

IG-97-015

**AUDIT  
REPORT**

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**SPACE STATION  
CHANGE ORDER PROCESS**

**MARCH 5, 1997**

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National Aeronautics and  
Space Administration

**OFFICE OF INSPECTOR GENERAL**

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National Aeronautics and  
Space Administration

**Headquarters**  
Washington, DC 20546-0001



Reply to Attn of: **W**

March 5, 1997

**TO:** Johnson Space Center  
Attn: AA/Director

**FROM:** W/Acting Assistant Inspector General for Auditing

**SUBJECT:** Final Report  
Space Station Change Order Process  
Assignment No. A-JS-96-002  
Report No. IG-97-015

The NASA Office of Inspector General completed an audit of the International Space Station Program Office's change order process. A copy of the final report is enclosed.

We found the program had not completed an effort to definitize old and high priority changes within a self-imposed deadline. However, the effort was viable in that the program definitized many of the changes by the deadline, and had developed realistic plans to definitize the remaining changes within a four-month period. We also found the program had not issued undefinitized changes on an exception basis as recommended by federal procurement regulations. The program's extensive use of undefinitized changes was dictated by a need to maintain schedule. A delay in starting change directed work pending definitization of the change orders would significantly increase the risk of not completing the station on time. These two findings are included in the report without recommendations.

In addition to the findings mentioned above, we found the program had not definitized changes within NASA's goal of 180 days from date of issuance. We previously reported this condition in our report on Undefinitized Change Orders (Space Station Freedom) dated November 9, 1994. The recommendation made to correct this condition was concurred with and actions planned by management were taken. In so far as the condition still exists, we believe that NASA management needs to take prompt action to correct this deficiency.

We received your written response to our December 10, 1996 discussion draft report on January 21, 1997. Your comments are incorporated in the report and the complete written response is included as an Appendix to the report.

Because the International Space Station Program has implemented the report recommendations, Recommendation 1 and 2 are considered closed upon issuance of the final report.

*Robert J. Wesolowski*

Robert J. Wesolowski

Enclosure

cc:

HQs-M/W. Trafton

JM/D. Green

JSC-BQ/P. Ritterhouse

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W. Bates

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# SPACE STATION CHANGE ORDER PROCESS

JOHNSON SPACE CENTER, TEXAS

## EXECUTIVE SUMMARY

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### *INTRODUCTION*

On March 15, 1996, NASA's Space Station prime contractor, Boeing Defense and Space Group, was working on 86 authorized, but unnegotiated Class I contract changes with an estimated value of \$393 million.<sup>1</sup> The dollar magnitude of changes, coupled with NASA's historical difficulty in managing contract changes, prompted this audit of the International Space Station Program Office's change order process.

### *OBJECTIVES*

Our audit objectives were to determine whether:

- a program effort to eliminate its backlog of undefinitized changes was viable and on schedule;
- the program issued undefinitized change orders on an exception basis; and
- the program definitized change orders within the agency's goal of 180 days.

### *RESULTS OF AUDIT*

Our review disclosed:

- although four months behind schedule, the program's effort to eliminate its backlog of changes was viable;
- the program had not issued undefinitized change orders on an exception basis due to schedule constraints; and
- the program had not definitized changes within the agency's 180-day goal.

Because the program's effort to definitize its backlog of changes was viable, and because the program was prevented from issuing undefinitized changes on an exception basis due to schedule constraints, we are not making any recommendations pertaining to these findings. (Page 7)

We are, however, making recommendations pertaining to changes not being definitized within the 180-day goal. Our review of the 86 undefinitized changes disclosed that 53 (62%) were more than 180 days old. If the program does not take corrective actions, it will continue to experience the adverse effects of undefinitized changes, such as, cost increases and questionable cost baselines. (Page 7)

## ***RECOMMENDATIONS***

We recommend:

1. The Space Station Program Manager assign responsibility for definitizing changes within, or close to, the 180-day goal to a program employee. The Program Manager should include the responsibility as an element in the selected employee's performance plan.
2. The selected program employee review program and contractor policies and procedures for the purpose of identifying, recommending, and implementing actions that will alleviate impediments to timely definitizations. To ensure that timely definitizations are a joint priority between the program and Boeing, appropriate Boeing personnel should participate in the review.

