W March 9, 1999

TO: AA/Director, Johnson Space Center

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Report on the Audit of Space Station Contingency Planning for International Partners (Assignment Number A-HA-98-031) Report Number IG-99-009

The subject final report is provided for your use and comments. Please refer to the Executive Summary for the overall audit results. Our evaluation of your response is incorporated into the body of the report. We incorporated, where appropriate, changes suggested by the Office of External Relations. The corrective actions planned for recommendation 2 were responsive. We request that you notify us when the actions are completed including the extent of testing performed to ensure corrective actions are effective. Recommendation 2 will remain undispositioned and open for reporting purposes until the planned corrective actions are implemented and determined to be effective. The proposed actions on recommendation 1 were not fully responsive. We request that management reconsider its position on the recommendation and provide additional comments by April 8, 1999. Recommendation 1 is unresolved until we reach an agreement on corrective actions and undispositioned until the agreed-upon corrective actions are implemented and determined to be effective.

If you have questions concerning the report, please contact Mr. Dennis E. Coldren, Program Director, Human Exploration and Development of Space Audits, at 281-483-4773, or Mr. Kenneth E. Sidney, Auditor-in-Charge, at 281-483-0728. We appreciate the courtesies extended to the audit staff. See Appendix D for the report distribution.

[original signed by]
Russell A. Rau

Enclosure

cc:
B/Chief Financial Officer
G/General Counsel
I/Office of External Relations
M/Associate Administrator for Space Flight
JM/Director, Management Assessment Division

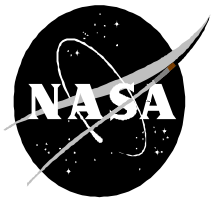
bcc:
AIGA, IG Reading (w/o Encl) Chrons
Q-1/N. Starkey
W/L. Ball
D. Coldren
K. Sidney
K. McDonald
JSC/BD5/P. Ritterhouse

IG-99-009

AUDIT REPORT

SPACE STATION CONTINGENCY PLANNING FOR INTERNATIONAL PARTNERS

March 9, 1999



National Aeronautics and
Space Administration

OFFICE OF INSPECTOR GENERAL

Additional Copies

To obtain additional copies of this audit report, contact the Assistant Inspector General for Auditing at 202-358-1232.

Suggestions for Future Audits

To suggest ideas for or to request future audits, contact the Assistant Inspector General for Auditing. Ideas and requests can also be mailed to:

Assistant Inspector General for Auditing
NASA Headquarters
Code W, Room 8V69
300 E Street, SW
Washington, DC 20546-1000

NASA Hotline

To report fraud, waste, abuse, or mismanagement, contact the NASA Office of Inspector General Hotline by calling 1-800-424-9183, 1-800-535-8134 (TDD), or by writing the NASA Inspector General, P.O. Box 23089, L'Enfant Plaza Station, Washington, DC 20026. The identity of each writer and caller can be kept confidential, upon request, to the extent permitted by law.

Acronyms

NPG	NASA Procedures and Guidelines
OMB	Office of Management and Budget

Contents

NASA Office of Inspector General

IG-99-009
AHA-98-031 **March 9, 1999**

Space Station Contingency Planning for International Partners

Executive Summary

Background. The International Space Station (the Space Station) Program Office (the Program Office) is responsible for building and operating the Space Station and for ensuring that it is safe, productive, affordable, and on schedule. A 1998 agreement[1] between NASA and each of the Space Station international partners[2] established the international partner contributions and levels of participation. Under the Space Station Agreement, the international partners agreed to provide and support critical Space Station hardware and functions that include guidance, navigation, control, propulsion, life support, extravehicular robotics, crew rescue capability, research modules and pressurized and unpressurized logistics resupply. Because the Space Station Program depends on timely and reliable performance and support from the international partners, adequate plans must exist to respond to international partner contingencies that could jeopardize Space Station survival and successful assembly.

Objectives. The overall objective was to determine whether NASA had developed adequate plans for international partner contingencies that present risks to the Space Station Program. Specific objectives were to determine whether NASA had identified significant international partner contingencies and had developed adequate plans to prevent and/or mitigate them. Also, we determined whether NASA was effectively updating and revising its contingency plans. Details on the objectives, scope, and methodology used for this audit are in Appendix A.

Results of Audit. The Space Station Program Office had developed a draft "International Space Station Program: Overview of Contingency Plans" (the Program contingency plan). A section of the plan identified 14 critical international partner contingencies (see Appendix B) that could cause a serious threat to Space Station assembly and operations. However, this section of the Program contingency plan did not include or clearly identify several critical elements for effective risk management, as required by Agency guidance. Specifically, the plan did not contain cost and schedule impacts and did not clearly identify mitigation measures and primary consequences of the contingencies. Further, the Program Office did not have a process that ensured the contingency plan was kept current. Specifically, the Program plan did not include some actions being taken to prevent further Russian delays. Also, the contingency plan did not address the Year 2000

---

[1]NASA and the international partners signed an agreement concerning cooperation on the International Space Station in Washington, D.C., on January 29, 1998.

