decision
for Secure Supercomputers, Assignment No. A-HA-98-008
Report No. IG-98-020

The subject final report is provided for your use. Please refer to the executive summary for the overall audit results. Your comments on the draft report were responsive to our recommendation. However, the recommendation will remain open until we have assessed the adequacy of the data the Consolidated Supercomputing Management Office will use to support the planned direct procurement of secure supercomputing services. We have requested that the office provide the data when available.

If you have questions concerning the report, please contact Mr. David L. Gandrud, Program Director for Information Technology Program Audits, at (650) 604-2672, or Mr. Roger Flann, Audit Program Manager, at (818) 354-9975. We appreciate the courtesies extended to the audit staff. See Appendix D for the report distribution.

[Original signed by Russell A. Rau]

Russell A. Rau

Enclosure

cc:

B/Chief Financial Officer

G/General Counsel

JM/Management Assessment Division

ARC/258-3/Director, Consolidated Supercomputing Management Office

bcc:

AIGA Chron, IG Chron Reading (w/o encl.) Chrons

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CONSOLIDATION DECISION FOR SECURE SUPERCOMPUTERS

EXECUTIVE SUMMARY

INTRODUCTION

This report summarizes the results of our review of the cost-benefit analysis, used by the Consolidated Supercomputing Management Office (CoSMO), to support a consolidation of NASA's secure supercomputers. CoSMO is located at the NASA Ames Research Center (ARC) and is responsible for ensuring the cost-effectiveness of NASA's secure supercomputing systems.

OBJECTIVES

The overall objective of the audit was to determine whether CoSMO's cost-benefit analysis adequately supported the planned supercomputer consolidation. Specifically, we performed the audit to determine whether (1) cost and other related data identified for the analysis were current, accurate, and complete; (2) appropriate analytical methods and assumptions were applied to the data; and (3) claimed benefits were realistic and properly valued. A detailed description of the scope and methodology used for this audit is in Appendix C.

AUDIT RESULTS

The cost-benefit analysis prepared by CoSMO personnel did not adequately support the decision to relocate secure supercomputing from the Langley Research Center (LaRC) to the Naval Oceanographic Office (NAVO) at the Stennis Space Center. CoSMO personnel had not estimated the costs of bartering items (satellite imagery data) in exchange for NAVO providing secure supercomputer services to LaRC.* Also, CoSMO had not adequately supported its cost-benefit analyses and consolidation alternatives. CoSMO personnel had gathered only partial or no data to support the conclusions reached for the consolidation alternatives considered. As a result, the conclusions drawn by the analyses may not be correct and erroneous decisions can be made concerning supercomputer consolidation.

RECOMMENDATION

We recommended that the CoSMO Director use only current, accurate, complete, and adequately documented data in consolidation decisions.

*Subsequent to issuance of our draft report, CoSMO decided not to pursue bartering and reimburse NAVO directly for supercomputer services. Therefore, we deleted our recommendation related to the bartering arrangement.

***MANAGEMENT'S
RESPONSE***

Management concurred with the recommendation. We will assess the adequacy of the data CoSMO will use to support its planned direct procurement of supercomputer services.

CONSOLIDATION DECISION FOR SECURE SUPERCOMPUTERS

BACKGROUND

The Office of Management and Budget (OMB) Bulletin 96-02 Consolidation of Agency Data Centers, provides guidelines for significantly reducing the number of agency data centers and reducing the total costs of data center operations government-wide. The guidelines call for agencies to concentrate their data center operations into a smaller number of physical locations by June 1998.

The Ames Research Center (ARC), through the Consolidated Supercomputing Management Office (CoSMO), is responsible for acquiring, maintaining, operating, managing, upgrading, and budgeting for NASA's supercomputers, regardless of location. NASA's supercomputers are used in three broad categories: production, research and development (R&D), and secure supercomputing. This report addresses the adequacy of the CoSMO cost-benefit analysis supporting secure supercomputing consolidation. (NASA has three secure supercomputers; two are located at ARC, and one is at the Langley Research Center ([LaRC]). We will address production and R&D supercomputing in a separate report.

