REPORT TO THE CONGRESS

Problems Of The Deep Submergence Rescue Vehicle Program Show Need For Improvement In Management Control B-167325

Department of the Navy

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

JUNE 3, 1971

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C 20548

B-167325

To the President of the Senate and the
Speaker of the House of Representatives

This is our report entitled "Problems of the Deep Submergence Rescue Vehicle Program Show Need for Improvement in Management Control, Department of the Navy."

Our review was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

Copies of this report are being sent to the Director, Office of Management and Budget; the Secretary of Defense; and the Secretary of the Navy.

Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

PROBLEMS OF THE DEEP SUBMERGENCE RESCUE VEHICLE PROGRAM SHOW NEED FOR IMPROVEMENT IN NAVY'S MANAGEMENT CONTROL
B-167325

D I G E S T

WHY THE REVIEW WAS MADE

The development cost and time for the Deep Submergence Rescue Vehicle have far exceeded original estimates. This review was made to determine the causes.

An earlier General Accounting Office (GAO) report to the Congress on the rescue vehicle's development, in February 1970, indicated that the increased effectiveness to be obtained from producing four more vehicles in addition to the two already on order, would be small in relation to their cost of purchase and operation. That report also noted the increases in the program's cost and development time.

The rescue vehicle is a small submersible craft designed to rescue personnel from a disabled submarine. It would be transported by air to a port near a submarine disaster and then be carried to the site by a support craft. The vehicle would then shuttle between the disabled submarine and the support craft, rescuing the submarine crew.

FINDINGS AND CONCLUSIONS

The estimated cost for the rescue vehicle program increased by more than 1,100 percent from 1964 to 1969--from $36.5 million for a 12-vehicle system and 1 year of operation to $463 million for a six-vehicle system. The estimated development and introduction period increased from 4 to 10 years. (See p. 9.)

In addition, changes made in the design of the vehicle necessitated a redesign of support craft and some of the supporting equipment, which increased their costs. (See p. 17.)

In response to GAO's earlier report, however, the Navy advised that it had initiated a cost-effectiveness study. In December 1970 the Navy decided to confine the program to two rescue vehicles, at an estimated cost of $199.4 million, rather than six rescue vehicles as had been planned before the study. (See pp. 5 and 6.)

GAO believes that a substantial portion of the cost growth and program stretch-out occurred because

--the original estimates, made by a Deep Submergence Systems Review Group established by the Secretary of the Navy after the U.S.S. "Thresher" submarine disaster of April 1963, were low and were made without sufficient design, preliminary development, and testing and

--changes were made in the vehicle design to increase its capabilities beyond those stated in the formal requirement document for the vehicle (Specific Operational Requirement).

The design changes included

--an increase in the operating depth of the vehicle to almost three times the depth at which rescue of submarine personnel is possible (see p. 16), and

--an increase in the vehicle's rescue capacity from 14 to 24 survivors. (See p. 20.)

Under the Navy management system, the Chief of Naval Operations determines the equipment needs of the operating forces. According to Navy records, however, the decisions to make changes in the rescue vehicle were made by the developing group--the Deep Submergence Systems Project Office. (See p. 14.)

GAO found no thorough and well-documented analysis of consideration given in the decisionmaking process to the effects the changes would have on development cost and time--which were considerable--or to the measurement of the benefits obtainable from the increased capabilities against the increased program costs. Moreover, there was little indication of specific approval by top Navy echelons of the significant change decisions. (See p. 14.)

The Navy management system includes many controls. It does not, however, require formal approval by top-level management of major changes increasing the capabilities of a developmental system beyond those called for in the Specific Operational Requirement. (See p. 25.)

Since all funds needed to complete the rescue vehicle project were not required at one time and since the Project Office was able to reprogram funds from its other projects, no point was reached at which a need for funds for technical changes forced a formal decision by the Chief of Naval Operations. (See pp. 31 and 32.)

The Project Office said that discussions were held with officials of the Office of the Chief of Naval Operations. (See pp. 14 and 15.) GAO believes that discussions do not ensure that responsible officials are fully informed of the consequences of major changes. In GAO's opinion, a requirement for formal approval by the Chief of Naval Operations, or other designated user representatives, of major changes would provide more effective control and assurance that benefits are carefully weighed against possible cost increases and development delays. (See p. 27.)

RECOMMENDATIONS OR SUGGESTIONS

To provide more effective control over development projects and over significant increases in development cost and time, the Secretary of the Navy should require that

--a sufficient body of design, experimental development work, and subsystem testing be done before promulgation of an end-item system requirement document and thus establish a sound factual basis for authorizing full-scale development (see p. 33);

--analyses be made of the impact on program cost and time schedules of proposed changes designed to increase the capabilities of equipment beyond the required level (see p. 33); and

--advance approval of top-level management be obtained for all changes which are designed to increase the capabilities of the equipment beyond requirements and which significantly affect program cost and time schedules (see p. 34).

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Navy did not agree with all of GAO's conclusions but considered the management objectives implicit in GAO's recommendations to be generally sound. The Navy, however, did not cite any actions to be taken.

The Navy pointed out that, after the rescue vehicle program had been initiated, the Department of Defense established new methods to improve the management of major acquisition programs. The Navy believes that the new methods will correct the problems reported by GAO. (See pp. 34 and 35.)

The new methods should help to ensure more participation by top management in the acquisition process. GAO believes, however, that it still is necessary to revise Navy regulations. The regulations should require that analyses be made of the impact on development cost and time of all significant technical changes designed to increase the capabilities of equipment beyond those in a program's Specific Operational Requirement. The analyses should provide the information necessary for determining whether such changes are expected to increase effectiveness sufficiently to justify added costs or time.

Navy regulations should require also that, where analyses show a significant increase in development cost or time, the Chief of Naval Operations, or other high-level user representative, certify that each major change is necessary for the equipment to perform its mission. The regulations should prohibit project managers from committing the Government to proceed with the changes until certifications are given. (See p. 35.)

MATTERS FOR CONSIDERATION OF THE CONGRESS

This report is being submitted to the Congress because of its expressed interest in the acquisition of major systems and to inform it of the opportunity, through tightened management control, to limit increases in cost and development time in acquiring equipment and systems.

Contents

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

PROBLEMS OF THE DEEP SUBMERGENCE RESCUE VEHICLE PROGRAM SHOW NEED FOR IMPROVEMENT IN NAVY'S MANAGEMENT CONTROL
B-167325

D I G E S T

WHY THE REVIEW WAS MADE

The development cost and time for the Deep Submergence Rescue Vehicle have far exceeded original estimates. This review was made to determine the causes.

An earlier General Accounting Office (GAO) report to the Congress on the rescue vehicle's development, in February 1970, indicated that the increased effectiveness to be obtained from producing four more vehicles in addition to the two already on order, would be small in relation to their cost of purchase and operation. That report also noted the increases in the program's cost and development time.

The rescue vehicle is a small submersible craft designed to rescue personnel from a disabled submarine. It would be transported by air to a port near a submarine disaster and then be carried to the site by a support craft. The vehicle would then shuttle between the disabled submarine and the support craft, rescuing the submarine crew.

