

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001



OCT 24 1995

Reply to Attn of: **W**

TO: M/Associate Administrator for Space Flight

FROM: W/Acting Deputy Assistant Inspector General for Auditing

SUBJECT: Final Rapid Action Report
Impacts of Performing Orbiter Maintenance Down Periods (OMDP's)
at KSC versus Palmdale
Assignment Nos. A-KE-95-010, A-KE-95-012
Report No. KE-96-001

The NASA Office of Inspector General is conducting an audit of Maintenance and Modifications of Orbiter Vehicles. During the audit, conditions came to our attention which we believe warrant management's immediate attention. We are, therefore, issuing the enclosed rapid action report. The audit objective addressed in this report was to determine whether maintenance and modifications on NASA's four orbiter vehicles could be performed more cost effectively at Kennedy Space Center (KSC) without adverse impacts to the shuttle program.

The overall results of our audit indicated that the Space Shuttle Program can save \$30 million annually, or a range of \$400 million to \$500 million over the remaining life of the shuttle program, by performing OMDP's at KSC rather than Palmdale without adverse impact to the program. These savings would occur through the elimination of (1) duplicate facilities and infrastructure costs, (2) orbiter ferrying costs, and (3) civil service support costs. Further, the time required to perform an OMDP can be shortened by as much as four months, thus, creating greater efficiencies in Orbiter Processing Facility operations.

We recommended that (1) OMDP's be performed at KSC, effective no later than the OV-105 OMDP, scheduled for July 1996, and (2) once OMDP's have been moved to KSC, continued support of the Palmdale facility should be evaluated. If continued support is not justified, the facility should be closed. A written response to the discussion draft report, concurring with our recommendations, was received from your office on September 25, 1995. These comments were incorporated into the report; the complete response is in Appendix A. Both recommendations are considered closed with the issuance of this report.

If you have any questions regarding this report, please contact Mr. Robert Wesolowski, Director, Audit Field Operations Division, or me at (202) 358-1232.



Carroll S. Little

Enclosure

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION	5
OBJECTIVE, SCOPE, AND METHODOLOGY	7
OBSERVATIONS AND RECOMMENDATIONS	9
OMDP's ARE MORE COST-EFFECTIVE AT KSC	9
OMDP's AT KSC INCREASE PROCESSING EFFICIENCIES	12
GENERAL COMMENT	18
APPENDIX A	A-1-1

ACRONYMS

JSC	Johnson Space Center
KSC	Kennedy Space Center
OMDP	Orbiter Maintenance Down Period

IMPACTS OF PERFORMING ORBITER MAINTENANCE DOWN PERIODS AT KSC VERSUS PALMDALE

JOHN F. KENNEDY SPACE CENTER, FLORIDA

EXECUTIVE SUMMARY

Introduction

The Office of Inspector General is conducting an audit of Maintenance and Modification of Orbiter Vehicles. During our audit, certain conditions came to our attention which we believe warrant management's immediate attention.

Maintenance and modifications are performed on NASA's fleet of four orbiter vehicles during a period known as the Orbiter Maintenance Down Period (OMDP). Consequently, each orbiter is taken out of service for an OMDP once every 3 years.

Currently, maintenance and modification work on each of the four orbiter vehicles is performed by the design contractor, Rockwell International Corporation's Space Systems Division at U.S. Air Force Plant 42 in Palmdale, California. Shuttle processing operations are currently performed by Lockheed Space Operations Company at Kennedy Space Center (KSC), Florida.

Objective

Our audit objective was to determine whether maintenance and modifications on the orbiter vehicles can be performed more cost-effectively at KSC without adverse impacts to the shuttle program.

Overall Results

The Space Shuttle Program can save \$30 million annually, or approximately \$480 million over the remaining life of the Shuttle Program, by performing OMDP's at KSC without adverse impact to the program. These savings would occur through the elimination of (1) duplicate facilities and infrastructure costs, (2) orbiter ferrying costs, and (3) civil service support costs. Further, the time required to perform an OMDP can be shortened by as much as 4 months, thus, creating greater efficiencies in Orbiter Processing Facility operations.

Recommendations

The Associate Administrator, Office of Space Flight, should ensure that OMDP's are performed at KSC rather than at Palmdale.

Transition should occur no later than the OV-105 OMDP, scheduled for July 1996. Once OMDP's have been moved to KSC, the Associate Administrator should evaluate the continued need for the Palmdale facility. If continued support is not justified, the Palmdale facility should be closed.