CoSMO studied secure supercomputing at NASA to identify (1) the current status of secure supercomputing, and (2) projected future requirements. The objectives of the study were to:

- satisfy the secure supercomputer requirements of NASA secure programs;
- improve the cost-effectiveness of NASA secure supercomputing as directed by OMB Bulletin 96-02, the NASA Zero Base Review, and budgetary pressures on NASA; and
- explore consolidation of secure supercomputing within NASA, and seek potential Departments of Defense and Energy and commercial sites that could provide at least the same level of service at a reduced cost.

CoSMO considered 16 consolidation scenarios (Appendix A) for the ARC and LaRC supercomputers. CoSMO eliminated nine scenarios involving relocation of ARC's supercomputers because alternative locations failed to meet ARC's high-level data security requirements. Consequently, ARC's secure supercomputing resources will remain in place.

The remaining seven scenarios dealt with consolidating LaRC's secure supercomputing resources. CoSMO eliminated six of the seven scenarios because (1) the cost exceeded the benefits, (2) the potential supercomputer provider was a Department of Defense organization that did not accept other agency-sponsored projects, (3) the organization had no plans to update its hardware, (4) the organization expressed no interest, or (5) the organization did not perform secure supercomputing.

CoSMO found only one of seven scenarios to be cost beneficial. Specifically, CoSMO concluded that NASA will benefit most by moving LaRC's secure supercomputing to the Naval Oceanographic Office (NAVO) at the Stennis Space Center in Mississippi. Under this scenario, CoSMO expects to save about \$247,000 annually. NASA had planned to barter imagery data in exchange for NAVO's agreement to handle LaRC's secure supercomputing requirements. NASA and NAVO will spell out the terms of their agreement in a memorandum of understanding (MOU).

According to the CoSMO Assistant Director, the consolidation of LaRC secure supercomputing to NAVO will benefit both NASA and NAVO. NAVO will make an existing communications network available to NASA at no cost. In addition, NAVO plans to continually upgrade its equipment and network technology, thereby saving NASA the expense of these upgrades. In exchange, NASA is to provide NAVO with satellite imagery data from the Jet Propulsion Laboratory (a contractor-operated facility) and the Stennis Space Center (a NASA-operated facility).

FINDING AND RECOMMENDATIONS

***COST-BENEFIT
ANALYSIS DOES NOT
SUPPORT
RELOCATION OF
SECURE
SUPERCOMPUTING***

CoSMO's cost-benefit analysis did not adequately support its decision to relocate secure supercomputing from LaRC to NAVO at the Stennis Space Center. This condition occurred because of various weaknesses in the cost-benefit analysis. Specifically, CoSMO had either incomplete or no documentation to support several consolidation activities. Consequently, CoSMO cannot assure NASA management that it has determined the full cost of consolidation and, in turn, made the most appropriate decision related to the consolidation.

***REFINED COST-BENEFIT
DATA REQUIRED BEFORE
MOU IS SIGNED***

In March 1997, the NASA Acting Deputy Administrator issued a memorandum concerning cost-benefit analyses for making decisions to consolidate, downsize, outsource, or eliminate research/programs. The memorandum stated in part:

To meet our goal, we [NASA] must make decisions based on the best information available. A key element in our decision making must be independent, up-front cost/benefit analyses. These analyses should represent a thorough review of the requirement identifying the costs and benefits of major decisions. The analyses should be of sufficient rigor to provide management with information it needs to make the best decisions as well as withstand the scrutiny of others.

CoSMO had not yet satisfied the Acting Deputy Administrator's expectations. Specifically, CoSMO personnel had not estimated the costs of bartered items (satellite imagery data) that NAVO wanted in exchange for providing secure supercomputer services to LaRC. (We confirmed NASA's authority to enter into this arrangement [Section 203(c) of the Space Act].)

At the time of our review, NAVO and CoSMO were working to finalize their MOU. According to CoSMO personnel, the MOU was to include the bartered items that NASA (through the Jet Propulsion Laboratory and the Stennis Space Center) would provide in exchange for NAVO's services. We believed CoSMO should not sign the MOU until it had determined the cost and feasibility of providing the bartered items. Without this determination, NASA would have been unable to ensure that the consolidation is cost-effective.