FINDINGS AND CONCLUSIONS

The estimated cost for the rescue vehicle program increased by more than 1,100 percent from 1964 to 1969--from $36.5 million for a 12-vehicle system and 1 year of operation to $463 million for a six-vehicle system. The estimated development and introduction period increased from 4 to 10 years. (See p. 9.)

In addition, changes made in the design of the vehicle necessitated a redesign of support craft and some of the supporting equipment, which increased their costs. (See p. 17.)

In response to GAO's earlier report, however, the Navy advised that it had initiated a cost-effectiveness study. In December 1970 the Navy decided to confine the program to two rescue vehicles, at an estimated cost of $199.4 million, rather than six rescue vehicles as had been planned before the study. (See pp. 5 and 6.)

GAO believes that a substantial portion of the cost growth and program stretch-out occurred because

--the original estimates, made by a Deep Submergence Systems Review Group established by the Secretary of the Navy after the U.S.S. "Thresher" submarine disaster of April 1963, were low and were made without sufficient design, preliminary development, and testing and

--changes were made in the vehicle design to increase its capabilities beyond those stated in the formal requirement document for the vehicle (Specific Operational Requirement).

The design changes included

--an increase in the operating depth of the vehicle to almost three times the depth at which rescue of submarine personnel is possible (see p. 16), and

--an increase in the vehicle's rescue capacity from 14 to 24 survivors. (See p. 20.)

Under the Navy management system, the Chief of Naval Operations determines the equipment needs of the operating forces. According to Navy records, however, the decisions to make changes in the rescue vehicle were made by the developing group--the Deep Submergence Systems Project Office. (See p. 14.)

GAO found no thorough and well-documented analysis of consideration given in the decisionmaking process to the effects the changes would have on development cost and time--which were considerable--or to the measurement of the benefits obtainable from the increased capabilities against the increased program costs. Moreover, there was little indication of specific approval by top Navy echelons of the significant change decisions. (See p. 14.)

The Navy management system includes many controls. It does not, however, require formal approval by top-level management of major changes increasing the capabilities of a developmental system beyond those called for in the Specific Operational Requirement. (See p. 25.)

Since all funds needed to complete the rescue vehicle project were not required at one time and since the Project Office was able to reprogram funds from its other projects, no point was reached at which a need for funds for technical changes forced a formal decision by the Chief of Naval Operations. (See pp. 31 and 32.)

The Project Office said that discussions were held with officials of the Office of the Chief of Naval Operations. (See pp. 14 and 15.) GAO believes that discussions do not ensure that responsible officials are fully informed of the consequences of major changes. In GAO's opinion, a requirement for formal approval by the Chief of Naval Operations, or other designated user representatives, of major changes would provide more effective control and assurance that benefits are carefully weighed against possible cost increases and development delays. (See p. 27.)

RECOMMENDATIONS OR SUGGESTIONS

To provide more effective control over development projects and over significant increases in development cost and time, the Secretary of the Navy should require that

--a sufficient body of design, experimental development work, and subsystem testing be done before promulgation of an end-item system requirement document and thus establish a sound factual basis for authorizing full-scale development (see p. 33);

--analyses be made of the impact on program cost and time schedules of proposed changes designed to increase the capabilities of equipment beyond the required level (see p. 33); and

--advance approval of top-level management be obtained for all changes which are designed to increase the capabilities of the equipment beyond requirements and which significantly affect program cost and time schedules (see p. 34).

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Navy did not agree with all of GAO's conclusions but considered the management objectives implicit in GAO's recommendations to be generally sound. The Navy, however, did not cite any actions to be taken.

The Navy pointed out that, after the rescue vehicle program had been initiated, the Department of Defense established new methods to improve the management of major acquisition programs. The Navy believes that the new methods will correct the problems reported by GAO. (See pp. 34 and 35.)

The new methods should help to ensure more participation by top management in the acquisition process. GAO believes, however, that it still is necessary to revise Navy regulations. The regulations should require that analyses be made of the impact on development cost and time of all significant technical changes designed to increase the capabilities of equipment beyond those in a program's Specific Operational Requirement. The analyses should provide the information necessary for determining whether such changes are expected to increase effectiveness sufficiently to justify added costs or time.

Navy regulations should require also that, where analyses show a significant increase in development cost or time, the Chief of Naval Operations, or other high-level user representative, certify that each major change is necessary for the equipment to perform its mission. The regulations should prohibit project managers from committing the Government to proceed with the changes until certifications are given. (See p. 35.)

MATTERS FOR CONSIDERATION OF THE CONGRESS

This report is being submitted to the Congress because of its expressed interest in the acquisition of major systems and to inform it of the opportunity, through tightened management control, to limit increases in cost and development time in acquiring equipment and systems.

CHAPTER 1

INTRODUCTION

As a part of its review of the development of the Deep Submergence Rescue Vehicle, the General Accounting Office issued a report to the Congress entitled "Evaluation Needed of Cost-Effectiveness of Four More Deep Submergence Rescue Vehicles Before Purchase by the Navy" (B-167325, February 20, 1970). The report noted significant increases in development cost and time; however, it did not deal with the causes of these increases, which is the subject of this report.

In response to our earlier report, the Navy advised us that it had initiated a cost-effectiveness study and that construction of four additional rescue vehicles was not to be undertaken unless, and until, it could be shown that their usefulness justified their cost.

The Navy completed its study and the Chief of Naval Operations approved it on December 3, 1970. This study concluded that:

--In the next 20 years, one plus or minus one rescuable submarine disasters would occur.

--The Deep Submergence Rescue Vehicle would be able to meet effectively the Navy's requirements for undersea rescue operations.

--If all system components (the rescue vehicle, support craft, etc.) performed as advertised and if all scheduling conflicts could be satisfactorily resolved, then the most effective mix of these components would be:

1. One Rescue Unit Home Port Facility.

2. No catamaran[1] hull auxiliary submarine rescue ships.

---

[1]A ship with two parallel hulls. These ships were developed for use with the Deep Submergence Rescue Vehicle.

3. Two Deep Submergence Rescue Vehicles.

4. Eighteen Mother Submarines.[1]

The Navy study recommended that requirements, program plans, and component procurement plans for undersea rescue operations be revised to reflect the conclusions of the study. Thus the program would be confined to only two Deep Submergence Rescue Vehicles at an estimated cost of $199.4 million.[2]

In our follow-on review, we evaluated the management controls that had been used by the Navy in this program. The evaluation was made to determine if development cost and time might have been controlled more effectively through better implementation of existing procedures or the use of improved procedures. In this review segment we inquired into the causes for the increases in development cost and time discussed in our earlier report.

The Deep Submergence Rescue Vehicle is a small submersible vehicle designed to rescue personnel from a disabled submarine. In the event of a disaster, the Deep Submergence Rescue Vehicle would be transported by aircraft to a port near the disaster. It was planned that the vehicle would then be carried to the site by a surface auxiliary submarine rescue ship or a Mother Submarine, either of which could act as the supporting craft. The Deep Submergence Rescue Vehicle would then shuttle between the bottomed submarine and the supporting craft rescuing the submarine crew.

