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September 24 1999

TO: AE/Chief Engineer
H/Associate Administrator for Procurement
R/Associate Administrator for Aero-Space Technology

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Report on the Audit of X-33 Cost Estimating Processes
Assignment Number A9901400
Report Number IG-99-052

The subject final report is provided for your information and use. Please refer to the Executive Summary for the overall audit results. Our evaluation of your response is incorporated into the body of the report. Your comments on a draft of this report were responsive to the recommendations. The recommendations will remain open for reporting purposes until corrective action is completed. Please notify us when action has been completed on the recommendations, including the extent of testing performed to ensure corrective actions are effective.

If you have questions concerning the report, please contact Ms. Karen VanSant, Audit Program Director, Aero-Space Technology Audits, at (256) 544-1149, or Ms. Sandra Leibold, Auditor-in-Charge, at (256) 544-0970. We appreciate the courtesies extended to the audit staff. See Appendix E for the report distribution.

[original signed by]
Russell A. Rau

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**AUDIT
REPORT**

X-33 COST ESTIMATING PROCESSES

September 24, 1999



National Aeronautics and
Space Administration

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Acronyms

FAR	Federal Acquisition Regulation
IGCE	Independent Government Cost Estimate
NPG	NASA Policy Guidance
RLV	Reusable Launch Vehicle
SEC	Source Evaluation Committee

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X-33 Cost Estimating Processes

Executive Summary

Background. In July 1996, NASA selected Lockheed Martin Skunk Works (Lockheed) for Phase II of the X-33 Program, to design, build, and fly the X-33 unmanned test vehicle.¹ NASA is using a cooperative agreement² for the X-33 Program, a first for a major technology program. Under the terms of the cooperative agreement for Phase II of the X-33 Program, NASA will provide \$912.4 million (about 80 percent) and Lockheed will invest at least \$212 million (about 20 percent). Lockheed is responsible for any costs that exceed or overrun its estimate.

Cost analyses and estimating activities are critical elements of any procurement process including a cooperative agreement. Program managers develop life-cycle cost estimates at the start of a program as guidance for needed resources and throughout the life of the program especially when a program undergoes major restructuring, since changes may significantly alter the cost of the program. If early life-cycle estimates are realistic, greater program stability results. The contracting officer and the source evaluation committee (SEC)³ use Independent Government Cost Estimates (IGCE's)⁴ to evaluate the reasonableness of contractors' proposed costs. Additionally, an independent cost estimate⁵ is required during the Non-Advocate Review,⁶ where the decision is made whether to proceed to the next phase of the program.

¹ The X-33 Program consists of three phases. Phase I, which has been completed, consisted of concept definition and preliminary design of the X-33 vehicle. Phase II, the focus of the audit, consists of final design and demonstration of the technologies that would reduce risks. After evaluating the results of Phase II, Lockheed will make a decision on whether to proceed to Phase III, which is construction of a full-scale operational vehicle.

² The cooperative agreement for Phase II of the X-33 Program is a legal instrument reflecting a voluntary partnership between NASA and a commercial firm, Lockheed, where substantial involvement is expected between both parties in carrying out the activity contemplated in the cooperative agreement. If at any time one of the partners decides it is not in its best interest to continue, it can terminate the partnership.

³ The NASA SEC is an evaluation team that assists the source selection official by providing expert analyses of offerors' proposals.

⁴ An IGCE is a Government-prepared estimate of the probable cost of a proposed procurement.

⁵ An independent cost estimate is any cost estimate developed by specialists outside and independent of the program office. The independent cost estimate serves as an analytical tool to validate or cross-check program office or contractor-developed estimates.

⁶ A team composed of NASA management, technical, and budget personnel who will not participate in the implementation of the proposed program or project performs this review.

Objective. The audit objective was to determine whether the Phase II X-33 cost estimating process relied on sound methodologies and procedures that produced realistic cost estimates. Appendix A contains details on the objectives, scope, and methodology used for this audit.

Results of Audit. NASA did not adequately address cost reasonableness and cost risk for Phase II of the X-33 Program. Specifically, NASA did not prepare an IGCE for the source evaluations of proposed costs. Further, the Non-Advocate Review's cost estimate did not include a risk analysis to quantify technical and schedule uncertainties. Therefore, NASA management approved the program without the benefit of realistic estimates of the probable cost of the X-33 Program. A risk analysis would have alerted NASA decisionmakers to the probability of cost overruns in the program. Cost overruns put NASA's investment in the X-33 Program at risk. Since the program is under a cooperative agreement, the recipient may end its part of the partnership should cost overruns become too burdensome or request that NASA invest more money. In addition, Lockheed's current estimate at completion is considered overly optimistic. Due to unforeseen challenges in the development of technology and resulting schedule delays, Lockheed may need to contribute from \$120 to \$300 million more than planned to complete the work contemplated in the cooperative agreement. NASA places a high priority on the success of the program, and the cost growth being experienced places program success at risk.

Recommendations. NASA should improve its evaluation processes for cost reasonableness and cost risk to ensure that decisionmakers are provided complete and accurate information, that sufficient resources are available, and that the final "agreed to" price is fair and reasonable. Further, the X-33 Program's estimate to complete should be updated to reflect cost uncertainties and determinations made of how remaining work will be funded.

Management's Response. Management concurred with the recommendations and stated it was taking action to correct the reported weaknesses. Management plans to issue a regulatory change that will require a well-supported cost analysis for commercial cooperative agreements and will require the recipient to provide an estimate at completion that includes a breakdown of the industry contributions to complete the X-33 program. Management will provide the recommended regulatory change that well-supported independent cost estimates include a quantification of cost risk to the NASA Program/Project Management Working Group for consideration. The group is responsible for review of Agency policy guidelines.

Evaluation of Management's Response. Management's planned actions are responsive to all the recommendations.

Introduction

Marshall Space Flight Center (Marshall) is the Lead Center for the X-33 Program. According to the Program Commitment Agreement, the program's goals are to mature single-stage-to-orbit technologies, demonstrate reduced launch costs, and reduce technical and programmatic risks enough to attract private industry to build and operate a Reusable Launch Vehicle (RLV).

The X-33 Program contains three phases. In 1995, three companies worked with NASA on defining the concept definition and design of the X-33 in Phase I. NASA selected Lockheed as its industry partner in 1996 and proceeded into Phase II, the design/demonstration phase of the X-33. Phase III of the X-33 Program is the commercial development/operation of the RLV and is expected to begin in 2000, pending the success of Phase II.

Cost realism analysis is the process of determining what the Government can realistically expect an effort to cost and of independently reviewing and evaluating the offeror's proposed cost estimate to determine whether it is realistic for the work to be performed. The objective of a cost realism analysis is to ensure that the final agreed-to-price is fair and reasonable, not only for the Government, but also for the offeror. Cost realism is appropriate for competitive fixed-price type contracts when new requirements may not be fully understood by competing offerors.