Managers of the International Space Station Program have implemented the recommendations. Management's written response to the recommendations is included as an Appendix to this report.



# INTRODUCTION

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## **Background**

In the government, changes to contracts can be issued in two ways. The preferred method is to negotiate the price of the change before the government directs the contractor to start the change-related work. The other method is to direct the contractor to start work before a price is negotiated. When the latter method is used, a contracting officer issues the direction to the contractor through a formal document called a *change order*. The change order process consists of the following major steps:

1. Contracting officer issues change order to contractor.
2. Contractor begins work directed by change order.
3. Contractor submits cost and technical proposals.
4. Program personnel analyze contractor's proposals.
5. Contracting officer and contractor negotiate cost and fee.
6. Contract is modified to incorporate change.

Changes that have not gone through the entire process are referred to as *undefinitized change orders*. Change orders are *definitized* when the last step is completed; i.e., the contract is modified to incorporate the language and negotiated cost of the change.

## **Prior Audit Reports**

Recent NASA Inspector General and General Accounting Office audits showed that NASA was not definitizing high-dollar value changes within the 180-day period agency guideline. <sup>2</sup>

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## **OBJECTIVES, SCOPE, AND METHODOLOGY**

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### ***OBJECTIVES***

The audit objectives were to determine whether:

- the program's effort to eliminate its backlog of undefinitized changes was viable and on schedule;
- the program issued undefinitized change orders on an exception basis; and
- the program definitized change orders within the agency's goal of 180 days.

### ***SCOPE AND METHODOLOGY***

The scope of the audit included Class I changes to the International Space Station Contract, issued between November 15, 1993 and March 15, 1996. A Class I change is a change resulting in any modification to the prime contract.

We conducted audit field work at the Johnson Space Center from February 12, 1996, to September 30, 1996.

We used the following audit techniques to accomplish the audit objectives:

- interviewed relevant NASA and contractor personnel;
- examined change order related records and documents; and
- analyzed pertinent cost and other change order related data.

To determine the adequacy of policies, procedures, and practices relating to the change order process, we reviewed applicable Federal and agency regulations and guidelines.

### ***MANAGEMENT CONTROLS REVIEWED***

We reviewed management controls to determine whether the program had effective control techniques for ensuring:

- undefinitized change orders were issued on an exception basis; and
- undefinitized changes were definitized within, or close to, NASA's 180-day goal.

Our review disclosed that the program had control weaknesses pertaining to meeting the 180-day goal. The weaknesses are described in the Observations and Recommendations section of this report.

***AUDIT STANDARDS***

The audit was performed in accordance with generally accepted government auditing standards.

## **OBSERVATIONS AND RECOMMENDATIONS**

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### ***OVERALL EVALUATION***

We found:

- although four months behind schedule, the program's effort to eliminate its backlog of changes was viable;
- the program had not issued undefinitized change orders on an exception basis due to schedule constraints; and
- the program had not definitized changes within the agency's 180-day goal.

### ***EFFORT TO ELIMINATE BACKLOG BEHIND SCHEDULE, BUT VIABLE***

The program's effort to eliminate its backlog of changes was viable, but four months behind the scheduled completion date of July 31, 1996. As of that date, the program had definitized 67 of 165 changes, including 60 of the 86 we reviewed during this audit. According to program representatives, the program had definitized another 55, or a total of 122, changes as of September 30, 1996. The program intended to incrementally definitize the remaining changes by November 30, 1996.

We did not make recommendations pertaining to this observation because the program had definitized most of the changes, and was continuing its efforts to definitize the remaining changes.

### ***TIGHT SCHEDULE THWARTS ISSUANCE OF UNDEFINITIZED CHANGES ON AN EXCEPTION BASIS***

The program had not issued undefinitized change orders on an exception basis. As of March 15, 1996, the program had not definitized any Class I changes prior to directing Boeing to start the work. In comparison, the program had authorized the contractor to begin work on 87 undefinitized Class I changes as of that date. Program officials authorized Boeing to start the work because they believed the contractor could not complete the critically required work on time if it was held up pending change definitization.