ORIGIN OF PROJECT

The requirement for a rescue vehicle may be traced to the U.S.S. "Thresher" disaster of April 10, 1963. The submarine, with 129 men on board, went down in 8,400 feet of

---

[1] Specially configured submarines used to carry the Deep Submergence Rescue Vehicle.

[2] The June 30, 1970, Selected Acquisition Report estimated a cost of $204.3 million for a two vehicle system.

water, well beyond her outer hull-collapse depth. Consequently, there was no possibility of survivors. Two weeks later the Secretary of the Navy established the Deep Submergence Systems Review Group (Review Group). This group was composed of Government employees and persons from outside the Government familiar with undersea problems.

One of the responsibilities assigned to the Review Group was to:

> "Review the Navy's plans for the development and procurement of components and systems related to location, identification, rescue from and recovery of deep submerged large objects from the ocean floor."

On February 22, 1964, the Review Group submitted its report to the Secretary of the Navy and recommended, among other things, the development, construction, and operation of rescue vehicles capable of personnel rescue down to collapse depths of current submarines, independent of weather, surface, or ice conditions, and capable of quickly responding to emergencies at any location in the world.

The Secretary of the Navy accepted the proposed program and directed that the project be undertaken.

PROJECT MANAGEMENT

Under the Navy's management system, the Chief of Naval Operations has responsibility for planning and determining the types of equipment needed to perform Navy missions. This responsibility includes determining the characteristics of, and priorities for, items to be developed and/or procured. When the Chief of Naval Operations determines that a system is required, is feasible based on preliminary development and experimental work, and should be developed for operational use, he issues a Specific Operational Requirement. This document defines the required operational capabilities of the system.

The Specific Operational Requirement is intended to be the controlling document throughout the remainder of the

development process. It was designed to serve as a contract between the Chief of Naval Operations and the Chief of Naval Material, the latter being responsible for obtaining equipment that will fulfill the operational requirements set forth therein. The Specific Operational Requirement for the Deep Submergence Rescue Vehicle was issued in October 1964.

In preparation for undertaking the project, the Chief of Naval Material in June 1964 established the Deep Submergence Systems Project Office as a division of his Special Projects Office. The Project Office assumed responsibility for development of a rescue vehicle that would meet the requirements presented in the Specific Operational Requirement.

The Project Office functioned as part of the Special Projects Office until February 1966, when the Chief of Naval Material established it as a separate project. The purpose of elevating the deep submergence system to the status of a separate project was to provide for the establishment of exceptional management policies and thereby give greater attention to the development of the deep submergence systems for which the Project Office had responsibility.

The Project Office was given responsibility for several deep submergence systems. The major effort at the Project Office, however, had been the development of the Deep Submergence Rescue Vehicle system. Through fiscal year 1970 about $150 million had been expended or obligated on the rescue system.

Data on the cost growth and schedule slippage in the Deep Submergence Rescue Vehicle program was included in a GAO report to the Congress titled "Acquisition of Major Weapon Systems" (B-163058, March 18, 1971), Appendix I and Summaries.

CHAPTER 2

COST GROWTH AND DELAYS IN DEVELOPMENT PROGRAM

During the period 1964 to 1969, the estimated cost of the rescue vehicle program increased from $36.5 million to $463 million, more than 1,100 percent, despite a 50-percent reduction in the number of vehicles to be built (from 12 to six). In addition, the estimated development and introduction period increased from 4 to 10 years.

We believe that a large part of the cost growth and program stretch-out can be attributed to the low original estimates established by the Review Group. We believe also that these low original estimates were made because the Navy did not conduct sufficient design, preliminary development, and testing to provide a sound factual basis for estimating realistic development cost and time.

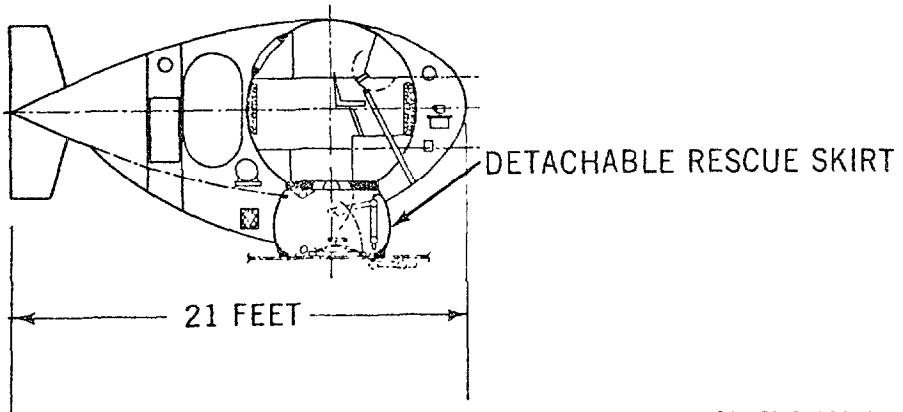
We believe further that another large part of the increases in development cost and time can be attributed to changes in the vehicle design which had increased the vehicle's capabilities beyond those that had been stated in the Specific Operational Requirement.

As a result of insufficient preliminary development and the changes in design, the rescue vehicle currently being produced bears little resemblance to the one contemplated by the Review Group or described in the Specific Operational Requirement. In this respect, the rescue vehicle, as originally planned, was expected to weigh about 15 tons, to hold a maximum of 14 rescuees, and to be able to make rescues down to the depth at which the hulls of modern submarines collapse from water pressure.

In 1969 the vehicle, as then designed and being built, weighed about 35 tons, held 24 rescuees, and could go far deeper than the depths at which rescue could be made. A pictorial comparison of the two vehicles follows. The configurations shown were obtained from the Navy.

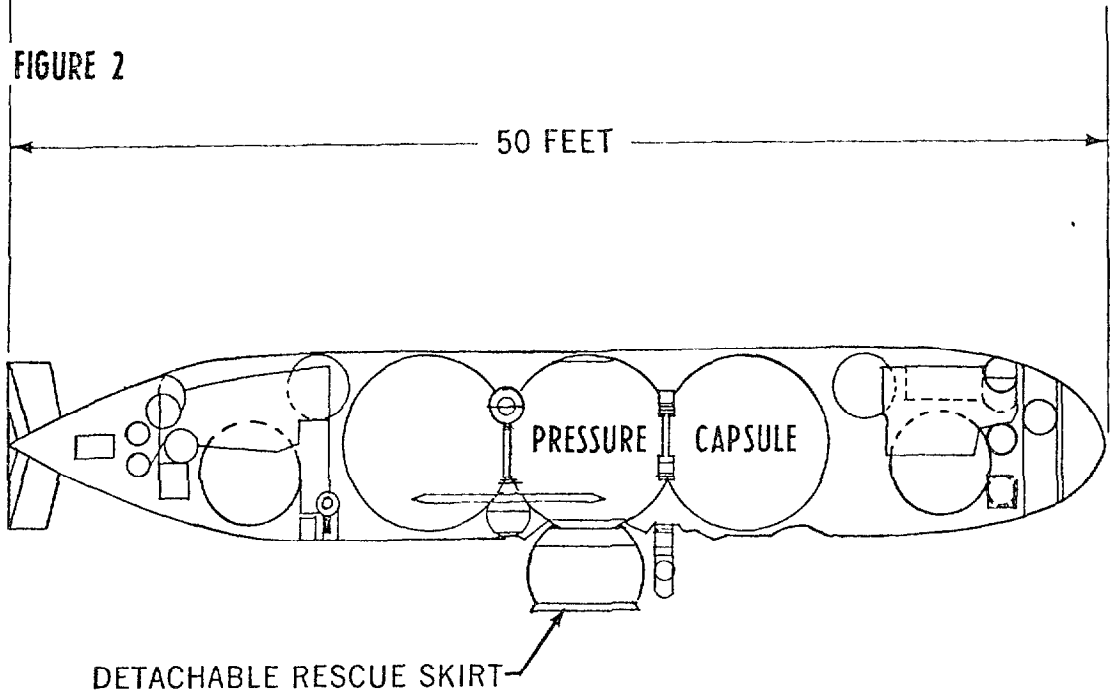
The first estimate of development cost and time for the rescue vehicle was made by the Review Group. In its