Cost analysts prepare cost estimates by applying scientific and statistical methods to evaluate the likely cost of a specific item. There are generally multiple uncertainties about an item's cost.⁷ As a program matures and becomes better defined, more precise estimates can be prepared. One test of the utility of a cost analysis is its ability to respond quickly to program turbulence. NASA planners must have reliable, quickly available information on the cost consequences of program changes, extensions, or cancellations.

Cost risk analysis is the quantification of uncertainty in a program cost estimate. Most cost estimates include a "point estimate" of the most likely cost. A cost risk analysis examines the likelihood that the point estimate will fall within a specified range of possible costs. Once the analysis is complete, program managers must define the risk and should recommend sufficient additional funding so that the probability of a cost overrun remains within reasonable limits. Knowledge of the cost impacts of risk helps to focus the application of scarce resources and to mitigate risk to the program.

All programs with a developmental cost of more than \$200 million fall under the overview of the NASA Program Management Council, a senior management group chaired by the Deputy Administrator. Independent reviews such as the Non-Advocate Reviews⁸ and Independent

⁷ Some "internal" uncertainties influencing costs are inadequate item definition, poor statements of work, optimistic proposed solutions, inexperienced management, and new technology. "External" uncertainties include such things as funding instability, contractor/recipient underestimating of complexity, contractor/recipient changing business base, and excessive or insufficient Government oversight.

⁸ The Non-Advocate Review team performs its reviews during program formulation phases as input to the program approval process; the reviews include the verification of life-cycle cost estimates.

Annual Reviews⁹ provide the Program Management Council with objective evaluations of program or project conformance to plans and objectives. The Non-Advocate Review team performed an independent cost estimate for the X-33 Program in 1996 before program approval to implement Phase II, and three Independent Annual Review's have been completed since the Phase II cooperative agreement was signed.

⁹ The Independent Annual Review is an analysis of the status of commitments (performance, cost, and schedule) as compared to the program/project baseline and established thresholds. The Independent Annual Review occurs during the program implementation phase.

Finding and Recommendations

Cost Reasonableness of the X-33 Program

NASA did not adequately determine a fair and reasonable amount for total contributions for Phase II of the X-33 Program. Specifically, NASA did not sufficiently evaluate the cost proposals for reasonableness and did not quantify in the cost estimates the technical and schedule uncertainties inherent in the program. In addition, NASA did not perform an IGCE for the purposes of determining, by comparison, the reasonableness of total contributions. Instead, NASA relied on the fixed-price nature of the agreement as a means to control costs without regard to the total cost of performance of the X-33 cooperative agreement. The NASA Program Manager concluded that because of the fixed funding, there was no risk to NASA. Additionally, NASA policy on program risk states that risk must be addressed but does not require that it be quantified in any cost estimate, including the independent cost estimate. In addition, the focus of the source evaluations looked ahead to the Phase III commercialization of the RLV rather than to the reasonableness of costs for Phase II of the X-33. Consequently, the resulting total cost of the cooperative agreement is understated and sufficient resources may not be available to complete the X-33 Program.

NASA and Federal Policy and Procedures

NASA policy guidance¹⁰ sets forth policy and procedures on award and administration of cooperative agreements. NASA policy states that “the grant officer and technical team will determine whether the overall proposed cost of the project is reasonable and that the Recipient’s¹¹ contribution is valid, verifiable, and available.” The policy further states:

If the Recipient’s share is projected to be less than 50% or the total value of the agreement is more than \$5 million, a more in-depth analysis of the proposed costs should be undertaken. . . . An analysis consistent with 48 CFR [Code of Federal Regulations] (FAR) [Federal Acquisition Regulation] 15.805-3 through 15.805-5 should be performed.

Since the Lockheed share in the cooperative agreement is 20 percent and the value of the agreement is more than \$1 billion, the cost analysis for the X-33 should have occurred to meet Federal Acquisition Regulation (FAR) requirements.

The FAR and 48 Code of Federal Regulations 15.805-3 through 15.805-5¹² state that the contracting officer shall perform a cost analysis to: (1) verify cost or pricing data and evaluate cost elements including “The necessity for and reasonableness of proposed costs, including allowances for contingencies”; and (2) compare costs proposed by the offeror for individual cost elements with “Independent Government cost estimates by technical personnel.”

¹⁰ NASA Policy Guidance 5800.1D, “Grant and Cooperative Agreement Handbook,” section D, “Cooperative Agreements with Commercial Firms.”

¹¹ Recipient means an organization receiving financial assistance under a cooperative agreement to carry out a program. A recipient may be an “individual firm, a consortium, a partnership, etc.”

¹² In a revision to the FAR in 1997, Parts 15.805-3 through 15.805-5 were deleted; however, the same requirements are now in Part 15.404.

NASA Policy Guidance (NPG) 7120.5A¹³ addresses the requirements for program life-cycle cost estimates and independent cost estimates. The NPG states that life-cycle cost estimates should be estimated throughout the program life cycle. Further, the approval process for all programs must include the Non-Advocate Review's independent cost estimate to verify and evaluate a program's readiness to proceed to the next phase of the program's life cycle.

NPG 7120.5A also requires that NASA recognize and address program risks. However, the NPG does not require that risks be quantified and the cost impact be included in the total cost estimate for a program. NASA management should have the most accurate information possible on the total cost of a program prior to program approval in order to make effective decisions regarding the expenditure of NASA's limited resources.

The Cooperative Agreement Notice for the X-33 identified programmatic criteria for tailored management methods to demonstrate the "new ways of doing business." The "new ways of doing business" are expected to significantly reduce the development and operational costs on the X-33 Program. These tailored methods are expected to be done using effective business practice, laws, and regulations to encourage innovation and to achieve "faster, better, cheaper" products. Although the cooperative agreement for the X-33 is one of the "new ways of doing business," NPG 5800.1D requires a determination of whether the overall proposed cost is reasonable. The new ways of doing business do not eliminate program requirements but allow for flexibility in their accomplishment.

Cost Realism

A cost realism analysis involves comparing proposed cost estimates with the IGCE to form an opinion as to whether proposed costs are unrealistically high or low. The X-33 Program Managers indicated that a "Business as Usual" IGCE was not appropriate for the X-33 Program because they believed that the cooperative agreement was comparable to a fixed-price instrument and, therefore, did not recognize any risk to the Government. Consequently, the grant/contracting officer¹⁴ did not require an IGCE to identify the most probable total program costs or to assist the SEC in its evaluation of offerors' cost proposals. Therefore, the SEC did not evaluate the cost realism of Phase II cost proposals. Instead, the SEC evaluation focused primarily on the commercialization of the RLV (Phase III) rather than on the costs of the X-33.