[2]The Space Station international partners are the Russian Space Agency, the Canadian Space Agency, the National Space Development Agency of Japan, the European Space Agency, the Italian Space Agency, and the Brazilian Space Agency.

computer problem.[3] Until the Program contingency plan is complete, NASA cannot fully reduce Space Station risks through advance planning and the establishment of response plans. Further, without estimated costs, the Agency, the Administration, and the Congress cannot adequately assess the feasibility of proposed responses or determine budgetary impact.

Recommendations. NASA should establish procedures to ensure the Program contingency plan complies with Agency guidance for effective risk management and establish a process to ensure the contingency plan is kept current.

Management's Response. Management concurred with the intent of the recommendations and stated it was fully complying with NASA Procedures and Guidelines (NPG) 7120.5A, "NASA Program and Project Management Processes and Requirements," April 3, 1998, through its Space Station Risk Management System, which, by extension, includes the contingency plan. Management agreed to include risk mitigation measures, consequences, and schedule impacts in future updates to the contingency plan and to implement regular reviews and updates to the plan. However, detailed cost would be maintained in a separate table rather than in the plan because the cost data is sensitive information. Further, the Year 2000 issue would not be included in the plan because it is a design issue and the plan is intended to cover assembly and operations issues. In addition, management did not specify in the contingency plan actions to prevent further Russian delays, such as Space Shuttle Orbiter modifications and the $60 million Russian contract, because those actions had not yet been finalized.

Evaluation of Response. Management's planned actions are responsive to include risk mitigation measures, consequences, and schedule impacts in the contingency plan and to conduct regular reviews and keep the contingency plan current. In addition, management's alternative plan to maintain cost information in a separate table is responsive. However, the Program contingency plan does not comply with NPG 7120.5A as a result of the stated compliance of the Space Station Risk Management System[4] because, as management acknowledged, the Program contingency plan contains scenarios not found in the Risk Management System. Further, management's decision to exclude from the contingency plan the Year 2000 issue and the planned actions to prevent further Russian delays is not responsive. Therefore, we request that management further review its position on these matters and provide additional comments.

---

[3]The Year 2000 problem relates to the potential problems that might occur with computer hardware and software that need to correctly interpret year-date data represented in 2-digit-year format. If the problem is not corrected, critical computer systems could malfunction or produce incorrect information causing costly delays or safety problems.

[4]Although we obtained an understanding of the Risk Management System, our audit objective was not to determine whether the Space Station Risk Management System complied with NPG 7120.5A, but to determine the adequacy of plans for international partner contingencies that present a risk to the Space Station Program.

Introduction

Effective risk management is important to ensure that the Space Station is delivered within cost, schedule, and technical requirements. The Program contingency plan is part of the Program Office's overall risk management process as well as the Risk Data Management Application database (risk database, which is discussed below). Additionally, NASA management and international partners meet frequently to discuss issues and risks that affect the Space Station.

The Program Office developed the Program contingency plan to cover all contingencies that would stop or significantly delay the assembly of the Space Station. The Program Office designed the plan to provide Program management with insight on how to respond and when decisions must be made to minimize the consequences of contingencies that affect Space Station assembly. If a contingency scenario occurred, such as the loss of the Functional Energy Block,[5] the response documented in the draft Program contingency plan would be the starting place for the Program Office's response. The Program Office included in the Program contingency plan the scenarios that had a high consequence to the Space Station. When these high consequence scenarios are imminent, the Program Office inputs them into the risk database.

The Program Office uses the risk database primarily to track the status of Space Station risks. Sponsoring Program Office organizations identify and rank undesirable situations based on the likelihood and consequence of their occurrence. Subsequently, risk review panels like the Space Station Mission Integration Control Panel determine which undesirable situations should be elevated to risks, maintain the electronic files in the risk database, and remove risks from the database when the closure/acceptance criteria has been satisfied. The panels also elevate risks with high likelihood and consequence to top Program risks. Program management discusses top Program risks at the monthly Program Risk Advisory Board and Program Monthly Review meetings.

Also, Agency management discusses Space Station contingencies through several additional venues. Specifically, NASA management discusses Space Station risks during the Lead Center Saturday morning review meetings, the monthly Station Development and Operations Meetings, and the Lead Center Program Management Council meetings. Also, NASA Headquarters discusses Space Station risks during its meetings of the Office of Space Flight Management Council and Headquarters Program Management Council. NASA management also discusses risks with the international partners at Joint Program Reviews, Space Station Control Board meetings, Multi-Lateral Control Boards (Headquarters chaired), and Heads of Agency meetings.

[5]The Functional Energy Block is a self-sufficient orbital transfer vehicle that contains propulsion, guidance, navigation and control, communications, electrical power, thermal control systems, and stowage capacity. NASA contracted for this element to be built by the Russian Space Agency. The Functional Energy Block was the Space Station's first hardware element (launched November 20, 1998).