FIGURE 1



CONFIGURATION ENVISIONED BY DEEP SUBMERGENCE SYSTEM REVIEW GROUP

FIGURE 2



CONFIGURATION AS CONSTRUCTED

NOTE: THE LENGTHS INDICATED ON THE ABOVE CONFIGURATIONS AS WELL AS OTHERS IN THE REPORT ARE APPROXIMATE.

February 1964 report, the Review Group stated that a prototype vehicle could be developed in about 2 years at a cost of about $4.6 million. Each additional vehicle was estimated to cost about $1.4 million. In addition, the Review Group estimated that the complete system could be obtained in 4 years at a cost of about $36.5 million. This cost estimate included 12 rescue vehicles and 1 year of operation.

A program plan containing revised project cost and time estimates was prepared by the Project Office in December 1964, several months after the Specific Operational Requirement had been issued, and that office had assumed responsibility for developing the vehicle. The estimated total cost and development time for the system contained in the revised estimates was about $100 million for 7 years (fiscal years 1965 to 1971, inclusive). The first rescue vehicle was estimated to cost about $13 million.

This plan provided for six rescue vehicles (as did the Specific Operational Requirement) rather than for 12 rescue vehicles as mentioned in the Review Group's plan. There were no significant changes in the technical characteristics of the vehicle to be developed. This program plan was reviewed by the Offices of the Chief of Naval Material, the Chief of Naval Operations, and the Secretary of the Navy. In October 1965 the plan was accepted by the Deputy Secretary of Defense.

In 1969 the Navy estimated that it would cost $463 million to obtain a rescue system consisting of six vehicles with the cost to be incurred through fiscal year 1974, a 10-year period. A Navy official estimated also that the first Deep Submergence Rescue Vehicle, which was launched on January 24, 1970, and is currently being tested, would cost about $41 million. This estimate for the first vehicle is over nine times the estimate of the Review Group and over three times the estimate contained in the plan accepted by the Deputy Secretary of Defense.

LOW ORIGINAL ESTIMATE

We believe that a large but undeterminable part of the cost growth and program stretch-out is attributable to the low original estimates established by the Review Group.

Commenting on our draft report, the Assistant Secretary of the Navy (Financial Management) in his reply of October 20, 1970, stated that the $36.5 million cited in the report of the Review Group was not a proper starting point for indicating cost growth. This estimate, according to the Navy, had been made simply to determine whether the concept looked sufficiently promising to warrant proceeding with further analysis. The Navy believes that its first engineering estimate of $100 million is the proper starting point for computing cost growth.

We believe that the $36.5 million is an appropriate starting point, because Navy records indicated that this estimate had been used in the Chief of Naval Operations' decision to issue the Specific Operational Requirement for the rescue system in October 1964. According to Navy documents the fiscal year 1965 reprogramming request (which provided the initial funds for the project) and the 1966 budget request would have been based on this early estimate.

In this report, we have included both this estimate and the later engineering estimate to present the full scope of the estimates of the cost of this program. Regardless of which starting figure is used, the cost growth of the program is very substantial, about 1,100 percent based on the $36.5 written estimate, or 360 percent, based on the $100 million estimate.

The Navy reply noted that GAO had compared the original cost estimate with the estimated cost of a six-rescue-vehicle program. The Navy contends that this comparison is inappropriate, because on April 29, 1969, the Chief of Naval Operations directed that a study be made of the number of rescue vehicles needed. The Navy stated that construction of the rescue vehicles beyond the two then under construction would not be undertaken unless, and until, their usefulness could be shown to justify the additional cost.

We have used the six-rescue-vehicle estimates because the Project Office had planned to buy six rescue vehicles and because all its calculations and estimates, after the initial estimate of $36.5 million for 12 rescue vehicles, had been based upon a six-rescue-vehicle acquisition program. As previously mentioned, the Navy study dated December 3, 1970, concluded that only two rescue vehicles were needed at a total program cost of $199.4 million.

In June 1965, about 8 months after the Specific Operational Requirement was issued, the Bureau of Ships prepared a report which summarized "the early results of exploratory design studies of a rescue vehicle." Similar studies were also performed by the Navy after the rescue system specific requirement had been issued.

In our opinion, such studies, as well as experimental subsystem tests, should be conducted in development work performed prior to, and included as the basis for, the Specific Operational Requirement. We believe that, if this had been done, the original estimate would have been more valid and beneficial to top-level management in their decisionmaking.

CHANGES IN VEHICLE DESIGN

We believe that a significant part of the increases in vehicle development cost and time is attributable to changes in design undertaken to increase the capabilities of the vehicle beyond those required in the Specific Operational Requirement. (These changes in design are discussed on pp. 16 to 24.) According to Navy records decisions permitting the design changes had been made by personnel of the Project Office. These decisions had significant effects upon development cost and time. We found no thorough and well-documented analysis detailing the consideration given to the effect the decisions would have on these factors or on the cost benefit of the increased capabilities.

The Navy contends that careful analyses have been made of the impact of the changes on the rescue vehicle; however, it acknowledges that a formal cost-effectiveness analysis of the impact on the whole system has not been conducted.

We found no detailed documented information in Navy files on the cost of these changes. Although considerations might have been given to many of the changes at the project office level, the considerations had not been reduced to writing and had not been communicated to higher Navy levels.

Moreover, we found little indication of specific approval by top-level management officials of many important decisions causing substantial increases in development cost and time. Whether these officials would have formally approved the changes had they been presented before they had been put into effect is conjectural.

Representatives of the Project Office told us that verbal discussions had been held with officials of the Office of the Chief of Naval Operations and the Naval Material Command. We could not obtain written records of such meetings nor could we find definite indications that specific approvals of decisions had been given. We believe that, for decisions of such importance, the specific approval of the responsible officials should be obtained in writing.

The Navy informed us that there had been constant communication between the Project Office and the higher levels.

The Navy further stated that, during the critical initial phase of the rescue vehicle's development, a high degree of urgency generated by the "Thresher" disaster had been present and that a Steering Task Group, to obtain rapid approval of system parameters, had been established and had met regularly. The Chief of Naval Operations and the Chief of Naval Material were represented. This group reviewed and approved all important decisions.