NASA Office of Inspector General personnel discussed the issues described in this report with the Director of CoSMO in October 1997. In response, the Director said CoSMO would determine the feasibility and cost of providing the bartered items before finalizing the MOU. In December 1997, the CoSMO Assistant Director stated that he was in the process of determining the feasibility and cost of the bartered items. He further stated that NAVO had previously been unable to fully determine its exchange requirements but had recently decided that the value of its service to NASA was \$200,000 annually. In return, NAVO wanted NASA to provide satellite imagery data of an equivalent value. The Assistant Director said he was determining the feasibility of NAVO's request. If CoSMO determined the feasibility and associated costs of the bartered items and ensured that all evidence is adequately supported, then it should have a sufficient basis for making its decision on the NAVO consolidation issue.

***SUPPORTING
DOCUMENTATION NOT
ADEQUATE***

CoSMO's Consolidation Study of Secure Supercomputing did not adequately support the Study's cost-benefit analyses and consolidation alternatives. While cost analyses were not applicable to 9 of 16 consolidation scenarios, the remaining scenarios had only partial or no data to support the conclusions reached. According to CoSMO's Consolidation Study of NASA Secure Supercomputing, the nine scenarios could not satisfy ARC's high-level data security requirements. Without adequate data, NASA management lacks assurance that it has pursued the most cost-effective alternative. Inadequate data was largely caused by (1) using unsupported data from another study and (2) not verifying data obtained from external sources. In addition, the CoSMO Assistant Director said he believed the benefits of the NAVO alternative significantly outweighed the other alternatives and thereby negated the need to gather further supporting documentation.

The following are examples of weaknesses in several of the scenarios.

- **LaRC to NAVO.** CoSMO did not have support for seven of the eight cost elements in its analysis. CoSMO either obtained the data orally (without documentation) or extracted unsupported data from another study. Also, the analysis did not include the one-time cost for encryption equipment needed at LaRC. The Assistant Director of CoSMO estimated the cost

of this equipment at \$20,000. Although the CoSMO analysis was incomplete and not fully supported, we believe the LaRC to NAVO scenario represented the best consolidation alternative because its potential benefits significantly exceeded the total costs associated with this scenario. See Appendix B, Chart 1, for a summary of the cost elements.

- LaRC to ARC. CoSMO did not have support for six of the eight cost elements in its analysis. CoSMO either obtained the data orally (without documentation) or extracted unsupported data from another study. See Appendix B, Chart 2, for a summary of the cost elements.
- LaRC to Army Research Laboratory (ARL). CoSMO reported total networking costs of \$50,000 a month; however, we found no documentation from ARL to support this amount. CoSMO did not determine any other costs for this scenario since the networking costs of \$600,000 annually exceeded the costs of the other scenarios.

Improved cost-benefit analyses are needed to provide management with the information it requires to make the best decisions. Current, accurate, complete, and adequately documented data are an essential component in this process.

***DELETED
RECOMMENDATION***

We made two recommendations in our draft report. We recommended that the CoSMO Director verify the cost-effectiveness and feasibility of providing bartered items in exchange for NAVO's secure supercomputing services, before finalizing the MOU with NASA. After issuance of the draft report, CoSMO decided to reimburse NAVO directly for supercomputing services rather than provide bartered items for those services. CoSMO expects to complete rate negotiations with NAVO by August 31, 1998. Therefore, we deleted the recommendation related to bartered items.

RECOMMENDATION

We recommend that the CoSMO Director use only current, accurate, complete, and adequately documented data in its consolidation decisions.

***MANAGEMENT'S
RESPONSE***

Management concurred with the recommendation. Management stated that CoSMO used current, complete, accurate and adequately documented data for the NAVO consolidation decision and will continue to do so for future consolidation decisions.

***EVALUATION OF
MANAGEMENT'S
RESPONSE***

Before CoSMO finalizes the MOU with NAVO, we would like to assess the adequacy of the data CoSMO will use to support the planned direct procurement of secure supercomputing services. Therefore, we request that the CoSMO provide us the data used to support the procurement so that we can close the recommendation.