We are not making recommendations pertaining to this condition because the program followed agency procedures for issuing undefinitized changes; e.g., only used undefinitized changes to meet urgent program requirements, and obtained Center Director approval on undefinitized changes over \$1 million. In addition, the program recently implemented an action placing greater emphasis on negotiating changes under \$500,000 prior to issuance. Program representatives claim that seven changes have been negotiated prior to issuance under the action.

**TIMELY  
DEFINITIZATIONS  
COMPROMISED BY  
NUMEROUS  
IMPEDIMENTS**

We also believe the program will have greater opportunities to definitize changes before authorizing the start of work when it is able to definitize changes within, or close to, the 180-day goal discussed in the following section.

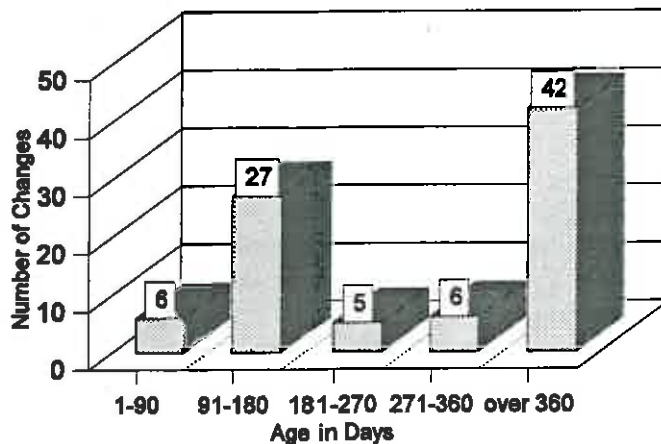
Changes were not definitized within the 180-day goal because the program had not clearly designated any one employee as responsible for eliminating existing impediments to timely definitizations. Untimely definitization of changes could result in cost increases and questionable cost baselines.

Subpart 43.204(b) of the Federal Acquisition Regulation states: *"Contracting officers shall negotiate equitable adjustments resulting from change orders in the shortest practicable time."* NASA further defined the policy in Subpart 18-43.7005 of its supplement to the federal regulation, which states that the agency's goal is to definitize undefinitized changes within 180 days from date of issuance.

We found that the program had not met the 180-day goal. Between November 15, 1993 and March 15, 1996, the program authorized Boeing to start work on 87 undefinitized Class I changes. As of March 15, the program had definitized one change, leaving 86 undefinitized changes. Fifty three of the 86 changes (62%) were more than 180 days old, with ages ranging from 184 to 731 days. Ages of the remaining 33 changes (38%) ranged from 8 to 177 days. Average age of the 86 changes was 320 days, or 1.8 times more than the 180-day goal.

The following chart shows the number of undefinitized changes in 90-day age ranges:

**Aging Schedule as of March 15, 1996**



The 86 changes aged another 128 days before the program definitized 60 of the changes on July 22, 1996. At that time, 83 of the changes (97%) were more than 180 days old, with ages ranging from 193 to 859 days. The average age of the 86 changes was 448 days, or 2.5 times the 180-day goal.

The total dollar value of the changes was significant. Estimated value of the 86 changes was \$393 million. Estimated value of the changes that were over 180 days old on July 22, 1996, was \$390 million, and \$3 million for changes under 180 days old.

***ASSIGNING  
RESPONSIBILITY WOULD  
FACILITATE TIMELY  
DEFINITIZATIONS***

We believe the ages of the undefinitized changes exceeded the 180-day goal because the program had not assigned responsibility for timely definitizations to any one employee. Several program employees were involved in negotiating and definitizing changes, but no one was clearly and formally tasked with definitizing changes within, or close to, the 180-day goal.

Two prominent program employees involved in the definitization process were a program contracting officer and the Technical Assistant to the Space Station Program Manager. The contracting officer served as custodian for the undefinitized changes. As custodian, the officer was responsible for tracking and monitoring the changes. The officer also authorized Boeing to start change-related work and executed the documents definitizing changes.

The Technical Assistant led an effort to definitize changes that the program considered old or of high priority. The focus of the effort was more on taking actions necessary to definitize those particular changes than on implementing overall process changes.

Because the program had not clearly assigned the responsibility, it could not hold any one employee accountable for the changes not being definitized within the 180-day goal. Without assigned responsibility and accountability, no one employee was strongly motivated, through rewards or penalties, to identify and alleviate impediments to timely definitizations.