In addition, personnel representing these two offices were kept informed of, and participated in, the decision-making process through day-to-day contacts, staff meetings, and regularly scheduled briefings. The Project Manager reported program status directly to the Chief of Naval Material and met with him on a weekly basis.

We examined records of the meetings of the Steering Task Group. The group was only advisory, and we therefore could not determine the effect which the group had upon decisions involving the rescue vehicle. We did note, however, that it did not meet between December 1966 and May 1968 and that during this period costs and time schedules continually increased. We also believe that informal discussions do not assure that responsible persons are fully informed of the consequences of proposed changes.

Details pertaining to major decisions follow.

Increased operating depth

The Specific Operational Requirement stated that the small submersible vehicles should be capable of personnel rescue down to the hull-collapse depth[1] of modern, nuclear submarines. Despite the fact that rescue below the collapse depth is not possible, the rescue vehicle has been designed to operate at three times that depth.

In requesting proposals for construction of the rescue vehicle, the Project Office specified an operating depth almost twice that of the rescue depth specified in the Specific Operational Requirement. The Project Office specified the use of a newly developed, high-strength steel, to achieve this greater operating depth. It was recognized that the use of this steel, which at the time had not been used in a submersible structure, might cause delays and additional cost. The Project Office also asked the contractors to submit proposals for a vehicle which could go even deeper.

In responding, Lockheed Missiles and Space Company, Sunnyvale, California, in its proposal, offered a choice of two vehicles--one capable of descending to almost twice the collapse depth of modern submarines and the other capable of reaching almost three times that depth.

The Project Office elected to accept Lockheed's proposal for a vehicle capable of operating at three times the hull-collapse depth of modern submarines. This decision had been made by the Project Office and, so far as we could ascertain, had been made without the formal approval of the Chief of Naval Material, Chief of Naval Operations, or higher echelons. Moreover, we found no evidence that the difference in development cost and time between the vehicles proposed by Lockheed and one required by the Specific Operational Requirement had been analyzed prior to the decision to accept Lockheed's proposal.

Because the Navy was unable to furnish evidence of a detailed analysis, we cannot assess the extent to which

---

[1]The exact collapse depth is classified.

this decision contributed to the cost increases and schedule slippages. Available records indicate that this was a significant factor and that this decision contributed to other problems in the vehicle's development. For example, we noted that a weight reduction program had been initiated during construction of the vehicle to meet the requirement for air transportability.[1]

In addition, the weight of the vehicle was a factor leading to a decision to redesign the handling equipment on the surface auxiliary submarine rescue ships under construction. The decision to obtain the greater operating-depth capability and the other changes discussed in the following sections contributed to the weight problem and increased the cost of the supporting equipment by an undeterminable amount.

Representatives of the Project Office informed us that it was common practice to exceed the requirements of the Specific Operational Requirement in an attempt to ensure that the technical problems encountered in development did not reduce the equipment's capability below the level specified. Although we agree that some margin may be desirable, we believe that a 200-percent increase beyond the stated requirement warrants careful consideration before a decision is made, in view of the additional costs and time involved. In this case, we found no documented evidence that the Project Office had made such a determination or that higher echelons had had an opportunity to formally consider all the effects of the decision.

The Navy, in its comments on our draft report, disagreed with our conclusion that changes made to the design of the vehicle to increase its capability, specifically its operating depth and rescue capacity, contributed to increases in development cost and time. The Navy stated that the Review Group's report recommended an operating depth of 6,000 feet, that the initial Specific Operational Requirement specified a minimum requirement of rescue at the

---

[1]As pointed out on p. 22, it was originally planned to use one C-141 aircraft to transport the system. It will now require three C-141's to do this.

collapse depth of submarines, and that a Navy analysis of the state of the art in machining 7-1/2-foot HY140 steel spheres allowed an operating depth of 3,500 feet.

The Navy stated also that the Circular of the Requirements[1] specified a 3,500-foot depth but requested ideas from industry as to how the 6,000-foot depth could be achieved. The Navy stated further that, through advanced machining techniques, Lockheed had been able to exceed the specified 3,500-foot-depth level without significantly increasing program costs.

The decision to use HY140 steel did enable the Navy to obtain the greater depths it had stated. If the Navy, however, had sought to meet only the depth requirement in the Specific Operational Requirement (the collapse depth of submarines), it would not have been necessary to use HY140 steel. This steel was difficult to machine and had never been used in the construction of an undersea structure. The use of HY140 steel, according to Navy records, appears to have been a costly increase in requirements. A cost-effectiveness analysis of this change was never made.

The Navy stated that it had been able to cancel plans for construction of a 6,000-foot-depth prototype search vehicle as a result of extending the operating depth of the rescue vehicle. Navy records indicated that the Navy had actually wanted to acquire a search vehicle capable of descending to 20,000 feet. Plans for the 20,000-foot-depth vehicles were retained for several years, but we were informed that the plans recently had been canceled.

The Navy stated also that the change to the three-sphere concept had been necessary to permit an injured rescuee on a stretcher to be loaded aboard the rescue craft. Under the original concept such loading also would have been possible, and this change was necessary only because of other changes accepted as a result of differences between the original concept and Lockheed's design.

---

[1]The technical requirements of the contract. This document is included in the request for proposal package.

In conclusion, the Navy stated further that it did not believe that the increase in operating depth and the addition of a third sphere were significant causes of increases in cost. The Navy attributed the cost increases to such causes as inability to use off-the-shelf items in the deep-ocean environment; unforeseeable problems in new technology development; and schedule slippages and stretch-outs as a result of design problems, late subcontractor deliveries, interface definition,[1] and test program extensions, as well as escalation in the cost of labor and material.

Navy records do not indicate what portion of the increased costs could be assigned to any of these factors. Therefore neither we nor the Navy can say with certainty precisely what caused the substantial cost increases or what portion of these increases can be attributed to any particular factor. Problems, such as the inability to use off-the-shelf items and interface definition, however, should have been recognized and provisions should have been made for them in estimating the program costs before the vehicle entered full-scale development. We believe that, if a sufficient body of design and experimental testing had existed before the vehicle entered full-scale development, many of the problems could have been avoided.

---

[1]This term is used to describe problems involved in fitting equipment, such as navigation and control parts on which the Massachusetts Institute of Technology was the prime contractor, into the rescue vehicle hull on which Lockheed was the prime contractor.

Increased capacity for rescuees

The technical decision to enlarge the capacity of the rescue vehicle from 14 to 24 rescuees contributed to increased development cost and time. This decision was made without the formal approval of officials outside the Project Office.