Management concurred with the above recommendations. The actions either taken or planned by the Associate Administrator for Space Flight are responsive to the intent of the recommendations. The report recommendations are considered closed with the issuance of this report.



Illustration 1 - U.S. Air Force Plant 42, Palmdale, California

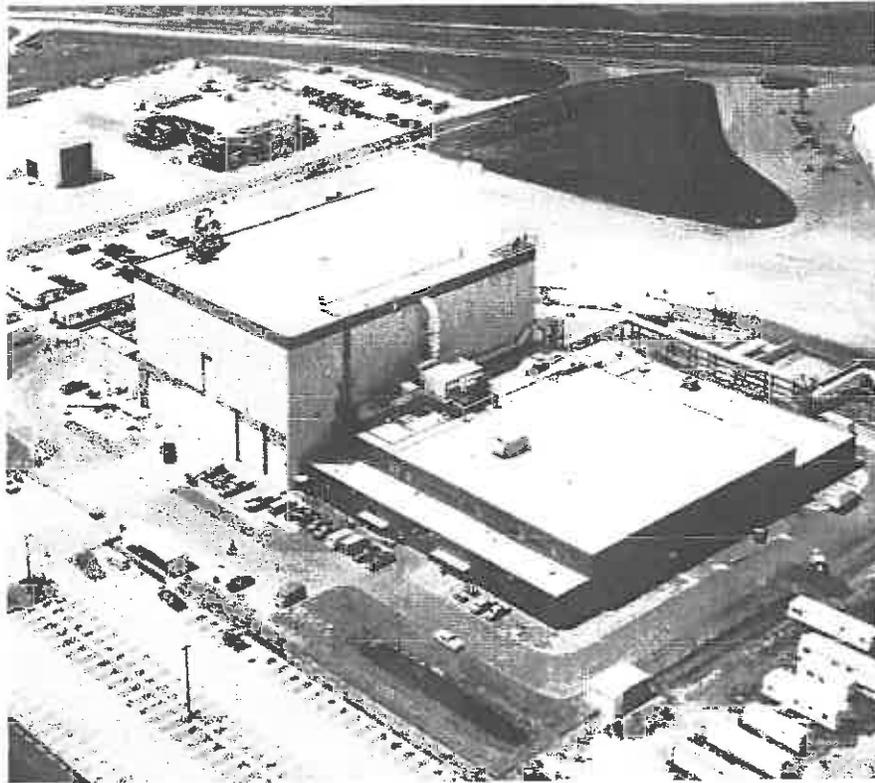


Illustration 2 - Orbiter Processing Facility, Kennedy Space Center, Florida

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INTRODUCTION

The Office of Inspector General is conducting an audit of Maintenance and Modification of Orbiter Vehicles. During the audit, conditions came to our attention which we believe warrant management's immediate attention.

A discussion draft report was issued on September 5, 1995. Management waived an exit conference and submitted their written response on September 25, 1995. Management's response is included, in part, in the report and, in whole, as Appendix A to the report.

Background

Maintenance and modification work on each of NASA's four orbiters is currently performed by the design contractor, Rockwell International Corporation's Space Systems Division (Rockwell) at U.S. Air Force Plant 42 in Palmdale, California. Shuttle processing operations are currently performed by Lockheed Space Operations Company (Lockheed) at KSC, Florida.

Currently, maintenance and modifications are performed on the orbiters during a period known as the OMDP. Orbiter maintenance, primarily structural inspections, is required approximately every 3 years under the Space Shuttle Program Operations and Maintenance Requirements and Specifications Documents. Consequently, each of the four orbiters is taken out of service for an OMDP every 3 years.

The Space Shuttle Program has scheduled modification work to be performed on the orbiters during an OMDP because it is more cost-effective and efficient to perform maintenance and modification work concurrently. The Orbiter Project Office at the Johnson Space Center (JSC) approves modifications on the orbiters to address safety issues or mission requirements. Currently, major modifications are scheduled for three of the four orbiters during the next three years. These modifications are scheduled to be performed by Rockwell at the Palmdale facility during the following time periods:

OV-103	October 1995 - July 1996
OV-105	July 1996 - March 1997
OV-104	December 1997 - August 1998

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OBJECTIVE, SCOPE, AND METHODOLOGY

Objective

Our audit objective was to determine whether maintenance and modifications on the orbiters can be performed more cost-effectively at KSC without adverse impacts to the shuttle program.