The SEC addressed cost realism only indirectly in its source evaluation by:

- evaluating proposed ground rules and assumptions;
- examining the content of the proposed cost elements;
- confirming offerors' rates;
- validating the offeror's proposed share of program costs to identify inconsistencies, if any; and

¹³ "NASA Program and Project Management Processes and Requirements."

¹⁴ The grant officer is a Government employee who has been delegated the authority to negotiate, award, or administer grants or cooperative agreements. A contracting officer may serve as a grant officer if authorized by installation procurement regulations.

- comparing the cost proposals to NASA's available funding profile by fiscal year, as provided in the Cooperative Agreement Notice.

Non-Advocate Review Estimate. The Non-Advocate Review team prepared an independent cost estimate of the X-33 Program costs in 1996 prior to the Phase II cooperative agreement award. The Non-Advocate Review team found the offeror's cost estimates reasonable, basing its conclusion on the Non-Advocate Review independent cost estimate that assumed no technical or schedule risks. The Non-Advocate Review team made this determination even though the X-33 Program is inherently a high-risk program and the schedule is considered optimistic. However, there is no documentation to indicate that the grant/contracting officer and/or the SEC used the Non-advocate Review independent cost estimate during its evaluation of cost proposals and negotiations.

Other Estimates. Additional cost estimates were developed in 1996 at the request of the Phase I (Concept Definition and Design) recipients. The recipients requested that Marshall cost estimators provide them an estimate of the costs to develop the X-33. Marshall estimators provided each Phase I recipient with six cost estimates. None of the estimates included costs for software development, ground facilities, or flight tests. Even though the estimates were incomplete, Lockheed proposed a cost that was less than five of the six Marshall estimates. In light of the omitted costs in the Marshall estimates, it is reasonable to conclude that Lockheed's proposed costs for Phase II were low.

NASA envisioned the X-33 Program to cost approximately \$1 billion, based on studies in 1994. NASA knew in advance that the Agency would invest about \$912 million for Phase II and that the industry partner was responsible for the balance. Bidders provided proposals to augment the NASA funds with whatever level of funds was necessary for their own unique and proprietary designs.

Cost Risk

Cost estimates for the X-33 Program did not quantify cost risks although the X-33 is inherently a high-risk program. As a result, decisionmakers did not have access to realistic estimates on which to base their decisions. The Non-Advocate Review's independent cost estimate assumed that the technology the X-33 needed to build upon would be available on schedule and as planned. The general consensus of the Program Office was that there was no cost risk to the Government because NASA was using a cooperative agreement and because NASA had a fixed-dollar investment in the program. In our opinion, there is risk to NASA's investment in that the technology may not be demonstrated, cost overruns may threaten the program, and sufficient resources may not be available to complete the program.

If cost overruns become too burdensome, the recipient may terminate the cooperative agreement or request that NASA invest more money. A risk analysis would have alerted NASA decisionmakers to the probability of cost overruns in the program.

As allowed under FAR 31.205-18, some recipient contributions may be allocated to overhead costs as independent research and development expenses and, therefore, be eligible for reimbursement by NASA or other Government agencies. Increases in the X-33 Program costs will also potentially increase the amount of independent research and development reimbursements received from the Government. This practice adds to NASA's fixed investment in the program.

Cost to Complete

Lockheed's estimated cost to complete the X-33 is overly optimistic and understates the probable final total cost of this high-risk, technology demonstration program. Lockheed will need an efficiency rate of 20 percent greater than what has been experienced to date to meet the current estimate at completion of \$1.2 billion. If efficiency remains unchanged, our earned value analysis indicated that the estimated final cost will be about \$200 million more than Lockheed's current estimate. Our analysis is supported by the 1999 Independent Annual Review and a 1997 Marshall estimate that \$120 million and \$300 million more, respectively, would be needed to complete the X-33 Program.

The 1999 Independent Annual Review of the X-33 concluded that at least \$120 million more would be needed to complete the program, not as originally planned, but as currently planned. The Independent Annual Review expressed concerns about X-33 Program content and further concluded that "several critical technologies, identified in the Program Commitment Agreement as necessary for an SSTO [single-stage-to-orbit] RLV, will not be demonstrated by the conclusion of the X-33 program." The X-33 Program Manager and Lockheed stated that the work is "refocused, but not descoped." The Program Management Council directed that a review be conducted to ensure that technical content is sufficient to demonstrate the RLV technologies as defined in the Program Commitment Agreement. If NASA finds there are reductions in work, the cooperative agreement will require modification to reduce the current level of NASA funding.

The Phase II cooperative agreement notice, which identified programmatic criteria for demonstrating the "new ways of doing business," suggested that independent assessments of costs be performed. The NASA Program Office, however, did not request any type of estimate independent of Lockheed's estimated costs until 1997. In response to the request, Marshall cost estimators prepared an independent estimate and determined an estimated \$1.5 billion for the X-33 Program (approximately \$300 million more than the current Lockheed estimate).

The Program Office should not rely completely on Lockheed's management of the program, but should couple it with effective insight. The SEC identified Lockheed's demonstrated reluctance to inform NASA of significant problems during Phase I as a weakness in the SEC presentation to the Phase II source selection official. The Program Office views the weekly estimate to complete provided by Lockheed to be the team estimate (NASA and all partners). Lockheed's weekly estimate to complete does not always reflect problems in the program. For example, from January until May

1999 Lockheed's estimate at completion remained constant although both NASA and Lockheed were aware of problems with the hydrogen tanks in January. However, in June 1999 NASA received a proposal from Lockheed to rebaseline¹⁵ the program.

The scheduled launch date of the X-33 has slipped from March 1999 to July 2000. Significant technical problems have been encountered with the engines (February 1998) and the hydrogen tanks (January 1999). Critical item testing of the engines and hydrogen tanks are still to be performed and are crucial for the successful completion of the X-33 Program. Delays and problems have increased costs to the program. NASA managers indicated that by program completion, the X-33 costs could increase to the \$1.5 billion Marshall estimate. On the other hand, managers have pointed out that Lockheed has experience with managing technically challenging programs with schedule delays and may yet bring the program in at Lockheed's current estimated cost.

Conclusion

NASA's objective to reduce the cost of space transportation is an important national priority; nevertheless, we are concerned that the X-33 estimates are overly optimistic and could lead to problems, such as reduced performance or system capability or inadequate resources to complete the program. While some problems in cost estimating are due to flaws in methodology and unforeseen technical problems, the more pervasive cause is lack of realism in reporting program cost estimates.