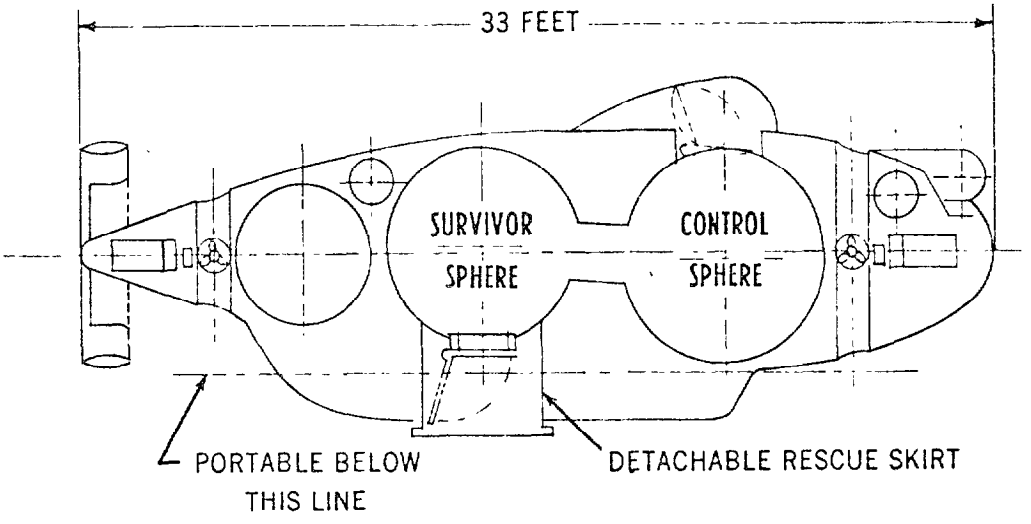
The Specific Operational Requirement issued by the Chief of Naval Operations called for a capacity of 12 to 14 rescuees. The configuration of the vehicle before the issuance of the request for proposal (see fig. 3, p. 21) called for this capacity and consisted of two connected spheres and a detachable rescue skirt. The skirt was to fit over the escape hatch of the disabled submarine to enable its crew members to enter the rescue vehicle's spheres. The skirt was to be detachable to facilitate air transportability.

This design was rejected--primarily because it was deemed important that the rescue skirt be an integral part of the hull for structural reasons and to minimize the assembly effort during rescue operations. The configuration in the request for proposal (see fig. 4, p. 21), having a nondetachable rescue skirt as an integral part of the hull, was subsequently prepared. This design was used to solicit proposals from Lockheed and other prospective builders. A comparison of the configurations, before and in the request for proposal as obtained from the Navy, are shown below.

In its response Lockheed proposed that the rescue skirt be detachable and that the small center sphere be increased in size to accommodate 24 resurees. The sketch entitled "configuration as constructed" shown on page 10 depicts Lockheed's proposed design. The proposal stated that the suggested design would cost about the same as the design contained in the request for proposal.

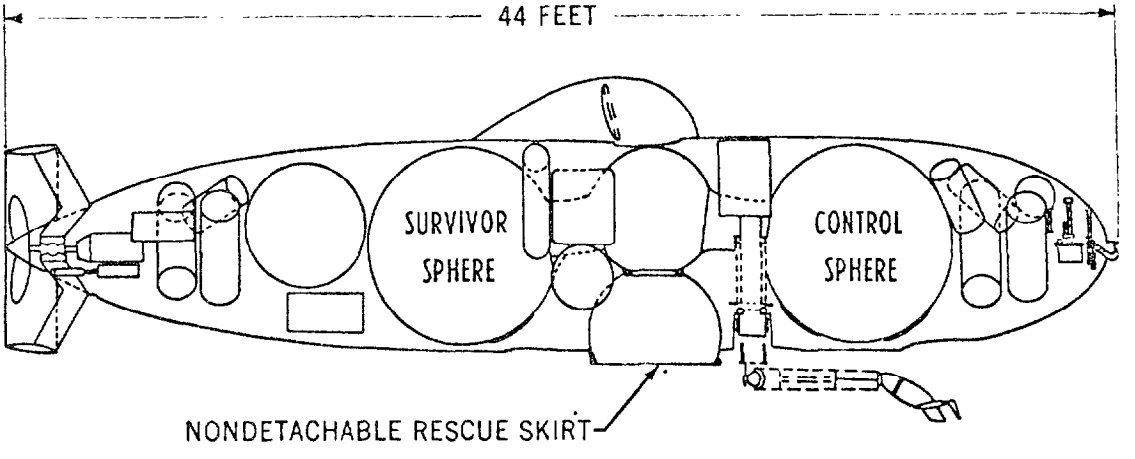
Although Lockheed's proposal contained the same objectionable feature that had been a major factor in the rejection of the Navy design shown as figure 3, page 21--the detachable rescue skirt--the Project Office accepted it. Moreover, the proposal had been accepted without comparing the development cost and time with the development cost and

FIGURE 3



CONFIGURATION BEFORE ISSUANCE OF REQUEST FOR PROPOSAL

FIGURE 4



CONFIGURATION IN THE REQUEST FOR PROPOSAL

time which would have been incurred had the preliminary design, with its capacity of 12 to 14 rescuees, been used.

Another factor that should have had a bearing on this decision was the effect of the increased size upon other components of the rescue system. Specifically, the Navy had designed a new surface auxiliary submarine rescue ship to transport the rescue vehicle. The change to 24 rescuees necessitated an increase in the length and weight of the rescue vehicle. These increases resulted in the redesign of the auxiliary rescue ship, including an increase in its length. The increased weight of the vehicle, as previously mentioned, contributed to problems in developing the rescue vehicle.

The Navy stated in its reply that the redesign of support craft and equipment and a corresponding increase in costs had occurred and that this had been caused by growth in the weight of the vehicle. The Navy, however, stated also that the three-sphere concept was not responsible for the growth in length of the surface ship, because it had been included in the contract design for the ship.

We agree that the increase in the length of the surface ship occurred before the contract award, but this increase occurred after the plans had been formulated for the support craft and equipment and thus substantial changes in the support craft and equipment were required.

Further, the increased size and weight of the vehicle affected its air transportability. It was originally planned to use one C-141 aircraft to transport the system (one vehicle and the supporting equipment necessary to effect rescue). It will now, however, require three C-141's to transport the system.

Project Office personnel had made the decision--despite its importance insofar as time and money are concerned--to increase the number of rescuees without obtaining formal approval from the Chief of Naval Material, the Chief of Naval Operations, or higher echelons. Moreover, many of the effects of the decision were not given adequate consideration at the Project Office, because essential data on development cost and time had not been obtained.

Addition of provision for diver lockout

Another decision which affected the development cost and time of the rescue vehicle was the addition of the diver-lockout provision. "Diver lockout" is a term referring to the process by which a diver exits from an underwater vehicle.

The Specific Operational Requirement did not require diver-lockout capability, and such capability is not needed for rescue missions according to Project Office officials. Personnel of the Project Office amended the contract in December 1966 to provide for the inclusion of this capability. According to the contract, the amendment was to "provide the capability in the pressure capsule and fittings for diver lockout to 600-foot depth." This modification did not provide the vehicle with diver-lockout capability.

It made only basic changes so that the vehicle could, with further modifications, have such a capability. The Project Office wanted this modification because it considered the use of the vehicle as a diver-lockout platform a likely secondary mission for the vehicle. We were advised by Project Office personnel that the vehicle could not be used for rescue while equipped for diver lockout. Equipping the vehicle for diver lockout, performing a diver-lockout mission, and returning the vehicle to use for rescue could require several weeks.