Scope

The audit scope was limited to a review of current requirements for performing maintenance and modifications to the Shuttle fleet's four orbiters. This included a review of Space Shuttle Program policy, contractual requirements, and specific impacts to the Space Shuttle Program based on where and how OMDP's are performed.

Methodology

The audit included interviews with officials from the Office of Space Flight, NASA Headquarters; Orbiter Project Office, JSC; Launch and Landing Project Office, KSC; and contractor personnel. The audit included examinations of Agency and contractor records as related to the audit objective.

We relied on cost and financial data presented by NASA and contractor personnel. We did not audit actual cost data for compliance with cost accounting standards or compliance with Federal Acquisition Regulation requirements, but relied on work performed by the Defense Contract Audit Agency. Limited testing was performed as considered necessary under the circumstances.

The audit was conducted in accordance with generally accepted government auditing standards and included such examinations and tests of applicable records as deemed necessary in the circumstances.

Management Controls

The observations addressed in this report did not require an evaluation of management controls.

Audit Field Work

Audit field work was conducted during the period of April to June 1995. Most of the field work was conducted at KSC, Florida. However, field visits were conducted to the NASA Industrial Plant, Downey, California, and U.S. Air Force Plant 42, Palmdale, California.

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OBSERVATIONS AND RECOMMENDATIONS

OMDP's ARE MORE COST- EFFECTIVE AT KSC

The Space Shuttle Program can save \$30 million per year or approximately \$480 million over the remaining life of the program by performing OMDP's at KSC rather than Palmdale, California. This transition could occur without adverse impact to the program. The estimated savings would occur through the elimination of (1) duplicate facilities and infrastructure costs, (2) orbiter ferrying costs, and (3) civil service support costs. Further, the time required to perform an OMDP could be shortened by as much as 4 months, thus, creating additional economies and efficiencies in Orbiter Processing Facility operations.

Current Policy Needs Re-evaluation

Currently, the Space Shuttle Program policy is to have maintenance and modifications performed on the Shuttle fleet's four orbiters by Rockwell in Palmdale, California. This decision was made after the United States (U.S.) and Russia agreed to perform joint space missions involving the U.S. Space Shuttle and the Russian Space Station Mir. Space Shuttle Program officials stated that while it was more cost-effective to perform the maintenance and modifications at KSC, other factors supported sending it to Palmdale. Specifically, Space Shuttle Program officials believed that sending the orbiters to Palmdale for OMDP's would allow KSC to concentrate its efforts on safe and efficient processing and enable Palmdale to specialize in modifications and periodic inspections. Overall, officials believed that the shuttle program would be better served by having OMDP's performed at Palmdale.

While the U.S./Russian agreement may have provided a sound basis at the time for performing the maintenance and modifications at Palmdale, it did not support performing OMDP's at Palmdale on a permanent basis. Based on our review, we believe it is now in the Space Shuttle Program's best interest, both financially and programmatically, to perform OMDP's at KSC. The financial and programmatic impacts of performing OMDP's at Palmdale versus KSC are described below.

Financial Impacts

Performing OMDP's at Palmdale costs more because three current operational practices are not necessary when OMDP's are performed at KSC. These practices include:

- (1) The Space Shuttle Program must support the management and infrastructure on two separate contracts.
- (2) Affected orbiters must be ferried to and from Palmdale.
- (3) KSC civil service personnel must travel to and from Palmdale to support the OMDP effort.

***1) Duplicative
Contract Costs***

Currently, the Space Shuttle Program is supporting two independent contractors, Rockwell and Lockheed, both experienced in performing maintenance and modifications on the orbiters. Each of these contractors maintains a separate infrastructure. This arrangement exists because the Space Shuttle Program made the decision to have maintenance and modifications performed at Palmdale and processing functions performed at KSC.

***Actual Cost of a
Generic OMDP at
Palmdale***

Rockwell contract costs associated with generic OMDP's could be eliminated. Performing a generic OMDP at Palmdale requires approximately 185 contractor personnel at a cost of \$8.6 million. Adding approximately \$25.8 million of indirect, general and administrative, and fee costs associated with performing OMDP's at Palmdale brings the total to \$34.4 million. (Note: These costs are based on the OV-102 OMDP performed during the period of October 1994 to April 1995. This 6-month OMDP was considered generic; that is, there were no major modifications to the vehicle.)