Finding and Recommendations

Contingency Planning Process

The Space Station Program Office had not developed an integrated and comprehensive contingency plan to address risks to the successful assembly of the Space Station by the possible delay or default of the international partners. The contingency plan did not contain or clearly identify several critical elements for effective risk management, as required by Agency guidance. Specifically, the Program contingency plan did not contain cost and schedule impacts and did not clearly identify risk mitigation measures and primary consequences of the contingencies. The Program contingency plan did not contain and clearly identify the required elements because the Program Office had not based the design of the plan on Agency guidelines. Further, certain Agency actions planned and being implemented to prevent additional schedule delays caused by shortfalls in Russian participation had not been incorporated into the contingency plan. This omission occurred because the Program Office had not implemented a process that ensured the Program contingency plan was kept current. Also, the contingency plan did not address the Year 2000 computer problem. The Program Office acknowledged the Year 2000 issue was inadvertently omitted and would be addressed in future updates to the plan. The Agency cannot effectively manage Space Station risks until mitigation measures including cost and schedule impacts are developed and compared to the costs of accepting the risks and until a process is implemented to ensure the contingency plan is kept current. Further, until the plan is complete, the Administration and Congress cannot assess the feasibility of the proposed contingency responses or determine the budgetary impacts.

Requirements for Effective Risk Management

Office of Management and Budget (OMB) Circular No. A-123, "Management Accountability and Control," issued in August 1986 and updated in June 1995, requires that Federal agencies establish policy to ensure that reliable and timely information is obtained, maintained, reported, and used for decision making. NPG 7120.5A implements OMB Circular No. A-123 and requires that each Agency program establish an effective risk management process. According to NPG 7120.5A, risk management is a continuous process that:

- identifies risks;
- analyzes their impact and prioritizes them;
- develops and carries out plans for risk mitigation, acceptance, or other action;
- tracks risks and the implementation of mitigation plans;
- supports informed, timely, and effective decisions to control risks and mitigation plans; and
- assures that risk information is communicated among all levels of a program/project.

NPG 7120.5A also requires that for each primary risk, a program should develop and maintain: (1) a description of the risk, including primary causes and contributors, actions taken to reduce or control the risk, and information collected for tracking purposes; (2) primary consequences should the undesired event occur; (3) an estimate of the probability; (4) significant cost estimates; (5) significant schedule impacts; (6) potential additional mitigation measures; and (7) characterization of the risk as acceptable or unacceptable with supporting rationale.

NPG 7120.5A superseded NASA Handbook 7120.5, "Program and Project Management," November 1993, which was in effect when the Program Office began development of the Program contingency plan. NASA Handbook 7120.5 required that risk management be part of program planning and control. It specifically required:

- characterization of all specific risks identified for the program, including technical, programmatic, supportability, and cost and schedule risks;

- description of the methodologies and processes used to identify, assess, and analyze the program risks;

- description of the plans for mitigating and tracking the program risks, including appropriate plans for removing the risks and technology development plans with supporting rationale; and

- delineation of responsibilities within the program for the implementation of the risk mitigation and tracking plans.

Development of the Contingency Plan

In February 1998, the Program Office initiated plans to:

- develop a contingency planning document that summarizes Space Station contingency plans;

- establish a process for updating the plan whenever significant Program changes occur;

- establish a process for developing and documenting contingency planning requirements in the Space Station Program requirements documents such as the Incremental Design Review Documents;

- establish a process for the flight-by-flight review of contingency plans to ensure adequacy; and

- conduct a flight review for the launch of the Functional Energy Block.

However, the Program Office had not effectively implemented a process that ensured the Program contingency plan was kept current and contained all significant Agency actions planned and taken in response to international partner participation.

The Program Office issued the first draft of the Program contingency plan in April 1998 and issued updated drafts in July and September 1998. In the September draft, the Program Office added one scenario for the Brazilian Space Agency participation. The Program Office created the contingency plan by compiling data sheets developed by NASA's technical personnel. The data sheets were designed to describe the contingency scenarios, discuss response strategies, and provide decision dates for taking corrective actions. The Program contingency plan refers the users to the technical personnel for further information. Lastly, the plan identifies contingencies that the Program Office considers to be on the critical path for Space Station assembly.

Mitigation Measures, Consequences, and Cost and Schedule Impact

The September 1998 draft contingency plan described the contingency scenarios and formulated the response strategies. However, the plan did not contain significant cost and schedule impacts and did not clearly identify mitigation measures and primary consequences of the contingencies. Also, the Program Office had not identified decision dates for implementing corrective actions for 7 of the 14 partner contingencies.

While the Program contingency plan describes international partner contingencies that could adversely affect Space Station assembly and provides response strategies, the plan does not clearly identify mitigating actions that should be implemented, when feasible, to prevent the contingencies from occurring. The Program Office should decide whether it is best to use scarce resources and try to prevent the problem from occurring or to accept the undesirable event. To make informed and timely decisions needed to manage international partner contingencies, the Program Office should develop, execute, and track the implementation of risk mitigation plans as required by Agency guidance.