Recommendations, Management's Response, and Evaluation of Response

The Associate Administrator for Procurement should:

- 1. Emphasize to NASA grant/contracting officers using cooperative agreements that have a value more than \$5 million that as required by the FAR, the officers should obtain independent Government cost estimates to be used in determining the cost reasonableness of offerors' cost proposals during source evaluations.**
- 2. Revise NPG 58001.D to require that a well-supported cost analysis that is consistent with FAR 15.404 be performed on all cooperative agreements in which the recipient does not share at least 50 percent of the cost or on all cooperative agreements valued at \$5 million or more, regardless of the share ratio.**
- 3. Request the grant/contracting officer for the X-33 Cooperative Agreement to require that Lockheed develop a more realistic cost estimate of the cost to complete the X-33 Program by preparing a quantitative risk analysis to quantify the uncertainty of costs and determine the sources of funding for the remainder of the program.**

¹⁵ The baseline of a program is intended to define the cost, schedule, and performance boundaries for a specific program. To rebaseline a program is to revise program boundaries.

Management's Response. Concur. Management stated that it would revise the NPG 58001.D to create a firm requirement for the performance of cost analyses on commercial cooperative agreements and will issue a Grant Information Circular in anticipation of the regulatory change. The circular will state that for cooperative agreements with commercial firms, grant/contracting officers must perform well-supported cost analyses for use in determining the cost reasonableness of offerors' cost proposals. Management also stated it has obtained a breakdown of additional industry contributions needed to complete the X-33 Program and is in the process of definitizing Lockheed's restructuring proposal to ensure a realistic cost to complete is determined. The complete text of the comments is in Appendix C.

Evaluation of Response. The actions planned by management are responsive to the recommendations. The recommendations are resolved but will remain undispositioned and open until agreed-to corrective actions are completed.

4. The Chief Engineer should revise NPG 7120.5A to require that well-supported, independent cost estimates include a quantification of cost risk.

Management's Response. Concur. Management agreed to provide our recommendation to the NASA Program/Project Management Working Group, which is responsible for revising NPG 7120.5A, for consideration in the upcoming revision process (see Appendix C).

Evaluation of Response. The actions planned by management are responsive to the recommendation. The recommendation is resolved but will remain undispositioned and open until agreed-to corrective actions are completed.

Appendix A. Objectives, Scope, and Methodology

Objectives

The overall objective was to determine whether the Phase II X-33 cost estimating process relied on sound methodologies and procedures that produced realistic cost estimates. Specifically, we determined whether the cost estimates were realistic and complete, the cost estimating methodology was sound, the cost estimate documentation was adequate, and the cost estimates were updated periodically and consistently.

Scope and Methodology

We examined the policies, procedures, and practices used in preparing cost estimates for Phase II of the X-33 Program. We reviewed the limited documentation on estimates that was available for the source selection evaluation, the Non-Advocate Review, and a postaward 1997 Program Office estimate. We also reviewed the current program status for the X-33. We interviewed personnel involved in preparing cost estimates. We also interviewed cost analysts, Program Office personnel, and personnel who were involved in the source evaluation, the Non-Advocate Review, independent annual reviews, and the Access to Space Study.¹⁶ In addition, we examined the methodology and results of a Marshall estimate for the Phase I recipient before the submission of proposals for Phase II.

Management Controls Reviewed

We reviewed NASA's policies on cost estimating and cooperative agreements. Specifically, we reviewed NPG 5800.1D, "Grant and Cooperative Agreement Handbook," Section D, "Cooperative Agreements with Commercial Firms"; FAR Part 15, "Contracting by Negotiation," Subparts 15.805-3 through 15.805-5; NPG 7120.5A, "NASA Program and Project Management Processes and Requirements," Chapter 4.1.2, "Life-Cycle Cost (LCC) Management and Accounting," and Appendix F, "Independent Reviews."

Management controls regarding cost estimating were not adequate as discussed in the finding.

Computer-Processed Data

We relied on computer-generated reports from NASA and Lockheed to assess the overall X-33 cost estimating process. We reviewed and tested selected data but did not verify the overall validity of the reports. The lack of verification did not affect our audit results.

¹⁶ NASA conducted the Access to Space Study during 1993 and issued a final report in January 1994. The study produced the first estimate related to the X-33 Program as one option in a study of alternatives for a long-range direction for space transportation.

Appendix A

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As a rule, NASA databases are updated as programs are completed. An estimate's reliability depends on the accuracy of the person inputting the data. Due to a lack of complete documentation of the estimates, we were unable to verify the input variables for the estimates.

Prior Audit Coverage

On March 29, 1999, the NASA Office of Inspector General issued audit report IG-99-019, "X-33 Cooperative Agreement." The report states that: (1) industry partners did not provide required analyses of their cost estimates at completion of the X-33 Program or submit monthly reports on their resource contributions and that (2) Center practices for controlling and reporting cost need improvement. The report made recommendations to improve these processes.

In November 1992, the General Accounting Office issued audit report GAO/NSIAD-93-73, "SPACE PROGRAMS: NASA's Independent Cost Estimating Capability Needs Improvement." The report states that NASA's actions to implement an independent cost estimating function were deficient because: (1) results of formal cost reviews were reported to program officials rather than directly to the Administrator; (2) advice provided to the Administrator on cost estimates was informal and undocumented; (3) cost estimates were reviewed only at the start of new initiatives, not at all major decision points over a program's life; and (4) the cost analysis group did not have adequate staff to perform independent estimates at all major decision points.

Audit Field Work

During March through July 1999, we conducted field work at Marshall, NASA Headquarters, and Lockheed. The audit was performed in accordance with generally accepted government auditing standards.

Appendix B. Policies and Procedures Relating to Cost Estimating

FAR Part 15, "Contracting By Negotiations," Subpart 15.8, "Price Negotiation," specifies the requirements for cost analysis in establishing the reasonableness of proposed costs. Specifically:

15.805-3 Cost analysis.

The contracting officer shall, as appropriate, use the techniques and procedures outlined in paragraphs (a) through (f) below to perform cost analysis:

- (a) Verification of cost or pricing data and evaluation of cost elements, including--
 - (1) The necessity for and reasonableness of proposed costs, including allowances for contingencies;
 - (2) Projection of the offeror's cost trends, on the basis of current and historical cost or pricing data;
 - (3) A technical appraisal of the estimated labor, material, tooling, and facilities requirements and of the reasonableness of scrap and spoilage factors; and
 - (4) The application of audited or negotiated indirect cost rates (see Subpart 42.7), labor rates, and cost of money or other factors.
- (b) Evaluating the effect of the offeror's current practices on future costs. In conducting this evaluation, the contracting officer shall ensure that the effects of inefficient or uneconomical past practices are not projected into the future. In pricing production of recently developed, complex equipment, the contracting officer should make a trend analysis of basic labor and materials even in periods of relative price stability.
- (c) Comparison of costs proposed by the offeror for individual cost elements with--
 - (1) Actual costs previously incurred by the same offeror;
 - (2) Previous cost estimates from the offeror or from other offerors for the same or similar items;
 - (3) Other cost estimates received in response to the Government's request;
 - (4) Independent Government cost estimates by technical personnel; and
 - (5) Forecasts or planned expenditures.
- (d) Verification that the offeror's cost submissions are in accordance with the contract cost principles and procedures in Part 31 and, when applicable, the requirements and procedures in 48 CFR Chapter 99 (Appendix B, FAR loose-leaf edition), Cost Accounting Standards.