***Estimated Cost of a
Generic OMDP
at KSC***

OMDP's could be performed at KSC using the existing facilities, equipment, and Lockheed workforce, augmented with an additional 65 personnel. The 65 personnel are needed for an additional shift to one of the existing Orbiter Processing Facilities. According to Lockheed estimates, the cost for the additional 65 personnel would be approximately \$5 million. The \$5 million includes direct labor and associated indirect costs for the additional personnel as well as an allowance for overtime. Since the OMDP activity falls within the scope of the existing Lockheed contract, no contract change would be required; therefore, no additional general and administrative or fee cost would be incurred.

In addition to the \$5 million for additional personnel, Lockheed would continue to incur \$3.8 million, currently funded for performing pre- and post-flight servicing for ferrying vehicles to Palmdale. However, the \$3.8 million would be incurred for existing personnel to perform actual OMDP activities rather than pre- and

post-flight servicing activities. Consequently, the total cost for OMDP's, if performed at KSC, would be \$8.8 million, consisting of \$5 million for 65 additional personnel plus \$3.8 million for existing personnel currently funded under the shuttle processing contract.

2) Ferrying Costs

When OMDP's are performed at Palmdale, the orbiters must be ferried to Palmdale via the shuttle carrier aircraft, a modified Boeing 747. There are two cost elements associated with ferrying the orbiters: (1) cost of pre- and post-flight servicing of the orbiters and (2) cost of fuel for the 747. These costs would not be incurred if OMDP's were performed at KSC.

Pre- and Post-Flight Servicing Costs

Orbiter pre- and post-flight servicing is required when ferrying the orbiters between KSC and Palmdale. Certain activities, such as removal of specific orbiter hardware, safing the orbiter for environmental requirements, and mating and de-mating the orbiter with the 747, must be performed when ferrying the orbiter. The Space Shuttle Program incurs \$3.8 million for these activities for each OMDP currently performed at Palmdale.

Fuel Costs

In addition to the pre- and post-flight servicing cost, the Space Shuttle Program incurs fuel cost for ferrying the orbiter via the 747. Fuel cost for each OMDP is about \$.3 million. This fuel cost, when combined with the pre- and post-flight servicing cost, results in a total cost of \$4.1 million (\$3.8 plus \$.3 million). This cost could be avoided if OMDP's were performed at KSC.

3) Civil Service Support Costs

The Space Shuttle Program also incurs costs of sending KSC civil service employees to Palmdale in support of OMDP's. Personnel from Shuttle Operations; Safety, Reliability and Quality Assurance; and Security travel to Palmdale in support of each OMDP. Shuttle Operations personnel travel to Palmdale several days prior to OMDP completion while Safety, Reliability, and Quality Assurance personnel travel to Palmdale for the entire OMDP. In addition, KSC Security personnel are required to escort the orbiter to and from Palmdale. Cost for the transportation and per diem for these civil service support personnel is about \$300,000 for a 6-month OMDP. These costs would not be incurred if OMDP's were performed at KSC.

Summary of Financial Impacts

The Space Shuttle Program can save \$30 million per year (see Table 1, below) by performing OMDP's at KSC. Over the remaining life of the Shuttle Program (retirement expected in the year 2012), approximately \$480 million will be saved.

**ESTIMATED COST SAVINGS FROM
PERFORMING OMDP's AT KSC
(In Millions)**

COST ELEMENTS	PALMDALE	KSC	COST SAVINGS
Duplicative Contract Costs:			
Direct Labor	\$8.6	\$8.8*	
Labor/Material Overhead	16.1		
General & Administrative	2.9		
Other Direct Costs	2.7		
Fee	4.1		
Sub-Total	\$34.4		
Ferrying Costs:			
Pre- and Post-Flight Servicing	3.8		
Fuel Costs	.3		
Sub-Total	\$4.1		
Civil Service Support Costs			
Transportation and Per Diem	.3		
TOTAL	\$38.8	\$8.8	\$30.0**

*\$8.8 million includes direct and indirect costs.

**Savings will be reduced by \$2.5 million for employee termination costs the year transition occurs.

Table 1

***OMDP's AT KSC
INCREASE
PROCESSING
EFFICIENCIES***

Performing OMDP's at KSC shortens the time an orbiter is out of service by as much as 4 months without any adverse impact to the shuttle program. This is because Lockheed, the Shuttle Processing Contractor at KSC, can (1) use existing personnel with some augmentation and (2) integrate OMDP work into the normal processing flow. Consequently, performing OMDP's at KSC creates additional efficiencies in Orbiter Processing Facility operations.