The Program Office determined neither the cost of implementing mitigating measures to avoid the contingencies nor the cost of implementing the contingency response strategies that are currently in the contingency plan. Although the consequence to the Program would be severe if the partner contingencies occurred, Program management stated that most of the partner contingencies in the contingency plan, excluding the Russian contributions, had a low likelihood for occurrence.

The Program Office typically does not estimate the cost of contingencies until it is imminent that alternative actions must be implemented in order to proceed with planned operations. Further, the Program Office had concerns regarding the political ramifications that could occur if potentially high estimated costs are disclosed in the contingency plan and was reluctant to prepare cost estimates for the international partner contingencies. However, without supporting cost data, NASA management cannot adequately assess the feasibility of partner contingencies, decide whether and when to implement mitigating measures, or determine the budgetary impact if it becomes necessary to fund and implement the proposed responses to the contingency scenarios.

Further, the President and Congress cannot effectively evaluate the prudence of NASA's proposals for addressing partner contingencies unless cost estimates are available.

Several Program officials agreed that the cost of partner contingencies should be estimated so that the Program Manager can determine resource requirements. When determining how best to estimate contingency costs and the level of detail needed to support those cost estimates, NASA should consider the impact, in terms of consequence and likelihood, of the partner contingencies and the status of Space Station funding.

The Program contingency plan did not clearly and fully identify primary consequences if the international partner contingencies occurred. While the contingency plan provided a short description of the partner contingency scenarios, included a table that briefly defines the functionality of the major partner contributions, and mentioned various dates for implementing the proposed response strategies, the contingency plan did not clearly specify the significant, adverse consequences that the Program would experience or how long and to what extent Space Station assembly would be delayed and affected by the international partner contingencies.

Year 2000 Computer Problem

The Year 2000 problem relates to the way dates are recorded and computed in many computer systems, most of which were designed to use two digits to represent the year. However, with the two-digit format, the Year 2000 cannot be differentiated from 1900, 2001 cannot be differentiated from 1901, and so on. After 1999, computer systems and application programs could generate incorrect results when dates are used to perform calculations, make comparisons, or perform sorting exercises. Correcting the problem to ensure information systems accurately process date data from, into, and between the 20th and 21st centuries will require that all mission-critical computer systems be identified and converted so that the year is represented by four digits rather than two digits.

The Space Station Program Manager had been working with the international partners to develop an integrated solution to the Year 2000 problem. During July 1998, the Program Manager sent letters to the international partners that acknowledged their commitment to cooperatively work toward a solution to the Year 2000 problem, recognized the Year 2000 work performed up to that time, and requested additional information to ensure all Space Station participants were working toward an integrated solution. Still, the Program contingency plan did not address the Year 2000 problem. The Program officials acknowledged the omission and responded that they would work with the Space Station contractor to ensure that future updates to the contingency plan appropriately address risks associated with Year 2000 implementation issues. Until the Year 2000 problem is adequately resolved, there is a risk of widespread computer system failures. A contingency plan must describe the steps that will be taken, including the activation of manual or contract processes, to ensure the continuity of critical operating processes in the event of a Year 2000-induced computer system failure.

Actions to Prevent Schedule Delays Caused by Russian Shortfalls

The Program contingency plan did not contain some Agency actions that were planned or being implemented to prevent schedule delays that could occur if the Russian contributions are not provided as planned. The Program Office had discussed the plans and actions with NASA Headquarters and Congress but had not included them in the Program contingency plan. Specifically, the plan did not include NASA actions to modify the Space Shuttle Orbiter to support Space Station reboost missions[6] or the purchase of goods and services from Russia as a means to supply funds needed to complete the development of Russian elements for the Space Station.

Modifying the Orbiter to Support Reboost Missions. NASA had initiated actions to modify the Space Shuttle Orbiter to support additional Space Station reboost missions in case there were short-term *Progress*[7] shortfalls. The Space Shuttle vehicles, as currently configured, can use their Reaction Control System to provide Space Station reboost through Flight 12A (now scheduled for May 2001). Following Flight 12A, the weight of the Space Station will have reached the point where the propellant required for Space Station reboost can no longer be provided solely by the Space Shuttle Reaction Control System. Currently, the Program contingency plan calls for increased reliance on the Autonomous Transfer Vehicle for reboost, propellant resupply, and dry cargo resupply if the Russian Space Agency is unable to meet the planned *Progress* flight rate for a short period of time. The Program Office has begun actions to modify the Space Shuttle Orbiter to provide reboost to the Space Station although the modification is not currently incorporated into the contingency plan. Specifically, the Program Office has provided the Space Shuttle Program Office with $23 million that is being used to fund a study to determine the detail design and to pay for the engineering drawings required before the Space Shuttle can be modified to support Space Station reboost missions. Boeing, a subcontractor to United Space Alliance, the Space Shuttle prime contractor, has almost completed the study phase that began in late July 1998. It will cost about $90 million to modify all four Space Shuttle vehicles to support Space Station reboost missions. Boeing will perform the Space Shuttle modifications during scheduled Orbiter maintenance down periods.