DESCRIPTION OF CONSOLIDATION SCENARIOS

<u>SCENARIO</u>	<u>DESCRIPTION OF SCENARIO</u>	<u>WAS COST ANALYSIS DONE FOR SCENARIO?</u>
LaRC - ARC	Physical move of LaRC's Cray J916 and STK (small) mass storage system from LaRC, Hampton, Virginia, to ARC, Moffett Field, California.	Yes
ARC - LaRC	Physical move of all ARC secure supercomputing inventory to LaRC.	No, this scenario did not meet ARC's security requirements.
LaRC - Army Research Laboratory (ARL)	Physical move of LaRC's Cray J916 and STK (small) mass storage system to the ARL, which is a Department of Defense (DOD) Major Shared Resource Center (MSRC), in Aberdeen, Maryland.	No, however, the monthly network costs were reported to be \$50,000 per month, or \$600,000 annually. No other costs were determined. Also, only LaRC projects having DOD affiliation, or a DOD sponsor could run at the ARL MSRC.
LaRC - Naval Oceanographic Office (NAVO)	Physical move of LaRC's Cray J916 and STK (small) mass storage system to NAVO, a DOD Major Shared Resource Center, at Stennis Space Center, Mississippi.	Yes
LaRC - Fleet Numerical Meteorology and Oceanography Center (FNMOC)	Physical move of LaRC's Cray J916 and STK (small) mass storage system to the FNMOC, Monterey, California.	No, FNMOC had no firm estimates of what networking and other costs were for LaRC's share of operations and maintenance on FNMOC computer equipment.
LaRC- Lockheed Martin (Denver, Colorado)	Physical move of LaRC's Cray J916 and STK (small) mass storage system to a commercial Lockheed Martin secure facility at Denver, Colorado.	No, however, Lockheed provided a cost estimate of \$315,602 for labor, facilities and utilities, and customer administration and support. No other associated costs were determined.

DESCRIPTION OF CONSOLIDATION SCENARIOS

<u>SCENARIO</u>	<u>DESCRIPTION OF SCENARIO</u>	<u>WAS COST ANALYSIS DONE FOR SCENARIO?</u>
ARC - ARL	Physical move of ARC's Origin 2000 and SGI Power Challenge Array to the ARL in Aberdeen, Maryland; mass storage to remain at ARC due to the requirements of R&D and production supercomputing.	No, the ARL environment did not meet the security requirements of ARC secure projects.
ARC - NAVO	Physical move of ARC's Origin 2000 and SGI Power Challenge Array to NAVO at Stennis Space Center, Mississippi; ARC mass storage to remain at ARC due to the requirements of R&D and production supercomputing.	No, the supercomputing environment at NAVO did not meet the security requirements of ARC secure projects
ARC - FNMOC	Physical move of ARC's Origin 2000 & SGI Power Challenge Array to the FNMOC, Monterey, California; mass storage to remain at ARC due to requirements of R&D and production supercomputing.	No, the secure supercomputing environment at FNMOC did not meet the security requirements of ARC secure projects. Also, FNMOC had no plans to upgrade to the next generation hardware.
ARC - Lockheed Martin (Denver, Colorado)	Physical move of ARC's Origin 2000 and SGI Power Challenge Array to a commercial Lockheed Martin secure facility at Denver, Colorado; Mass storage to remain at ARC due to the requirements of R&D and Production supercomputing.	No, the supercomputing environment at Lockheed did not meet the security requirements of ARC secure projects.
ARC & LaRC - ARL	Physical move of ARC's Origin 2000 and SGI Power Challenge Array and LaRC's Cray J916 and STK (small) mass storage system the to ARL in Aberdeen, Maryland; mass storage to remain at ARC due to the requirements of R&D and production supercomputing.	No, the ARL environment did not meet the security requirements of ARC secure projects. This scenario was not considered feasible or economical.