Programmatic Impacts

In addition to the financial benefits, there are three programmatic factors which impact OMDP's. Specifically, performing OMDP's at KSC:

- (1) Would reduce the amount of time the orbiters are taken out of service for an OMDP, allowing significantly more processing or contingency time for the orbiter.
- (2) Would not adversely impact the normal processing flows for the remaining orbiters.
- (3) Would create additional flexibility and efficiency in Orbiter Processing Facility operations.

The programmatic factors supporting OMDP's at KSC are based on two alternative manifest studies prepared by the KSC Flight Assignment Working Group. The two alternative studies included (1) the current manifest that assumes OMDP's will be performed at Palmdale and (2) a specially-prepared manifest that assumes OMDP's will be performed at KSC, starting with the OV-105 OMDP scheduled to begin in FY 1996.

The manifest studies were based on the following assumptions:

- 7 space shuttle flights per year
- 4 orbiters
- 3 Orbiter Processing Facilities
- Retainment of the April 27, 1995, flight manifest

We reviewed shuttle manifest studies for the period May 1996 to April 2000. There are three OMDP's and 26 normal processing flows scheduled during this period. Our review showed that there are various impacts to shuttle processing operations when OMDP's are performed at KSC rather than Palmdale. These impacts are described below.

1) Increased Contingency Days for an OMDP

Exhibit 1 shows that the number of days when an Orbiter Processing Facility is available for processing or contingencies would increase by as much as 4 months if OMDP's were performed at KSC. This is true for the OV-105 OMDP (STS-88) and OV-102 OMDP (STS-106). The number of days available increases by 62 days (2 months) and 120 days (4 months), respectively, for these two flows.

Exhibit 1 also shows that performing the OV-104 OMDP (STS-95) at KSC results in 21 additional days compared to a 10-day shortfall when the OMDP is performed at Palmdale. This 21-day surplus could be used for additional processing and contingency time. These additional days will be critical during the ambitious Space Station launch schedule beginning in FY 1998.

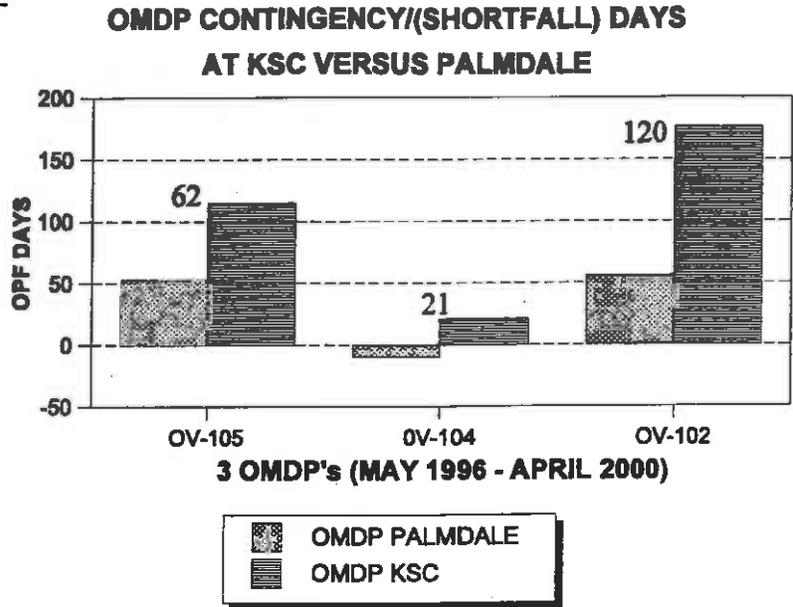


Exhibit 1

2) No Adverse Impact on Normal Processing Flows

Exhibit 2 shows that performing OMDP's at KSC would have no adverse impact on the 26 shuttle processing flows occurring during the period May 1996 through May 2000. Only 3 of the 26 flows (STS-87, 90, and 98) would be impacted. There would be no impact on the remaining 23 flows.

One Shuttle processing flow, STS-87, would be favorably impacted; it would have an additional 34 days available for processing. The other two flows, STS-90 and STS-98, would be unfavorably impacted. For these two flows, available days would be reduced by 47 days and 5 days, respectively.