Purchasing Goods and Services from the Russian Space Agency. In October 1998, NASA planned to pay about $660 million[8] over the next 4 years to the Russian Space Agency and other Russian entities for goods and services related to the Space Station. NASA concluded that the Russian Space Agency needed immediate funding to help ensure timely delivery of the critical Russian Service Module and to avoid costly delays in the first launches of Space Station hardware. Therefore, during October 1998, NASA obtained congressional approval to reallocate $60 million in fiscal year 1998 Space Station funds for the purchase of goods and services to help ensure the completion and launch of the Service Module by summer 1999. In light of the

[6]Reboost missions involve Russian *Progress* and Space Shuttle vehicle missions for which propellants are burned in order to raise the altitude and to maintain the planned orbit of the Space Station.

[7]The *Progress* is an unmanned Russian spacecraft that will be used to transport propellants and dry cargo to the Space Station.

[8]In December 1998, OMB limited total spending to $160 million ($60 million in FY1998 funds and $100 million in FY1999 funds) for Russian goods and services related to the Space Station.

increased uncertainty in the Russian economic situation, NASA plans to begin a buildup of U.S. capability, which would allow NASA to operate the Space Station without dependence on Russian capabilities, while simultaneously procuring specific critical requirements from Russia at appropriate intervals before achieving U.S. self-reliance. NASA estimates that this buildup will be completed by 2003. During December 1998, NASA met at the Johnson Space Center with the Russian Space Agency and began negotiations to ensure the availability of Russian *Progress* and *Soyuz*[9] vehicles and to provide for the integrated testing and launch processing of the Russian Service Module in the event Russian government funding is not forthcoming.

Recommendations, Management's Response, and Evaluation of Response

1. The Director, Johnson Space Center, should develop and implement procedures to ensure the Space Station Program contingency plan complies with Agency guidance for effective risk management. Specifically, the plan should clearly describe and fully address:

- **Risk mitigation measures, primary consequences, and schedule and cost impacts for each international partner scenario, as required by NPG 7120.5A.**
- **The Year 2000 computer implementation problem.**
- **All actions planned or implemented in response to the international partner contingencies.**

Management's Response. Concur with the intent. The International Space Station Risk Management System complies with NPG 7120.5A, and the contingency plan is not meant to displace but rather be an extension of the Risk Management System. Risk mitigation measures, consequences, and schedule impacts will be included in subsequent updates to the contingency plan. Also, detailed cost is sensitive information and will be maintained in a table separate from the contingency plan. The Program Office will ensure Year 2000 compliance. However, the Year 2000 issue is a design issue and the plan is intended to cover assembly and operations issues; therefore, the Program Office will not include it in the contingency plan. Because some actions and plans implemented in response to Russian contingencies had not yet been agreed upon by NASA or the Congress, those actions were not included in the contingency plan.

The complete text of management's comments is in Appendix C.

Evaluation of Response. Management's planned actions to include risk mitigation actions, consequences, and schedule impacts in the contingency plan are responsive. Further, although management did not agree to include cost information in the plan because of the sensitivity of reporting that information, its alternative action to maintain cost data in a separate table is also responsive. However, management's other comments are not fully responsive.

[9]The *Soyuz* is a manned Russian spacecraft that will be used to support crew rotation and crew rescue missions for the Space Station, pending delivery of a U.S.-built Crew Return Vehicle in 2003.

Concerning the Year 2000 issue, if management has determined that the contingency plan is not the appropriate vehicle for addressing that issue, then the contingency plan should describe how the Risk Management System and technical management process are being used to resolve the Year 2000 problem.[10]

During the audit, management confirmed that the Program contingency plan was a complete and stand-alone document that incorporated all Program contingencies with a high risk to the assembly of the Space Station and that the information was not contained elsewhere in its entirety. Our report discusses the Program's risk management process (or Risk Management System) and the various ways the Program Office addresses risk. However, none of those venues duplicated or included all the scenarios in the Program contingency plan. Management acknowledged that the Program contingency plan includes assembly contingencies not included in the Risk Management System. Therefore, the Program contingency plan does not comply with NPG 7120.5A because of the stated compliance by the ISS Risk Management System.[11] In addition, management did not agree to include all actions planned and implemented in response to international partner contingencies because actions had not been finalized. Management plans and actions, whether finalized or not, that have been designed to effectively mitigate significant Space Station risks, should be included in the contingency plan. Therefore, the contingency plan should include management actions such as the planned Orbiter modifications and the potential additional funding to the Russian contract that have been designed to respond to Russian contingencies.

We request that management further review its position and provide additional comments on how the Program will ensure that the contingency plan complies with Agency guidance for effective risk management.

2. The Director, Johnson Space Center, should develop and implement procedures to ensure the Space Station Program contingency plan is kept current.

Management's Response. Concur with the intent of the recommendation. The Program Office will institute a regular review and update of the contingency plan to ensure consistency with budget revisions and strategies and assembly sequence changes.

Evaluation of Response. The actions planned by management are responsive to the recommendation.

[10]We are reviewing Year 2000 compliance in a series of other audits.