***IMPEDIMENTS TO TIMELY  
DEFINITIZATIONS***

Program and Boeing representatives told us there were several impediments to timely definitizations, including:

- delayed consent to subcontracts;
- incomplete technical definitions of changes;
- untimely and inadequate price proposals;
- time-consuming contractor negotiation practice;
- lack of contractor motivation; and
- insufficient staffing coupled with a higher than expected number of undefinitized changes.

**Consent to Subcontracts.** According to program representatives, Boeing was unwilling to definitize changes until the program consented to the contractor's subcontracts with McDonnell Douglas and Rocketdyne. This was because delays in obtaining the contractually required consent to the subcontracts carried a greater fee risk to Boeing than delays in definitizing changes. Consequently, Boeing's position was that obtaining the program's consent to the subcontracts took precedence over the definitization of changes. NASA consented to the subcontracts in May 1996.

**Technical Definitions.** The program issued undefinitized changes without complete technical definitions. As a result, the changes aged while the program and Boeing worked the final technical impacts and scopes of the changes. Because early technical authorizations were essential to address significant space station redesign issues, the changes often exceeded the 180-day goal.

**Price Proposals.** According to program representatives, Boeing was reluctant to initiate price proposal efforts without final approval of all change-related documents. The result was delayed proposals. Program representatives also claimed that proposals were of poor quality, which further slowed the definitization process.

**Negotiation Practice.** Boeing's practice was to complete change-related negotiations with McDonnell Douglas and Rocketdyne before completing negotiations with the program. Boeing did this because of past difficulties in negotiating with its subcontractors, and to reduce its cost risk. The practice significantly delayed definitizations of changes.

**Motivation.** Boeing was not motivated to definitize changes quickly, because it lowered its risk of overrunning costs by doing as much change-related work as possible before negotiating the cost.

**Staffing.** Boeing, McDonnell Douglas, and Rocketdyne were not staffed to manage and definitize the higher than expected number of changes on the program. When the redesigned space station program was in negotiations, the assumption for cost negotiations was a "zero change" contract. Therefore, manpower for implementing changes was not included in the prime contract, or Boeing's subcontracts with McDonnell Douglas and Rocketdyne.

***TIMELY  
DEFINITIZATIONS MUST  
BE JOINT PRIORITY***

The nature of the impediments clearly shows that the program needs Boeing's cooperation to effectively improve the definitization process. Timely definitizations must be a joint priority between the program and the prime contractor. Consequently, it is important that the program provide the contractor with an incentive to definitize changes quickly.



One incentive available to the program is award fee. For various reasons, the program did not use the award fee provision during the first two award fee periods, January 1995 through March 1996. Boeing managers, therefore, had little incentive to definitize changes.

The program used the award fee provision for the third period, April 1996 through September 1996. The award fee criteria focused on timely submission of proposals and eliminating the backlog of changes. According to a program representative, the award fee performance report cited the contractor's overall change management as a major weakness.

**Conclusion:**

The program experienced numerous impediments to timely definitizations of changes. As a result, a backlog of undefinitized changes developed. In response to the growing backlog, the program implemented a viable effort to definitize the existing changes.

We commend the program for taking this first step to eliminate its change-related problems; i.e., the effort to definitize the changes comprising the backlog. We also commend the program for its refusal to compromise the need for sound cost analysis, arms-length negotiations, and fair and reasonable settlements in the interest of timely definitizations.

However, we believe the program now needs to take additional steps to ensure future changes are definitized within, or close to, the 180-day goal. We believe the program's next step should be assigning the responsibility for timely definitizations to one individual. The ensuing step should involve the responsible individual identifying, recommending, and implementing procedures that eliminate existing impediments. To ensure success, this step should be a joint effort between the program and Boeing.

Without additional actions, the program will continue to experience the adverse effects of undefinitized changes, e.g., cost increases and questionable cost baselines. If most or all the work is completed before pricing the change, the program will not have the opportunity to point out more efficient production methods or increase the prime contractor's motivation to manage change-related costs. In addition, the program will not have a true cost baseline until the costs are negotiated and incorporated into the contract.

The effects of untimely definitizations severely impacted the Space Station Freedom Program's ability to stay within budget, a condition that eventually led to cancellation of the program. In our opinion, implementation of the following audit recommendations should help managers of the International Space Station Program avoid a similar fate.