In this case, the Project Office did estimate the cost of including the diver-lockout provision before making the decision to proceed with modifications. The estimated cost on the first rescue vehicle was $35,000. In July 1967, however, the amount negotiated for this provision was almost $180,000. Part of the work included in this modification was the installation of heavier internal hatches in the pressure hull. Later, however, these heavier hatches were replaced with lightweight hatches at a cost of about $48,000 as part of a weight reduction program.

The Project Office did not determine, however, the entire cost of obtaining diver-lockout capability. Project officials stated that no cost studies had been made of the additional modification needed to provide the first

rescue vehicle with diver-lockout capability. The officials stated that the cost would be significant and could be as much as several million dollars. The 1969 estimate of $463 million for the program did not include an amount for modifications associated with diver lockout.

In this case, as in the others, we could find no indication that this technical decision had been formally considered by the Chief of Naval Material or the Chief of Naval Operations, even though its potential effect upon the rescue vehicle program was significant.

CHAPTER 3

LACK OF TOP-LEVEL APPROVAL OF CHANGES IN DEVELOPMENT PROGRAM

As explained in the preceding chapter, the personnel of the Project Office were able to make technical changes having a significant effect on development cost and time without formal approval by the Chief of Naval Operations who represents the operating forces that ultimately use the equipment. Navy regulations and instructions suggest that a check-and-balance relationship is intended to exist between the developer and the user. Although the Navy management system contains many controls, it does not require a positive formal decision from the Chief of Naval Operations before a major change to a project can be implemented that would increase capability beyond requirements. In this respect:

--The system provides for review of changes in the technical characteristics of the item to be developed only if the technical characteristics contained in the Specific Operational Requirement are not met. Exceeding the requirements specified in that document does not require approval even if costs are increased significantly.

--The planning documents, required under the Navy management system, do not call for specific approval by the Chief of Naval Operations and did not bring the technical changes cited in this report to his attention for formal decisions.

--Because all funds were not obtained from the Chief of Naval Operations and because they were not required at one time, the need for funds to finance the additional costs that resulted from the cited technical changes did not force a formal decision by the Chief of Naval Operations.

Details of our findings on each of these points are presented below.

TOP-LEVEL APPROVAL NOT REQUIRED FOR TECHNICAL CHANGES INCREASING EQUIPMENT'S CAPABILITIES

Navy policy requires that the developing organization advise the Chief of Naval Operations if it cannot attain a technical characteristic specified in the Specific Operational Requirement. The requirement is spelled out in that document. In the case of the Deep Submergence Rescue Vehicle, it was stated as follows:

> "In an instance where the attainment of a particular specification threatens the orderly progress, or early realization of the development, or deserves a decision based on trade-off considerations, the developing agency will immediately advise the Chief of Naval Operations and will make appropriate alternative remedial recommendations."

As the above requirement indicates, the Chief of Naval Operations must be notified if the developing organization cannot fulfill the requirements of certain specifications without delaying the project's completion.

We found, however, that no such reporting was required when the developing agency planned to exceed the established requirements. Consequently, formal approval by the Chief of Naval Operations was neither requested nor given for the changes which were made even though the rescue vehicle's size, weight, operational capabilities, and development cost and time were increased appreciably.

In April 1969 a revised Specific Operational Requirement, which had been prepared by the Project Office, was approved by the Chief of Naval Operations. This document included the changes which the personnel of the Project Office had already contracted for with Lockheed. At that point, of course, the Government was already committed to a larger and more costly vehicle. Thus, in our opinion, the issuance of the revised Specific Operational Requirement merely ratified actions already taken.

Project Office officials advised us that they maintained close liaison with the appropriate representatives of the Office of the Chief of Naval Operations and that these representatives were fully informed of all pertinent matters. We were unable to ascertain precisely what information had been provided to that office, because of personnel changes and the lack of written records of such meetings with the appropriate representatives.

It is our view that informal discussions do not assure that responsible officials are fully informed of the consequences of proposed major changes. The possibility exists that proposed major changes will not receive sufficient attention from these officials if they are not called upon to approve these changes.

Furthermore, we believe that it is important that decisions increasing, as well as those decreasing, the capabilities of equipment should receive the specific approval of the operating forces, in this case represented by the Chief of Naval Operations. Greater capabilities for equipment mean little unless the operating forces have a specific need for them. Therefore we believe also that such decisions merit the formal, written approval, in advance, by the Chief of Naval Operations.

APPROVAL OF TECHNICAL PLANS NOT A CONTROLLING FACTOR

The Navy management system calls for the submission of two planning documents which are used for management purposes. One of these documents is the Technical Development Plan; the other is the Project Master Plan. These two plans are approved by the Chief of Naval Material and then used by other high-echelon officials in reviewing and evaluating the development of the system. As explained below, the Project Office submitted one of these plans late and did not submit the other at all. The failure to comply with Navy regulations did not, however, stop Project Office personnel from continuing with vehicle modifications, because approval of these plans had not been regarded as necessary for continuing the work.

Technical Development Plan

The Technical Development Plan contains technical, financial, schedule, and management plans for development of an item. According to Navy instructions, this document "serves as a basic decisionmaking document at all management levels" and "is the primary management control and reporting document." Navy instructions specify that a revised Technical Development Plan be submitted at certain established milestones or at least once a year.

The initial Technical Development Plan for the Deep Submergence Rescue Vehicle and related systems was submitted in January 1965; in April 1965 a revised and updated Technical Development Plan was submitted and later approved. Project Office officials stated that a revision to the April 1965 Technical Development Plan was not submitted until August 1967, even though many significant program changes were made during the period. The revised Technical Development Plan, submitted over a year late, was reviewed and returned without the approval of the Chief of Naval Material.

In his reply to the Project Office, the Chief of Naval Material stated that the system characteristics set forth in the Technical Development Plan deviated from the operational concepts and performance constraints of the

Specific Operational Requirement and that it did not present a comprehensive development plan.

A revised Technical Development Plan was submitted to the Chief of Naval Material for approval on February 15, 1968; it was approved in January 1969. Approval of the Technical Development Plan was delayed, because a revision to the Specific Operational Requirement proposed by the Project Office was awaiting the approval of the Chief of Naval Operations. The Chief of Naval Material would not approve the revised Technical Development Plan until the proposed revision to the Specific Operational Requirement had been approved. By the time the Technical Development Plan had been approved, the decisions on the technical changes had long been made and its approval had been largely academic.

We believe that the fact that an updated Technical Development Plan was rejected and was not approved for years after approval of the initial plan indicates a need for improved coordination among these offices.

Project Master Plan

The other document which Navy instructions specified as being essential to control and review development efforts effectively was the Project Master Plan. This plan, according to Naval Material Command Instruction 5200.11, dated February 24, 1965, was:

> "*** designed to provide the single comprehensive plan for the control, direction, coordination, and evaluation of project evaluations throughout the normal phases of a project life-cycle."

A Project Master Plan for designated projects was required to be submitted to the Chief of Naval Material within 120 days after establishment of a project manager or 120 days after receipt of the Specific Operational Requirement, whichever was later. The plan was then to be made available to the Chief of Naval Operations and other concerned officials. To ensure current and complete data, the Project Master Plan was to be revised whenever significant changes occurred and updated at least annually by February 15.