[11]Although we obtained an understanding of the Risk Management System, our audit objective was not to determine whether the Space Station Risk Management System complied with NPG 7120.5A, but to determine the adequacy of plans for international partner contingencies that present a risk to the Space Station Program.

Appendix A. Objectives, Scope, and Methodology

Objectives

The overall objective was to determine whether NASA has established adequate contingency plans to accommodate changes by the international partners for the Space Station. Our specific objectives were to evaluate the Space Station Program Office international partner contingency planning effort to:

- identify potential Program changes by international partners including risk assessments and Program cost/schedule impacts;
- develop adequate contingency plans; and
- monitor and periodically revise contingency plans as necessary.

Scope and Methodology

In conducting the audit, we interviewed cognizant NASA personnel and reviewed the:

- January 29, 1998, Agreement Among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station and the implementing Memorandums of Understanding.
- June 24, 1998, congressional hearing before the House of Representatives Committee on Science concerning the Administration's plan to resolve significant Space Station issues.
- NASA Administrator's September 29, 1998, congressional testimony concerning NASA's plans to purchase goods and services from Russia so that the Russian Space Agency will have the funds to complete and deliver near-term Russian Space Station elements.
- Program Office's April, July, and September 1998 drafts of the contingency plan for international partner contingencies.
- Program Office's risk management process.
- Office of Inspector General Report No. JS-96-007, "Russian Involvement in the International Space Station Program," September 26, 1996, related General Accounting Office audit reports, and the independent NASA Advisory Council's April 1998 Cost Assessment and Validation Report on risk areas to the Space Station.

Further, we attended:

- The Town Meeting at the Johnson Space Center presented by Congressman James Sensenbrenner, Chairman of the House Science Committee, August 28, 1998.

- The Space Station Program Monthly Review, August 25, 1998.

Management Controls Reviewed

We reviewed OMB Circular No. A-123, "Management Accountability and Control," issued August 1986 and updated in June 1995, which provides guidance to Federal managers on improving the accountability and effectiveness of Federal programs and operations by establishing, assessing, correcting, and reporting on management controls. Also, we reviewed NASA Policy Directive 7120.4A, "Program/Project Management," November 14, 1996; NASA Handbook 7120.5, "Program and Project Management," November 1993; and NASA Procedures and Guidelines 7120.5A, "NASA Program and Project Management Processes and Requirements," April 3, 1998, which establish requirements for the effective management of Agency programs. Management control over implementation of the OMB and Agency guidance was not adequate to ensure compliance with the requirements of NPG 7120.5A. Details are in the finding.

Audit Field Work

We conducted field work from March through October 1998 at the Johnson Space Center. The audit was performed in accordance with generally accepted government auditing standards.

Appendix B. Contingency Scenarios for International Partners

Title of Scenario (See Note 1)	Functionality of System	Contingency Scenario Described	Response Strategies Formulated	Decision Date Provided*
Russian Space Agency:				
1. Russian Withdrawal Or Delay	(See Note 2)	Yes	Yes	No
2. *Progress* Shortfall or Loss	Vehicle providing propellant resupply, attitude reboost, and dry cargo resupply.	Yes	Yes	No
3. *Soyuz* Shortfall or Loss	Vehicle providing crew rotation and rescue.	Yes	Yes	No
4. Functional Energy (or Cargo) Block Loss (See Note 3)	Module providing propulsion, attitude control, fuel storage, service area, and living and experimentation space.	Yes	Yes	Yes
5. Service Module Loss	Module providing attitude and reboost control, communications, electrical power generation, life support, supplies and storage, crew systems and mechanism control.	Yes	Yes	No
6. Solar Power Platform Late	Element providing increased power and thermal rejection capability.	Yes	Yes	N/A
7. Russian Contingency Plan	(See Note 4)	N/A	N/A	N/A
European Space Agency:				
8. Autonomous Transfer Vehicle Shortfall/Loss	Nonreusable vehicle providing delivery and removal of cargo, and reboost and refueling.	Yes	Yes	Yes
Italian Space Agency:				
9. Mini-Pressurized Logistic Module Shortfall or Loss	Carrier providing pressurized dry cargo.	Yes	Yes	N/A
Canadian Space Agency:				
10. Space Station Remote Manipulator System Loss	Manipulator system or a robotic arm to assist in the maintenance of the station.	Yes	Yes	N/A
11. Mobile Servicing System Loss	Transport device to move the remote manipulator system.	Yes	Yes	No
12. Special Purpose Dexterous Manipulator Loss	Manipulator system to assist in maintenance of the station.	Yes	Yes	No
National Space Development Agency of Japan:				
13. H-II Transfer Vehicle Loss	Vehicle providing pressurized cargo delivery and removal.	Yes	Yes	No
Brazilian Space Agency:				
14. Unpressurized Logistics Carrier Loss	Carrier providing storage of unpressurized cargo and spares.	Yes	Yes	Yes

Appendix B

Acronym

N/A Not Applicable

Notes:

1. The Program Office had neither estimated the cost of performing the response nor addressed the Year 2000 computer problem for any of the contingency scenarios.