Appendix B

(e) Review to determine whether any cost or pricing data necessary to make the contractor's proposal accurate, complete, and current have not been either submitted or identified in writing by the contractor. If there are such data, the contracting officer shall attempt to obtain them and negotiate, using them or making satisfactory allowance for the incomplete data.

(f) Analysis of the results of any make-or-buy program reviews, in evaluating subcontract costs.

NPG 5800.1D, "Grant and Cooperative Agreement Handbook," section D, "Cooperative Agreements with Commercial Firms," sets forth policy and procedures on award and administration of cooperative agreements. This section incorporates Title 14 of the Code of Federal Regulations, Part 1274, which provides guidance on cost evaluation and source selection for cooperative agreements.

Sec. 1274.204 Evaluation and selection.

(d) Cost evaluation.

(1) The grant officer and technical team will determine whether the overall proposed cost of the project is reasonable and that the Recipient's contribution is valid, verifiable, and available. Commitments should be obtained and verified to the extent practical from the offeror or members of the consortia that the proposed contributions can and will be made as specified in the proposal or statement of work.

(i) If the Recipient's verified share on a cooperative agreement equals or exceeds 50% of the total cost of the agreement and the total value of the agreement is less than \$5 million, the cost evaluation of the offeror's proposal should focus on the overall reasonableness and timing of the proposer's contribution. Cost or pricing data should not be required and information other than cost or pricing data (defined in 48 CFR 15.801) (FAR) should not normally be required.

(ii) If the Recipient's share is projected to be less than 50% or the total value of the agreement is more than \$5 million, a more in-depth analysis of the proposed costs should be undertaken. Only information other than cost or pricing data should be required. An analysis consistent with 48 CFR 15.805-3 through 15.805-5 (FAR) should be performed.

(2) As part of the evaluation of the cost proposal, the source of the recipient's contribution should be determined. Each of the cost elements contributed by the recipient and their amounts should be identified. If the contribution will consist at least in part of IR&D, the extent to which the IR&D may be recoverable from Government awards should be established. This will involve using the estimated Government participation rate of the recipient's General and Administrative indirect cost base for the period of the cooperative agreement. An analysis consistent with 48 CFR (FAR) 15.404-1(c), 15.404-1(c), and 15.404-2 should be performed.

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NPD 7120.5A, “NASA Program and Project Management Processes and Requirements,” establishes the management system for processes, requirements, and responsibilities for managing NASA programs. This system includes requirements for the independent cost estimate, life-cycle cost estimates, and independent reviews.

CHAPTER 2. Program Management Process and Functional Requirements

2.4 Program Evaluation

2.4.1 Plan and Conduct Reviews and Assessments

2.4.1.6 Concurrent with the formulation subprocess, evaluation shall include one or more NAR’s, which includes an Independent Cost Estimate (ICE), to determine the readiness of the program, either to proceed with further formulation or to request approval to enter implementation. The NAR of a program is conducted by an independent review team upon request of the EAA. The review is coordinated by the IPAO at Langley Research Center (LaRC).

Chapter 4-Program/Project Management Systems Requirements

4.1.2 Life-Cycle Cost (LCC) Management and Accounting

4.1.2.1 Purpose. LCC management and accounting is to ensure that programs and projects are managed on the basis of LCC, that costs are fully accounted for, and that the LCC of each program is minimized.

4.1.2.2 Requirements.

- a. LCC shall be estimated, assessed, and controlled throughout each program or project life cycle.
- b. LCC shall be determined on the basis of the full cost initiative guidance available at the point of its calculation.
- c. All cost estimates shall be summarized according to the current WBS and time phased by Government Fiscal Year (FY).
- d. LCC effects shall be projected for all major changes and submitted as a part of any formal change control request.
- e. LCC estimates shall be prepared in support of the following:
 - (1) The development of program commitment.
 - (2) Major reviews
 - (3) Budgetary submissions.
- f. Financial reserves shall be established and maintained commensurate with the identification and assessment of programmatic, technical, cost, and schedule risks. The total program and project management flexibility is comprised of the financial reserves, schedule margin, and technical performance margins. The financial reserves shall be sized accordingly. These reserves shall include the following:

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(1) Allowance for Program Adjustment (APA). These reserves shall be available for approved changes in program or project objectives or scope, the resolution of unforeseen major problems, project stretchouts from Agency funding shortfalls, and similar fiscal difficulties.

(2) Contingency. These reserves shall be allocated to and managed by the project manager for the resolution of problems normally encountered while ensuring compliance to the specified project scope. A project shall have sufficient contingency to allow the manager to solve the routine problems that typically arise during implementation.

APPENDIX F. Independent Reviews

F.1 Non-Advocate Review (NAR)

F.1.1 Purpose

The approval subprocess for all programs and selected projects must include a NAR which provides an independent verification of a candidate program or project's plans, LCC status, and readiness to proceed to the next phase of the program's life cycle. A NAR is conducted by a team comprised of highly knowledgeable specialists from organizations outside of the advocacy chain of the program or project being reviewed.

F.1.2 Content

A NAR provides the NASA PMC with an independent verification and evaluation of a program or selected project's readiness to proceed. The NAR shall assess the following:

- a. Compatibility with NASA policy and baselined documentation.
- b. Clarity of goals and objectives.
- c. Thoroughness/realism of technical plans, schedules, and cost estimates (including reserves and descoping options).
- d. Adequacy of management plans, including organizational structure and key personnel credentials.
- e. Technical complexity, risk assessment, and risk mitigation plans.

When an EAA is ready to have a NAR performed, the Chief Engineer will be requested to initiate the review process. The Chief Engineer will direct the IPAO at LaRC to establish the NAR team and conduct the review for presentation to the NASA PMC. To the extent possible, continuity of the team membership will be maintained from IA to NAR and carried forward to the IAR.