DESCRIPTION OF CONSOLIDATION SCENARIOS

<u>SCENARIO</u>	<u>DESCRIPTION OF SCENARIO</u>	<u>WAS COST ANALYSIS DONE FOR SCENARIO?</u>
ARC & LaRC - NAVO	Physical move of ARC's Origin 2000 and SGI Power Challenge Array and LaRC's Cray J916 and STK (small) mass storage system to NAVO; ARC mass storage to remain at ARC due to the requirements of R&D and production supercomputing.	No, the supercomputing environment at NAVO did not meet the security requirements of ARC. Also, this scenario was not considered feasible or economical.
ARC & LaRC - FNMOC	Physical move of ARC's Origin 2000 and SGI Power Challenge Array and LaRC's Cray J916 and STK (small) mass storage system to FNMOC; ARC mass storage to remain at ARC due to the requirements of R&D and production supercomputing.	No, the supercomputing environment at FNMOC did not meet the security requirements of ARC. This scenario was not considered feasible or economical.
ARC & LaRC - Lockheed Martin (Denver, Colorado)	Physical move of ARC's Origin 2000 & SGI Power Challenge Array and LaRC's Cray J916 and STK mass storage system to a Lockheed Martin secure facility at Denver, Colorado; ARC mass storage to remain at ARC due to other supercomputer requirements.	No, the supercomputing environment at Lockheed Martin did not meet the security requirements of ARC. This scenario was not considered feasible or economical.
ARC & LaRC - Department of Energy (DOE)/ National Energy Scientific Super-computing Center (NERSC)	Request made for NERSC, a DOE site at Berkeley, California, to perform secure supercomputing; no moves of existing supercomputing inventory to be made.	No, DOE/NERSC did not perform secure supercomputing and was not interested.
ARC & LaRC - Cray/Silicon Graphics (SGI)	Scenario to consider outsourcing NASA secure supercomputing; no moves of existing NASA supercomputing inventory to be made.	No, SGI did not express any interest in performing supercomputing services for NASA. Also, SGI did not have facilities that could handle the NASA secure supercomputing requirements.

COST ELEMENTS FOR LARC TO NAVO AND LARC TO ARC SCENARIOS

Chart 1 LaRC to NAVO Consolidation			
Cost Element	Type Cost	Supported By Documentation	Amount
De-install J916	Nonrecurring	No ⁽¹⁾	\$ 2,000
Pack/Ship	Nonrecurring	No ⁽¹⁾	6,354
Re-host Mass Storage	Nonrecurring	Not Applicable	0
Start-up Costs	Nonrecurring	Not Applicable	0
Application Re-host	Nonrecurring	Not Applicable	0
Mass Storage Provision	Nonrecurring	Not Applicable	0
Cost to Install	Nonrecurring	No ⁽²⁾	0
Encryption Equipment	Nonrecurring	Not included ⁽³⁾	20,000
Decrease Labor - LaRC	Recurring	Yes	237,000
Decrease Facilities - LaRC	Recurring	No ⁽¹⁾	10,000
Increase Facilities - NAVO	Recurring	No ⁽²⁾	0
Increase Labor - NAVO	Recurring	No ⁽²⁾	0
Increase Networking	Recurring	No ⁽²⁾	0

Chart 2 LaRC to ARC Consolidation			
Cost Element	Type Cost	Supported By Documentation	Amount
De-install J916	Nonrecurring	No ⁽¹⁾	\$ 2,000
Pack/Ship	Nonrecurring	No ⁽¹⁾	6,354
Re-host Mass Storage	Nonrecurring	Not Applicable	0
Start-up Costs	Nonrecurring	Not Applicable	0
Application Re-host	Nonrecurring	Not Applicable	0
Mass Storage Provision	Nonrecurring	Not Applicable	0
Cost to Install	Nonrecurring	No ⁽¹⁾	4,800
Encryption Equipment	Nonrecurring	Not Applicable	0
Decrease Labor - LaRC	Recurring	Yes	237,000
Decrease Facilities - LaRC	Recurring	No ⁽¹⁾	10,000
Increase Facilities - ARC	Recurring	No ⁽¹⁾	20,000
Increase Labor - ARC	Recurring	No	200,000
Increase Networking	Recurring	Yes	285,000

⁽¹⁾ Cost estimates were extracted from CoSMO's Optimal Architecture Study. The costs were not verifiable from available documentation.