Even with this reduction, each of these flows would still have a sufficient number of days in the Orbiter Processing Facility -- 86 and 134, respectively. Since the average number days required for

an orbiter in an Orbiter Processing Facility is 90, neither of these flows will be adversely impacted.

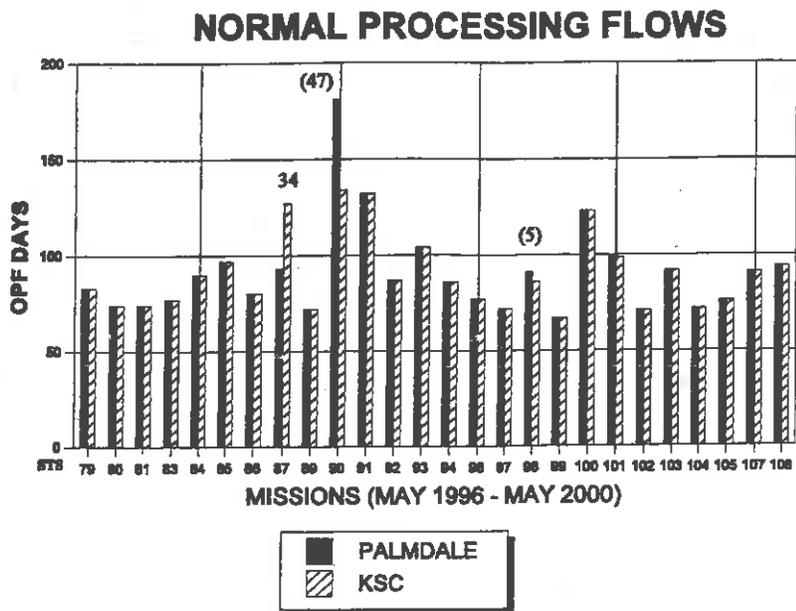


Exhibit 2

Bumping of Orbiter Processing Facilities Required

The KSC Flight Assignment Working Group manifest study takes into consideration that there will be periods where no Orbiter Processing Facilities will be available for Shuttle processing. This occurs because there are four orbiters and only three Orbiter Processing Facilities. During these periods, an orbiter would have to be "buttoned up" and moved to make room for a priority mission. Although this "bumping" of orbiters results in a loss of processing time and some inefficiencies, the studies show that the resulting impact on allotted days in the Orbiter Processing Facility would be minimal and the launch manifest can still be met.

3) Greater Flexibility and Efficiency in OPF Operations

In addition to cost savings achieved by performing maintenance and modifications at KSC, the Space Shuttle Program can achieve increased efficiency in all Shuttle processing flows. For example, personnel could be reassigned from OMDP work to normal shuttle processing work, or vice versa, depending on work requirements at each Orbiter Processing Facility. In theory, when one Orbiter Processing Facility is empty, personnel could be reassigned to the

designated OMDP facility. Also, if a normal Shuttle processing flow falls behind schedule, OMDP personnel could be temporarily reassigned to support the effort.

***Summary of
Programmatic
Impacts***

KSC's flexibility, combined with integrating maintenance and modifications with normal processing flows, results in greater efficiencies at Lockheed. This is because Lockheed can (1) use the existing workforce with some augmentation and (2) integrate maintenance and modification work into the normal processing flow. Consequently, the OMDP work can be performed at KSC in less time and at a lower cost than is currently being experienced at the Palmdale facility.

Conclusion

The Space Shuttle Program can save \$30 million per year or approximately \$480 million over the remaining life of the Space Shuttle Program by performing OMDP's at KSC. Further, the time required to perform an OMDP can be shortened as much as 4 months, thus, creating greater efficiencies in Orbiter Processing Facility operations.

RECOMMENDATION 1

The Associate Administrator for Space Flight, should ensure that OMDP's are performed at KSC rather than at Palmdale. Transition should occur no later than the OV-105 OMDP, scheduled for July 1996.

***MANAGEMENT'S
RESPONSE***

We understand this recommendation, and for budget purposes we are using the cost estimates for conducting OV-105 OMDP at KSC in the summer of 1996. Your report has been very valuable as an aid to our planning for future maintenance of the Orbiters. We will factor it into our restructure guidelines for the Space Shuttle program.