To effectively support the NASA PMC in its recommendations for progressing, the review team shall gain a thorough understanding of the present status and position of the program or project, as well as an understanding of the major tradeoffs and alternatives explored by the design team. The program or project shall brief the following information to the NAR team:

- a. Program/project background.
- b. Scientific and technological objectives.
- c. Formulation and implementation plans and schedules.
- d. Documentation and agreements status.
- e. Management structure and acquisition strategies.
- f. LCC estimate which includes the following:
 - (1) Funding resource requirements.
 - (2) Reserves allocations (contingency and APA).
 - (3) Workforce requirements.
 - (4) Infrastructure requirements.
 - (5) External contributions or partnering efforts.
- g. Program risk assessment and plans for mitigating risks.

F.1.3 Outcomes

The findings of the review shall document each of the areas above. The conclusions and recommendations will be used by NASA Senior Management in deliberations and recommendations for moving the program or project into the next phase of its development.

F.2 Independent Annual Review (IAR)

F.2.1 Purpose

The NASA PMC shall establish procedures to ensure that it remains cognizant of the status and performance of the programs and projects over which it has responsibility.

An IAR provides a validation of conformance to the PCA.

F.2.2 Content

An IAR shall provide for the following:

- a. Assess progress/milestone achievement against original baseline.
- b. Review and evaluate the cost, schedule, and technical content of the program over its entire life cycle.
- c. Assess technical progress, risks remaining, and mitigation plans.

Appendix B

d. Determine if any program deficiencies exist which result in revised projections exceeding predetermined thresholds.

To accomplish this, the IAR team will assess progress to date against the plan to date, incorporating the use of performance indicators and milestone success criteria, as well as assessing risk for completing future efforts as presently planned. The program/project presentation to the IAR team should include, at a minimum, the following:

- a. Quick overview of program/project.
- b. Status and changes since the last NAR or IAR of the following:
 - (1) Primary goals and objectives.
 - (2) Scientific and technical objectives that drive mission requirements and implementation plans.
 - (3) Implementation plans.
 - (4) Progress against performance indicators and productivity measures (technical, cost, schedule).
- c. The NASA Chief Engineer, with process responsibility, along with the NASA CFO and LaRC Center Director shall establish standards to ensure continuity of reviews and for their conduct.
- d. The program manager will ensure that a current and accurate PCA and program baseline is available to the IAR team to facilitate the conduct of the assessment.

F.2.3 Outcome

The IAR shall support the deliberative process of the NASA PMC by providing realistic status on Agency commitments.

The IAR team report shall contain the following:

- a. Recommendations to the NASA PMC relative to compliance with the PCA.
- b. Recommendations for additional reviews or individual program/project briefings that the IAR team deems necessary.
- c. A recommendation on the advisability of continuing the program. This shall specifically include a recommendation as to whether or not a Termination Review is required.
- d. Minority reports in the event that team consensus is not reached.

Appendix C. Management's Response

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



SEP. 16 1999

Report #

HC

TO: W/Assistant Inspector General for Auditing

FROM: HC/Director, Analysis Division

SUBJECT: Code H Response to OIG Draft Audit Report on the X-33 Cost Estimating
Process Assignment No. A9901400

Enclosed is our response to the subject report dated August 20, 1999.

Please call Steven Miley at 202-358-0493 or Jack Horvath at 202-358-0456 if you have
any questions or need further coordination on this matter.

Anne Guenther

Anne Guenther

Enclosure

Appendix C

HEADQUARTERS OFFICE OF PROCUREMENT
RESPONSE TO
OFFICE OF INSPECTOR GENERAL (OIG)
DRAFT REPORT ASSIGNMENT NUMBER A9901400
DATED AUGUST 20, 1999
X-33 COST ESTIMATING PROCESSES

DATE: SEP. 16 1999

ENCLOSURE

Code H Response to OIG
8/20/99 Draft Report,
A9901400
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The narrative response is provided as follows:

GENERAL COMMENTS:

The report contains a summary paragraph entitled "Results of Audit" on page ii. Included in the summary are three statements, each of which are addressed separately in the following paragraphs: 1) NASA did not prepare an independent government cost estimate (IGCE) for the source evaluations of proposed costs; 2) the non-advocate review's (NAR) cost estimate did not include a risk analysis to quantify technical and schedule uncertainties; and 3) Lockheed's current estimate at completion is considered overly optimistic.

1) *NASA did not prepare an IGCE for the source evaluations of the proposed costs.*

This conclusion is incorrect. MSFC's Engineering and Cost Office (now a part of the new System Management Office) did develop and provide independent cost estimates on the X-33 Phase II program in April 1996. In fact, for the selected Lockheed X-33 Phase II concept, six estimates were prepared. They used three different cost estimating models with assumptions of "Business as Usual" and "New Ways of Doing Business (NWODB)." The range of the NWODB estimates was \$973.4M to \$1,504.6M. The "Business as Usual" estimates ranged from \$1,274.3M to \$3,765.8M, but were not appropriate for the way business is being conducted today, particularly under this unique cooperative agreement approach. The draft report covers these under *Other Estimates* on page 5 and indicates that Lockheed's proposed cost was lower than 5 of the 6 estimates, thus concluding that the estimate was too low. This conclusion is misleading. As previously stated, the three "Business as Usual" estimates are not valid for X-33 Phase II which is the reason NWODB estimates were developed. The three NWODB estimates are roughly \$1.0B to \$1.5B. The OIG indicated that these estimates excluded launch facilities, software, and flight tests, and are consequently low. However, these NWODB estimates also assume that G&A and Cost of Money are applied, which are roughly 10% and would offset these omitted items. The total cooperative agreement amount of \$1.123B, when adjusted to include civil service salaries, is approximately \$1.25B, which is at the midpoint of the IGCE range. Given this data, no adjustment to the probable cost was warranted. Further, given the available budget, NASA's options would have been to shift risk to the offeror or to reduce scope. The cooperative agreement already limited NASA's investment to a fixed amount with the recipient assuming the cost risk for overruns or changes. The Source Evaluation Committee (SEC) included the lead and members of the Engineering Cost Group that performed the above IGCEs. However, there were no explicit findings comparing the X-33 Phase II cost proposals with these IGCEs, since the proposals were all consistent with the range of IGCEs.

2) *The NAR's cost estimate did not include a risk analysis to quantify technical and schedule uncertainties.*

Key members of the SEC also attended the NAR briefing to the Program Management Council (PMC) on June 18, 1996, (prior to selection and award) where independent cost assessments were discussed. The NAR validated the SEC's findings with the conclusions that: a) the contractors cost estimates were reasonable; b) the IGCE for new technology hardware such as composite structures, tanks, thermal protection systems, and engine development show similar costs for all three contractor teams; and c) project management and system engineering costs reflected the rapid prototype approach of much lower than "Business as Usual" costs and as supported by the ICE results. The NAR cost model also predicted a schedule of 30-32 months, which is close to the proposed schedule and indicates that schedule risks were addressed by the NAR.