2. Russian withdrawal or delay can include any combination of the other scenarios for Russian participation. This scenario addresses possible contingency responses for reduced or eliminated Russian Space Agency participation for the Service Module, Functional Energy Block, *Progress*, *Soyuz*, and Solar Power Platform.

3. NASA contracted for this element to be built by the Russian Space Agency.

4. This row is a "place holder" for a contingency plan that NASA asked the Russians to furnish. Since this is not a scenario that NASA plans to execute, the data fields are marked not applicable (N/A) and our analysis does not include this scenario.

*Date on which the action is needed for the response strategy.

Appendix C. Management's Response

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Road 1
Houston, Texas 77058-3696

FEB 0 2 1999

Reply to Attn of: BD

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

FROM: AA/Director

SUBJECT: Management Response to OIG's Draft Report on the Audit of Space Station Contingency Planning for International Partners, Assignment A-HA-98-031

We have reviewed the findings contained in the subject draft audit report, and thank you for the opportunity to provide our comments. The report discusses NASA's plans to prevent or mitigate any risks to the International Space Station (ISS) Program by international partner participation. The International Space Station Program Office maintains a Risk Management System which identifies significant Program risk to the ISS vehicle survival and continuation of assembly. It is in full compliance with the guidelines provided in NPG 7120.5A. Your recommendations to also apply the guidelines for risk management to the ISS Contingency Plan are of merit and will be evaluated.

The audit findings were briefed to Space Station personnel on November 25, and we acknowledge the changes made to the report following that meeting. In our response, we have addressed each recommendation individually with actions taken or planned as shown in the enclosure. At the request of the Office of External Relations, Code I, we are also including in this response suggested wording changes to the report.

If you have any questions regarding this response, please contact Ms. Pat Ritterhouse, Audit Liaison Representative, at 281-483-4220.

George W. S. Abbey

Enclosure

cc:
OA/R. H. Brinkley
OA/B. G. Luna
HQ/JM/M. E. Peterson
HQ/MX/G. A. Gabourel

Appendix C

Management Response to OIG's Draft Report on the Audit of Space Station Contingency Planning for International Partners, Assignment A-HA-98-031

Auditor's Findings

"The Space Station Program Office had not developed an integrated and comprehensive contingency plan to address risks to the successful assembly of the Space Station by the possible delay or default of the international partners. The contingency plan did not contain or clearly identify several critical elements for effective risk management, as required by Agency guidance. Specifically, the Program contingency plan did not contain cost and schedule impacts and did not clearly identify risk mitigation measures and primary consequences of the contingencies."

Recommendations

The Director, Johnson Space Center, should develop and implement procedures to ensure the Space Station Program contingency plan:

1. Complies with Agency guidance for effective risk management. Specifically, the plan should clearly describe and fully address:

    - Risk mitigation measures, primary consequences, and schedule and cost impacts for each international partner scenario, as required by NPG 7120.5A
    - The Year 2000 computer implementation problem.
    - All actions planned or implemented in response to international partner contingencies.

2. Is kept current.

JSC Comments

Concur with the intent of the recommendations. The Risk Management System maintained by the International Space Station Program Office (ISSPO) is in full compliance with NPG 7120.5A, "NASA Program and Project Management Processes and Requirements", and does identify the significant Program risks to ISS vehicle survival and continuation of assembly. It has been thoroughly reviewed in the ISS Independent Annual Reviews and found to adequately serve the ISS management process. The ISS Contingency Plan was not intended to displace the ISS Risk Management System as the implementation of the program risk management requirement. As the transition to operations approached, ISS Program Management recognized the need to consolidate the contingencies with major long-range consequences into a single document to enable integrated program planning and strategy development beyond that which is possible with the Risk Management System alone. The Plan includes summaries of major assembly contingencies some of which are not included in the Risk Management System depending upon their perceived

Enclosure

likelihood of occurrence. The program views this as an extension of the Risk Management System tailored to meet the unique purposes of the ISS Program as encouraged in NPG 7120.5A. Updates to the plan will clarify this relationship and specific linkage of contingencies to the Risk Management System will be defined.

The ISS Contingency Plan has been given to the International Partners for review and comment. As discussed with and agreed to by NASA Headquarters, the multilaterial ISS Contingency Plan does not include detailed cost information because this is sensitive information. Thus, the September draft of the Plan did not include the Orbiter modifications and the $60M Russian contract as these had not been agreed upon internal to NASA or with Congress. The potential US funding of the Russian Partner to ensure adequate Progress and Soyuz supply is still under negotiation, and is not included. These items are worked in a very detailed manner with Headquarters and Congress, and it was a cognizant decision to not include costs as part of the Contingency Plan. The Program intends to maintain cost data in a separate table, and will not include it in this multilateral document.