NASA agrees with the Inspector General's methodology of estimating cost savings associated with moving OMDP's from Palmdale to KSC. However, there are some unknowns or pending management decisions, thus making it difficult to estimate a specific dollar saving. Therefore, NASA suggests that the projected dollar savings be presented as a potential range of savings. Based on our analysis, we feel a range of \$400 million to \$500 million total over the projected remaining life of the Shuttle program is a more prudent approach at this early stage.

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

The actions taken and planned by the Associate Administrator for Space Flight are responsive to the recommendation. Further, the use of a range of \$400 million to 500 million over the projected remaining life of the shuttle program is acceptable.

RECOMMENDATION 2

Once OMDP's have been moved to KSC, the Associate Administrator for Space Flight should evaluate the continued need for the Palmdale facility. If continued support is not justified, the Palmdale facility should be closed.

***MANAGEMENT'S
RESPONSE***

We concur with this recommendation. NASA will carefully study the manufacturing activities at Palmdale, and challenge Rockwell to look for more consolidations and efficiencies in the context of the restructured Space Shuttle program. As the Inspector General's report points out, a number of options are available. The employment impacts will be considered as well as the overall efficiency, skills required, and manufacturing space available.

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

The actions planned by the Associate Administrator for Space Flight are responsive to the intent of the recommendation.

GENERAL COMMENT

The NASA Office of Inspector General staff members associated with this audit express their appreciation to NASA Headquarters, JSC, KSC, and contractor personnel for their courtesy, cooperation, and assistance.

Associate Administrator for Space Flight's Response
Dated September 25, 1995

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001



Reply to Airm of: ME

SEP 25 1995

TO: W/Inspector General

FROM: M/Associate Administrator for Space Flight

SUBJECT: Discussion Draft Rapid Action Report, Impacts of
Performing Orbiter Maintenance Down Periods (OMDP)
KSC versus Palmdale, Assignment Nos. A-KE-95010
and A-KE-95-012

I appreciate the detailed analysis and audit field work performed by the KSC Inspector General's staff who accomplished the subject study. Their work was thorough and provides valuable guidance for NASA. I recognize that this was a Rapid Action report and appreciate its timeliness.

RECOMMENDATION 1

"The Associate Administrator for Space Flight should ensure that OMDP's are performed at KSC rather than Palmdale. Transition should occur no later than the OV-105 OMDP, scheduled for July 1996."

We understand this recommendation, and for budget purposes we are using the cost estimates for conducting OV-105 OMDP at KSC in the summer of 1996. Your report describing all the detailed cost, time, and flexibility trade-offs has been very valuable as an aid to our planning for future maintenance of the Orbiters. We will factor it into our restructure guidelines for the Space Shuttle program.

NASA agrees with the Inspector General's methodology of estimating cost savings associated with moving OMDP's from Palmdale to KSC. However, at this time, there are some unknowns or pending management decisions, thus making it difficult to estimate a specific dollar saving. These include, but are not limited to the following:

- * Additional unknown mods in the out years;

Associate Administrator for Space Flight's Response
Dated September 25, 1995

2

- Uncertainty of appropriate number of OMDP's for aging fleet, i.e., frequency in later years.
- Uncertainty of whether OMDP's are performed in final years of program;
- Rates impact at Rockwell given reduced business base;
- Increased processing efficiencies at KSC;
- Increased costs for KSC logistics, and;
- Rockwell support at KSC.

Therefore, NASA suggests that the projected dollars savings be presented as a potential range of savings. Based on our analysis, we feel a range of \$400M to \$500M total over the projected remaining life of the Shuttle program is a more prudent approach at this early stage.

RECOMMENDATION 2

"Once OMDP's have been moved to KSC, the Associate Administrator for Space Flight should evaluate the continued need for the Palmdale facility. If continued support is not justified, the Palmdale facility should be closed."

We concur with this recommendation. NASA will carefully study the manufacturing activities at Palmdale, and challenge Rockwell to look for more consolidations and efficiencies in the context of the restructured Space Shuttle program. As the Inspector General's report points out, a number of options are available. The employment impacts will be considered as well as the overall efficiency, skills required, and manufacturing space available.

REQUEST FOR CLOSURE

We believe that the actions NASA will take, which are described above, are adequate to fully answer the recommendations. Therefore, I request closure of the two OIG recommendations in the subject report.

If you have any questions, please contact Howard Roseman at 202/358-4451.

for BO'Connor
for J. Wayne Little 9/25/95