See Appendix D,
OIG Comment 1.

See Appendix D,
OIG Comment 2.

See Appendix D,
OIG Comment 3.

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Page 3

Page 3 of the draft report references the requirements of Federal Acquisition Regulation (FAR) 15.805-3 through 15.805-5 which state that *the contracting officer shall perform a cost analysis to: (1) verify cost or pricing data and evaluate cost elements including "The necessity and reasonableness of proposed costs, including allowances for contingencies;" and (2) "compare costs proposed by the offeror for individual cost elements with Independent Government Cost Estimates by technical personnel."*

The above paragraph is an excerpt from the FAR which, when taken out of context, leads to a misrepresentation of the role of IGCEs in the context of performing cost and price analysis. FAR 15.805-3 through 15.805-5 provide the grant officer a wide range of alternatives to use "as appropriate" in assessing cost realism and reasonableness, and comparison of the proposed cost to the IGCE is only one type of price analysis. The OIG report also states the SEC addressed cost only indirectly in its source evaluation by: evaluating proposed ground rules and assumptions; examining the content of the proposed cost elements; confirming offerors' rates; validating the offerors' proposed share of program costs to identify inconsistencies, if any; and comparing the cost proposals to NASA's available funding by fiscal year, as provided in the Cooperative Agreement Notice. These actions undertaken by the SEC are consistent with the FAR requirements for cost analysis and are actually a direct evaluation of the proposed cost while comparison with the IGCE is an indirect method.

Further, the SEC also did a thorough technical analysis (reference FAR 15.805-4) of the X-33 Phase II technical approach and developed significant strengths and weaknesses under that category. This technical analysis was used in addressing cost realism during discussions and ultimately resulted in a \$50M increase in cost. The SEC also conducted price analysis by assessing the proposed cost segregated by work breakdown structure for each offer and across the three offers. The overall cooperative agreement amount was determined to be fair and reasonable by the grant officer and the SEC.

3) *Lockheed's current estimate at completion is considered overly optimistic.*

The industry partners have recently submitted a proposal to restructure the X-33 Program, which is currently being coordinated with NASA. As part of this restructuring effort, the Lockheed team performed a comprehensive analysis of the estimated cost to complete the X-33 Program. The results of this analysis were used to determine the additional contributions required by the industry partners. The X-33 Program believes that after the restructuring process is completed, it will have an accurate projection of the cost and schedule to complete the X-33.

OIG RECOMMENDATION 1:

Emphasize to NASA grant/contracting officers using cooperative agreements that have a value more than \$5 million that as required by the FAR, the officers should obtain independent Government cost estimates to be used in determining the cost reasonableness of offerors' cost proposals during source evaluations.

CODE H RESPONSE TO RECOMMENDATION 1: CONCUR

There are two items of clarification regarding this recommendation. First, the guidance to be provided to NASA grant/contracting officers is specifically for cooperative agreements with commercial firms. These agreements are governed by the regulations set forth in NPG 5800.1, Section D. Although analysis to determine cost reasonableness must be done prior to award of all cooperative agreements, this recommendation specifically addresses cooperative agreements with commercial firms.

See Appendix D,
OIG Comment 4.

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 Page 4

Second, the recommendation endorses the use of an independent Government cost estimate. While this specific cost analysis tool is useful in many cases, FAR 15.404-1 does not mandate its use. Rather, the independent Government Cost estimate is one of a number of cost analysis tools that may be used to determine cost risk and cost reasonableness. Because of the research and development nature of much of the work performed under cooperative agreements with commercial firms, the exact scope of work is not known prior to the actual receipt of unique industry proposals, thus, it would be impractical to mandate an independent Government cost estimate. In these cases, the Government performs a cost analysis of the industry proposal incorporating the technical evaluation of Government technical experts.

Based on the aforementioned clarifications, NASA concurs with the recommendation and will take action to emphasize the importance of proper cost analyses. NASA will issue a Grant Information Circular (GIC) in anticipation of the regulatory change to be issued in response to Recommendation 2. Rather than specifically recommending the use of independent Government cost estimates, the GIC will state that for cooperative agreements with commercial firms, grant/contracting officers must perform well-supported cost analyses to be used in determining the cost reasonableness of offerors' cost proposals during source evaluations. Further, the GIC will state that the cost analyses must be performed consistent with FAR 15.404-1.

CORRECTIVE ACTION OFFICIAL: Code HC/S. Miley
 CORRECTIVE ACTION CLOSURE OFFICIAL: Code HC/A. Guenther
 PROJECTED CORRECTIVE ACTION CLOSURE DATE: October 29, 1999

OIG RECOMMENDATION 2:

Revise NPG 5800.1D to require that a well-supported cost analysis that is consistent with FAR 15.404 be performed on all cooperative agreements in which the recipient does not share at least 50 percent of the cost or on all cooperative agreements valued at \$5 million or more, regardless of the share ratio.

CODE H RESPONSE TO RECOMMENDATION 2: CONCUR

There is one item of clarification regarding this recommendation. The recommended revised language in NPG 5800.1D applies only to cooperative agreements with commercial firms. These agreements are governed by the regulations set forth in NPG 5800.1, Section D. Although analysis to determine cost reasonableness must be done prior to award of all cooperative agreements, this recommendation specifically addresses cooperative agreements with commercial firms.

This recommendation is consistent with the guidance already contained in NPG 5800.1D. Where the current language states that a cost analysis *should* be performed, the recommended revision creates a firm requirement to perform a cost analysis in accordance with FAR 15.404. Due to the fact that a sweeping revision to NPG 5800.1D is in the 60-day Federal Register comment period, NASA will issue a Grant Information Circular as described under the response to recommendation 1 above. Upon completion and issuance of the overall NPG revision, NASA will issue a Grant Notice to formally change 1274.204(d)(1)(ii) to make the cost analysis a mandatory requirement.

CORRECTIVE ACTION OFFICIAL: Code HC/S. Miley
 CORRECTIVE ACTION CLOSURE OFFICIAL: Code HC/A. Guenther
 PROJECTED CORRECTIVE ACTION CLOSURE DATE: January 15, 2000

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OIG RECOMMENDATION 3:

Request the grant/contracting officer for the X-33 Cooperative Agreement to require that Lockheed develop a more realistic cost estimate of the cost to complete the X-33 Program by preparing a quantitative risk analysis to quantify the uncertainty of costs and determine the sources of funding for the remainder of the program.