***RECOMMENDATION 1***

The Space Station Program Manager assign responsibility for definitizing changes within, or close to, the 180-day goal to a program employee. The Program Manager should include the responsibility as an element in the selected employee's performance plan.

***Management's Response***

The Space Station Program Manager has assigned the sole responsibility for definitizing changes within the 180-day goal to the Program Procurement Officer in the International Space Station Business Office. In fact, this responsibility is stated in the Senior Executive Service Performance Planning and Appraisal for this position, dated August 22, 1996.

***RECOMMENDATION 2***

The selected program employee review program and contractor policies and procedures for the purpose of identifying, recommending, and implementing actions that will alleviate impediments to timely definitizations. To ensure that timely definitizations are a joint priority between the program and Boeing, appropriate Boeing personnel should participate in the review.

***Management's Response***

The Program Procurement Officer is reviewing ISS Program and contractor policies and procedures to implement a standard process of definitizing changes in 180 or less days. The ISS Program has already taken several steps to emphasize the importance of this goal. In August and September 1996, the Program Procurement Officer and the Boeing Contracts Manager jointly discussed and agreed upon award fee Areas of Emphasis that recognize the importance of change definitization of all changes in less than 180 days. The joint NASA/Boeing Business Management Analysis and Integration Team (BMAIT) developed a work plan, called an Issues Summary, to improve the lengthy change definitization process, including streamlining the interim steps of the process such as technical definition, negotiation of changes under \$500K, and preparation and processing of change proposals. The BMAIT meets biweekly to review status of process analyses and resolve issues and remove impediments to process improvement. In conjunction with the ISS Configuration Management Office and Boeing, the Program Procurement Officer has led a series of working level meetings to

reengineer the change management process, from the point of issue definition to definitization, including the responsibilities of each group, NASA and Boeing, at each process step. The activity has resulted thus far in a comprehensive statement of assumptions, process groundrules, and outcomes for each change process step. More importantly, the draft process, to be presented to NASA and Boeing Management in January 1997, states a process timeline of 180 days, with a goal of getting the Program to 150 or less days to definitize all contract changes.

***Evaluation of  
Management's Response***

Actions planned or taken by the ISS Program are responsive to Recommendations 1 and 2.

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## END NOTES

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1. NASA awarded the International Space Station Contract to Boeing Defense and Space Group on November 15, 1993. The contract is for the design, manufacture and integration of the space station. As of March 31, 1996, the negotiated cost of the contract was \$5.1 billion.
2. Our office's audit of changes to the Space Station Freedom contract found that NASA had not definitized 112 of 119 reviewed changes within 180 days.<sup>1</sup> The average age of changes that had been definitized was 430 days. The estimated total dollar value of undefinitized Freedom changes was \$1.6 billion on August 31, 1993.

In our audit report, we recommended that the Space Station Program Manager, with the Associate Administrator for Procurement, stress the importance of timely definitizations to managers and other employees involved in the change process. Management concurred by replying that the agency had issued Procurement Notice 89-60, Undefinitized Contract Actions. The notice provided guidelines on the issuance of undefinitized changes, including NASA's goal of definitizing changes within 180 days from date of issuance.

A March 1992 General Accounting Office report on procurement practices at NASA's four largest procurement centers stated that 10 of 23 changes reviewed were not definitized within a 180-day period.<sup>2</sup> Five of the ten changes remained unnegotiated for approximately one year or more; one remained unpriced for 552 days. The estimated total dollar value of the ten changes was \$32 million.

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<sup>1</sup>Undefinitized Change Orders (Space Station Freedom) (HA-95-001, November 9, 1994).

<sup>2</sup>NASA Procurement: Agencywide Action Needed to Improve Management of Contract Modifications (GAO/NSIAD-92-87, March 2, 1992).