⁽²⁾ CoSMO personnel said installation, operations, and maintenance would be provided at no cost. No documentation existed to support this assertion.

⁽³⁾ CoSMO personnel did not include encryption equipment costs in the cost analysis. These costs were identified after the consolidation study was completed.

OBJECTIVES, SCOPE, AND METHODOLOGY

OBJECTIVES

The overall objective of the audit was to determine whether CoSMO's cost-benefit analysis adequately supported the planned supercomputer consolidation. This report discusses secure supercomputing consolidation; production, and research and development supercomputing will be addressed in a separate report. Specifically, we performed the audit to determine whether:

- cost and other related data identified for the analysis were current, accurate, and complete;
- appropriate analytical methods and assumptions were applied to the data; and
- claimed benefits were realistic and properly valued.

SCOPE AND METHODOLOGY

To determine whether CoSMO's cost-benefit analysis adequately supported the planned supercomputer consolidation decisions, we reviewed:

- OMB Bulletin 96-02, Consolidation of Agency Data Centers; and
- available documentation supporting the Consolidation Study of NASA Secure Supercomputing.

We also discussed the procedures used to develop the Consolidation Study of NASA Secure Supercomputing with NASA (including CoSMO) personnel.

AUDIT FIELD WORK

Audit field work was conducted from August 1997 through February 1998. We performed the audit in accordance with generally accepted government auditing standards.

MANAGEMENT'S RESPONSE

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000



Reply to A-1101

J:241-11

June 15, 1998

TO: NASA Headquarters
Attn: W/Assistant Inspector General for Auditing

THRU: R/Associate Administrator, Aeronautics and Space Transportation Technology *for W. Coleman*

FROM: Jana M. Coleman, Director of Center Operations

SUBJECT: Draft Report on the Audit of Consolidation Decision for Secure Supercomputers,
A-HA-98-008

The Center has reviewed the May 14, 1998, draft report and appreciates the opportunity to respond. The following are the Center responses to the recommendations:

Recommendation 1: Verify the cost-effectiveness and feasibility of providing bartered items in exchange for NAVO's secure supercomputing services, before finalizing its MOU with NAVO.

Response: Partially Concur. During the MOU negotiations with NAVO, bartering of items in exchange for NAVO's secure supercomputing services was an alternative considered. However, that alternative was not chosen. The alternative agreed upon in June 1998 was to pay NAVO directly for these services. Preliminary discussions on rates with NAVO compare favorably with FY 98 CoSMO supercomputing rates. The final MOU, with exact rates, is expected to be completed and signed by August 31, 1998. CoSMO will verify the cost-effectiveness of the rates before finalizing the MOU with NAVO. We partially concur with this recommendation, however, since there are no bartered items in the MOU, it is not possible to verify cost-effectiveness of bartered items. The feasibility of providing bartered items was a major issue that was considered during the MOU negotiations.

Cost benefit analyses of options were still ongoing as negotiations were being held with NAVO regarding reimbursement for providing NASA secure supercomputing services. The May 14, 1998, draft audit report was prepared prior to the completion of negotiations. The "Audit Results" section provides comments on one of the alternatives, which was not selected. CoSMO could not present a cost-benefit analysis of bartered items until NAVO identified exactly which NASA items they wished to barter. Because NAVO could not agree internally on what data, services, or combination thereof, they desired from NASA, we ultimately settled on the alternative to pay NAVO directly for secure supercomputing services.

Estimated completion date on this recommendation is August 31, 1998.

Recommendation 2: Use only current, accurate, complete, and adequately documented data in its consolidation decisions.

Response: Concur. The data used to make this consolidation decision was current, accurate, complete, and adequately documented, and available to both NASA and NAVO. CoSMO will use only current, accurate, complete, and adequately documented data in future consolidation decisions. The action was completed June 8, 1998, after discussion with the NAVO Major Shared Resource Center (MSRC) Manager.

This recommendation is considered closed.

MANAGEMENT'S RESPONSE

J:241-11

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Should you have any questions regarding our response, please contact Katie Garcia at (650) 604-5669.


Jana M. Coleman

cc: NASA HQ/Code JM

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