CODE H RESPONSE TO RECOMMENDATION 3: CONCUR

The draft report implies that the X-33 Program has been operating with an unrealistic estimate at completion (EAC). While the X-33 Program disagrees with this conclusion, actions are underway to comply with the recommendation. The Lockheed team has provided an updated EAC as part of their restructuring proposal, which is currently being definitized with the NASA team. Since NASA's funding is fixed on this agreement, a fundamental part of the restructuring effort required the industry partners to determine a realistic cost to complete the X-33 Program and the sources of funding to meet these requirements. The revised EAC includes a breakdown of these additional industry contributions. Risks associated with completion of the program were also considered and addressed as part of this process. We believe that after this restructuring effort is finalized, the intent of the recommendation will have been met without the need for a separate quantitative risk analysis.

CORRECTIVE ACTION OFFICIAL: MSFC/GP01/Mark Stiles
CORRECTIVE ACTION CLOSURE OFFICIAL: MSFC/DE01/Sidney Saucier
PROJECTED CORRECTIVE ACTION CLOSURE DATE: December 31, 1999

OIG RECOMMENDATION 4:

The Chief Engineer should revise NPG 7120.5A to require that well-supported, independent cost estimates include a quantification of cost risk.

CODE AE RESPONSE TO RECOMMENDATION 4: CONCUR

The recommendation to require in NPG 7120.5A that well-supported, independent cost estimates include a quantification of cost risk will be provided to NASA's Program/Project Management Working Group (PPMWG). This group is responsible for the revision of NPG 7120.5A and will consider this recommendation in the upcoming revision process. Upon review of this proposed change by the PPMWG, NASA will inform the OIG of any changes to be implemented with appropriate rationale.

CORRECTIVE ACTION OFFICIAL: Code AE/K. Hudkins
CORRECTIVE ACTION CLOSURE OFFICIAL: Code AE/D. Mulville
PROJECTED CORRECTIVE ACTION CLOSURE DATE: December 1, 1999

Appendix D. OIG Comments on Management's Response

NASA management provided the following general comments in its response to our draft report. Our responses to the comments are also presented.

Management's Comment. The Office of Inspector General (OIG) conclusion that NASA did not prepare an IGCE for the source evaluations of proposed costs is incorrect.

1. OIG Comments. We continue to believe that the estimate prepared by Marshall's Engineering and Cost Office does not qualify as an IGCE. The Engineering and Cost Office estimate was performed under a task agreement at the request of the contractors. The definition of an IGCE states that it is done at the request of the contracting officer for the purposes of evaluating proposals. Further, the definition of an IGCE indicates that it is prepared by Government personnel **independent** of contractors. In addition, if the IGCE is considered to be source selection information, it should not be released to the contractors. The estimates Marshall prepared were addressed to the contractor. FAR 3.104 states that access to source selection information should be limited to Government personnel. Lastly, the Program Manager and Marshall's Engineering and Cost Office both agreed, during interviews, that they did not do an IGCE. They stated that one was not required because the procurement instrument is a cooperative agreement and because of the "new ways of doing business."

Management's Comment. The OIG conclusion that Lockheed's estimate was too low is misleading.

2. OIG Comments. We continue to believe that the proposed cost was low. The estimates obtained under the new ways of doing business are subjective. Much judgement was necessary in the cost modeling process to try to reflect the economies such an approach might yield. The new ways of doing business estimate reflects a 65-percent cost reduction from the adjusted historical Shuttle costs. The 1998 NASA Cost Symposium used 30 percent as the expected savings. The difference in projected cost reductions is a subjective difference in expert opinion.

Management's Comment. The Non-Advocate Review cost model predicted a schedule of 30-32 months, which is close to the proposed schedule and indicates that schedule risks were addressed by the Non-Advocate Review.

3. OIG Comments. We continue to believe that NASA management would have benefited from a cost risk analysis. The Non-Advocate Review team's agreement with the SEC does not mean that a cost risk analysis was done, because the SEC also did not quantify risk. We agree that schedule and technical risks were acknowledged but continue to believe that NASA did not identify the dollar impact of these risks. Cost estimates for the X-33 have emphasized a point estimate rather than a range of estimates. A cost risk analysis would have given management

visibility into a range of estimates and the probability each point estimate has of being the actual cost that will be realized. A range of estimates would include a lowest possible cost, most likely

Appendix D

cost, and highest possible cost. Both the SEC and the Non-Advocate Review summed the individual point cost estimates for each cost element into a total cost point estimate. Research has shown that point estimates err toward being understated. A cost risk analysis is needed to help compensate for this underestimate so that the probability of cost overruns does not exceed 50 percent.

Management's Comment. The OIG report also states the SEC addressed cost only indirectly during source evaluations and that actions undertaken by the SEC are not consistent with FAR requirements for cost analysis.

4. OIG Comments. We continue to believe that the SEC addressed cost analysis indirectly. Most of the activities identified: (1) evaluating ground rules and assumptions; (2) confirming offerors' rates; (4) validating the offerors' proposed cost to identify inconsistencies; (5) comparing cost proposals to NASA's available funding by fiscal year are more appropriately price analysis¹⁷ activities rather than cost analysis¹⁸ activities.

The technical team did analyze the proposals for strengths and weaknesses, but there was no supporting documentation to indicate that the input from the technical team was used to perform a cost analysis of the recipient's cost proposal in order to arrive at a most probable cost.

¹⁷ Price analysis is the process of examining and evaluating a prospective price without evaluation of the separate cost elements. It is used to determine whether the price is reasonable.

¹⁸ Cost analysis is the review and evaluation, element by element, of the cost estimate or probable costs with which the contractor supports the price proposal. Costs are analyzed to determine whether the total cost estimate approximates the dollars it should cost to perform the contract. It is used when price analysis alone does not assure the reasonableness of prices.

Appendix E. Report Distribution

National Aeronautics and Space Administration (NASA) Headquarters

A/Administrator
AE/Chief Engineer
AI/Associate Deputy Administrator
B/Chief Financial Officer
B/Comptroller
BF/Director, Financial Management Division
G/General Counsel
H/Associate Administrator for Procurement
J/Associate Administrator for Management Systems
JM/Director, Management Assessment Division
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NASA Center Directors

Director, George C. Marshall Space Flight Center
Chief Counsel, Kennedy Space Center

Non-NASA Federal Organizations and Individuals

Assistant to the President for Science and Technology Policy
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Branch Chief, Science and Space Programs Branch, Energy and Science Division, Office of Management and Budget
Associate Director, National Security and International Affairs Division, Defense Acquisition Issues, General Accounting Office
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 Subcommittee on National Security, Veterans Affairs, and International Relations

Appendix E

Chairman and Ranking Minority Member - Congressional Committees and Subcommittee (Cont.)

House Committee on Science

House Subcommittee on Space and Aeronautics

Congressional Member

Honorable Pete Sessions, U.S. House of Representatives

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