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## **MAJOR CONTRIBUTORS TO THIS AUDIT**

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CENTER***

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**APPENDIX**

Reply to Attn of:

**BQ-97-001**

**JAN 21 1997**

**TO: W-JS/Program Director, Human Exploration and Development of Space**

**FROM: AA/Director**

**SUBJECT: Management Response to Discussion Draft Report  
Space Station Change Order Process, Assignment No. A-JS-96-002**

As discussed with your office, we waive the opportunity of an exit conference and are responding to the findings and recommendations contained in the discussion draft report. We acknowledge the positive finding stated in the report of the efforts being made to reduce the number of undefinitized change orders, and to develop a plan to definitize change orders in a timely manner. We are able to report, that as of December 31, 1996, Space Station has definitized 171 changes. This group includes the largest and oldest changes the Program had outstanding.

We have addressed each of the recommendations and stated actions taken as shown in the enclosure. With the actions taken, the continued focus on change management being provided by Station Program management, and with your acceptance of these actions, we will consider the recommendations to be closed upon issuance of the final report. In accordance with Agency guidelines and OMB Circular A-50, this audit will be considered for postclosure follow-up and validation. If you have any questions regarding this response, please contact Pat Ritterhouse at 483-4220.

  
George W. S. Abbey

Enclosure

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OG/D. C. Tam  
OG3/L. Yates  
HQ/HC/J. Horvath  
HQ/JM/M. Peterson

BQ/PRitterhouse:lsd:1/6/97:34220

**Management Response to Discussion Draft Report  
Space Station Change Order Process, Assignment No. A-JS-96-002**

**Auditors Findings**

**"Changes were not definitized within the 180-day goal because the program had not clearly designated any one employee as responsible for eliminating existing impediments to timely definitizations. Untimely definitization of changes could result in cost increases and questionable cost baselines."**

**Recommendation 1**

**"The Space Station Program Manager assign responsibility for definitizing changes within, or close to, the 180-day goal to a program employee. The Program Manager should include the responsibility as an element in the selected employee's performance plan."**

**JSC Comments**

**The Space Station Program Manager has assigned the sole responsibility for definitizing changes within the 180-day goal to the Program Procurement Officer in the International Space Station Business Office. In fact, this responsibility is stated in the Senior Executive Service Performance Planning and Appraisal for this position, dated August 22, 1996.**

**Auditors Findings**

**"Program and Boeing representatives told us there were several impediments to timely definitizations..."**

**The nature of the impediments clearly show that the program needs Boeing's cooperation to effectively improve the definitization process. Timely definitizations must be a joint priority between the program and the prime contractor. Consequently, it is important that the program provide the contractor with an incentive to definitize changes quickly."**

**Recommendation 2**

**"The selected program employee review program and contractor policies and procedures for the purpose of identifying, recommending, and implementing actions that will alleviate impediments to timely definitizations. To ensure that timely definitizations are a joint priority between the program and Boeing, appropriate Boeing personnel should participate in the review."**

**Enclosure**

## **JSC Comments**

The Program Procurement Officer is reviewing ISS Program and contractor policies and procedures to implement a standard process of definitizing changes in 180 or less days. The ISS Program has already taken several steps to emphasize the importance of this goal. In August and September 1996, the Program Procurement Officer and the Boeing Contracts Manager jointly discussed and agreed upon award fee Areas of Emphasis that recognize the importance of change definitization of all changes in less than 180 days. The joint NASA/Boeing Business Management Analysis and Integration Team (BMAIT) developed a work plan, called an Issues Summary, to improve the lengthy change definitization process, including streamlining the interim steps of the process such as technical definition, negotiation of changes under \$500K, and preparation and processing of change proposals. The BMAIT meets biweekly to review status of process analyses and resolve issues and remove impediments to process improvement. In conjunction with the ISS Configuration Management Office and Boeing, the Program Procurement Officer has led a series of working level meetings to reengineer the change management process, from the point of issue definition to definitization, including the responsibilities of each group, NASA and Boeing, at each process step. The activity has resulted thus far in a comprehensive statement of assumptions, process groundrules, and outcomes for each change process step. More importantly, the draft process, to be presented to NASA and Boeing Management in January 1997, states a process timeline of 180 days, with a goal of getting the Program to 150 or less days to definitize all contract changes.

In summary, the International Space Station Program has implemented the subject report recommendations to more closely manage the change definitization process. Metrics obtained as a result of the reengineered change management process will demonstrate both the impediments to timely definitization for appropriate management action and the overall effectiveness of the streamlined change process. With these actions taken, or underway, we consider the recommendation closed.