The other suggestions made by the Office of Inspector General for improvements to this document are appreciated and will be evaluated. Future updates will include the risk mitigation actions planned or implemented in response to International Partner contingencies. Adding the Risk Management System terminology to the technical data sheets may ensure better consistency in inputs. Specifically, ensuring that the "Background" and "Scenarios" sections include the description, consequences, likelihood and schedule impacts is thought to be an improvement. In addition, identifying which risks are considered to be acceptable with no action versus those which require detailed plans and funding is thought to be an improvement.

Please note the ISS Contingency Plan is intended to cover assembly and operations contingencies only, and not design issues such as the Year 2000 issue. The ISS Risk Management System and the ISS technical management process is used to manage the Year 2000 issue. The ISS Program was cognizant of the potential impact of the Year 2000 issue and developed a program risk item (#3451) to address this issue as early as February 1997. The risk mitigation plan includes the identification of all US ISS related hardware, software and firmware; IP and contractor system, and the development of compliance schedule. The progress of this risk mitigation effort is reviewed with the program manager monthly at the Program Risk Advisory Board and the Space Station Integrated Product Team. For mission critical systems, a rigorous procedure of testing for Y2K compliance has been established to ensure that the Year 2000 induced computer system failure will not occur. The Y2K is a known technical problem, and Station Program is taking every step to ensure compliance. Therefore, it is not, and should not be, part of the Contingency Plan. This issue was erroneously included in the Draft ISS Contingency Plan, and will be removed.

The program will institute a regular review and update of the Contingency Plan with Program Management and will ensure the plan is consistent with ISS budget revisions and strategies. All formal risks included in the Contingency Plan are reviewed by the Program Manager at the monthly Program Risk Advisory Board. It is envisioned that the integrated task and decision tracking sections of the Contingency Plan will be maintained routinely and reviewed at the Program Management Review at least quarterly. The Contingency Plan will further be updated with full concurrence given by

Appendix C

the International Partners at the time of any Assembly Sequence changes and approved by the Space Station Integration Control Board.

We believe these actions are responsive to the intent of the recommendations. As stated, we have included suggested changes to the wording of the report as shown in the attachment. *

*Attachment is not included in this report, but can be provided upon request.

Appendix D. Report Distribution

National Aeronautics and Space Administration (NASA) Headquarters

Code A/Administrator
Code AI/Associate Deputy Administrator
Code AO/Chief Information Officer
Code B/Comptroller
Code BR/Director, Resources Analysis Division
Code G/General Counsel
Code I/Associate Administrator for External Relations
Code J/Associate Administrator for Management Systems and Facilities
Code JM/Director, Management Assessment Division
Code L/Associate Administrator for Legislative Affairs
Code M/Associate Administrator for Space Flight
Code M-4/Chief Engineer (Space Station)
Code P/Associate Administrator for Public Affairs
Code Q/Associate Administrator for Safety and Mission Assurance
Code R/Associate Administrator for Aero-Space Technology
Code S/Associate Administrator for Space Science
Code U/Associate Administrator for Life and Microgravity Sciences and Applications
Code Y/Associate Administrator for Earth Science
Code Z/Associate Administrator for Policy and Plans

NASA Advisory Officials

Chairman, NASA Aerospace Safety Advisory Panel
Chairman, Advisory Committee on the International Space Station

NASA Field Installations

Director, Lyndon B. Johnson Space Center
  JSC/BD5/Audit Liaison Representative
Director, John F. Kennedy Space Center
  KSC/HM-E/Audit Liaison Representative
Director, George C. Marshall Space Flight Center
  MSFC/BE01/Audit Liaison Representative
Director, John C. Stennis Space Center

Appendix D

NASA Offices of Inspector General

Ames Research Center
John H. Glenn Research Center at Lewis Field
Goddard Space Flight Center
Jet Propulsion Laboratory
Lyndon B. Johnson Space Center
John F. Kennedy Space Center
Langley Research Center
George C. Marshall Space Flight Center
John C. Stennis Space Center

Non-NASA Federal Organizations and Individuals

Assistant to the President for Science and Technology Policy
Assistant to the President and Chair, President's Council on Y2K Conversion
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Budget Examiner, Energy Science Division, Office of Management and Budget
Associate Director, National Security and International Affairs Division, General Accounting Office
Special Counsel, House Subcommittee on National Security, International Affairs, and Criminal Justice
Professional Assistant, Senate Subcommittee on Science, Technology, and Space

Chairman and Ranking Minority Member - Congressional Committees and Subcommittees

Senate Committee on Appropriations
Senate Subcommittee on VA, HUD, and Independent Agencies
Senate Committee on Commerce, Science, and Transportation
Senate Subcommittee on Science, Technology, and Space
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on VA, HUD, and Independent Agencies
House Committee on Government Reform and Oversight
House Committee on Science
House Subcommittee on Space and Aeronautics

Congressional Member

Honorable Pete Sessions, U.S. House of Representatives

Major Contributors to this Report

Dennis E. Coldren, Program Director for Human Exploration and Development of Space Audits

Kenneth E. Sidney, Auditor-in-Charge

Kathleen E. McDonald, Auditor

June C. Glisan, Program Assistant

Nancy C. Cipolla, Report Process Manager