We found that the Project Office had not submitted a Project Master Plan. A report to the Chief of Naval Material on a management review of the Project Office in October 1966 stated that the Project Office had not prepared a Project Master Plan. The report went on to state that an informal and unrecorded agreement had been made some time ago that permitted the Project Office to submit an updated and expanded Technical Development Plan in lieu of a Project Master Plan until such time as the Project Office could comply with the requirement for a Project Master Plan.

One of the recommendations of the report had been that the Project Office:

> "*** immediately establish a file into which they can begin to collect data, fragmented though it may be, for the preparation of a Project Master Plan."

In reply to the report on the project management review, the Project Manager stated on May 31, 1967, that the Project Office had established procedures to gather data for the preparation of a Project Master Plan. He stated also that, after the submission of the Technical Development Plan, he intended to embark on the preparation of the Project Master Plan. In March 1968 some work was begun on a Project Master Plan.

In April 1968, however, Headquarters, Naval Material Command Notice 5000 deferred the requirement for producing a Project Master Plan until promulgation of a new document, the Acquisition Plan, which would combine the Project Master Plan and Technical Development Plan. No further action was taken, however, until March 1970 when the requirement for a Project Master Plan was reinstated. The instruction which reinstated the requirement also changed the scope and objectives of the Project Master Plan. As of March 1970 the requirement for an Acquisition Plan was still being studied.

As is obvious from the above, the requirement for the Project Master Plan, like that for the Technical Development Plan, neither resulted in bringing the decisions on the technical changes to the attention of the Chief of Naval Operations when the decisions were in the formulative stage nor required him to formally approve them.

NEED FOR ADDITIONAL FUNDS DID NOT FORCE TOP-LEVEL CONSIDERATION OF CHANGES

We found that the need for additional funds did not ensure formal consideration of the technical changes by the Chief of Naval Operations or other high-level officials. A major reason for this condition was the nature of development work and the manner in which it was funded.

In the development of a system, decisions made early in the program may not have a significant effect on the immediate fund requirements. For example, although the contract for the first Deep Submergence Rescue Vehicle was awarded in June 1966, additional funds to pay costs incurred under this contract were not requested until fiscal year 1970. This, coupled with the fact that only one of the six planned vehicles had been contracted for early in the program, delayed the full impact of fund requirement decisions until later in the program.

We found also that two other factors had prevented the need for additional funds from forcing a top-level decision on the technical changes. The first of these factors was the delays encountered in the program. Even though large cost increases were occurring, program delays allowed for the funds planned for the development to be sufficient to cover costs incurred during the first few years. For example, in the program change request approved in October 1965, the estimated cost of the six-vehicle rescue system in the Five Year Defense Plan was about $100 million, whereas the funds planned for fiscal years 1965 through 1968 were less than $77 million.

Although the estimated cost of the six-vehicle rescue system rose to $463 million, less than $85 million was required in fiscal years 1965 through 1968. Since the funds expended were within the limits of the Five Year Defense Plan, the cost growth did not result in a Department of Defense review of the program.

The second factor was the ability of Project Office officials, under Navy policies and procedures, to reprogram funds from other deep submergence systems, which allowed some of the cost increases on the rescue vehicle to be met

with funds originally planned for the other systems. This was possible because all systems managed by the Project Office were funded as a whole, rather than each system's being funded separately.

CHAPTER 4

RECOMMENDATIONS AND AGENCY COMMENTS

RECOMMENDATIONS

To help prevent problems similar to those in the Deep Submergence Rescue Vehicle program from occurring in programs in the future, we recommend that the Secretary of the Navy take action to ensure that a sufficient body of design, experimental development work, and subsystem testing be accomplished prior to the promulgation of an end-item system requirement document (Specific Operational Requirement) and thus establish a sound factual basis for authorizing full-scale development.

The Navy stated that this recommendation was consistent with long-standing Navy policy and with current Department of Defense policy of "fly before buy." The Navy instruction governing the Specific Operational Requirement requires that it be established that there are no unacceptable technological risks and that the necessary technology is at hand. The Navy noted, however, that the decision as to what constituted a "sufficient body," particularly of subsystem testing, must be made very carefully in accordance with good engineering judgment and with the nature of the development in question.

We agree that such decisions must be made very carefully. We believe that the problems described in this report demonstrate that the decision to undertake the Deep Submergence Rescue Vehicle program had been made primarily on a conceptual analysis without a sufficient body of fact.

We recommend also that the Secretary of the Navy:

--require that analyses be made of the impact on program cost and time schedules that could result from proposed changes designed to increase the capabilities of equipment beyond the level required by the Specific Operational Requirement and

--establish procedures which will require that advance approval of top-level management be obtained for all technical changes which are designed to increase the capabilities of the equipment beyond those required and which have a significant impact upon program cost and time schedules.

The Navy stated that it agreed that significant changes and their operational and financial consequences should be approved at sufficiently senior levels, consonant with the magnitude of the development. The Navy, however, did not cite any actions to be taken.

The Navy advised us in its reply that, after the rescue vehicle program had been initiated, measures had been taken to improve management procedures in the areas in which GAO considered improvements were needed. These were:

--Development Concept Papers are memoranda expressing the Secretary of Defense's decisions on the initiation of, or changes to, major research and development programs. A Development Concept Paper establishes the limits within which changes can occur. Changes beyond these limits trigger a review of the program and require a decision by the Secretary of Defense on the action to be taken.

--The Defense Systems Acquisition Review Council was established, consisting of the Director of Defense Research and Engineering and the Assistant Secretaries of Defense (Comptroller), (Installations and Logistics), and (Systems Analysis). This council reviews weapons programs at three major transition points in the acquisition process and when established limits are breached. Separate, detailed reviews of program management are also conducted by the Department of Defense early in the acquisition process, to ensure that adequate management procedures have been established.

--The Selected Acquisition Reports are now required on all major acquisition programs. They serve as the

management tool by which programs are monitored on a regular basis and deal with the source and amount of both cost variances and schedule changes.

--A new organization was created on August 3, 1970, within the Naval Material Command. This organization, called the Requirements Analysis Office, has specific responsibility for review of all documents which respond to requirements. In addition, the Navy stated that procedures required that program changes be approved through the chain of command to the Director of Defense Research and Engineering.

The new management method, which the Navy advised us the Department of Defense had established, should help prevent the recurrence of the conditions that existed for the rescue vehicle. With the advent of the Selected Acquisition Report, which consists of a quarterly reporting of current cost estimates and major changes to high management levels, including the Congress, management visibility of what is going on in a particular program should be improved.

We believe that it still is necessary to revise Navy regulations to require that analyses of the impact on development cost and time of all significant technical changes designed to increase the capabilities of equipment beyond those in the Specific Operational Requirement be conducted and that these analyses provide the information necessary to determine if such changes are cost effective.

The regulations should require also that, if these analyses show a significant increase in cost or delivery schedules, the Chief of Naval Operations, or other top-level user representative, certify that each major change is necessary for the equipment to perform the assigned mission for which it is being acquired. The regulations should also prohibit project managers from committing the Government to proceed with such changes until these certifications are given.

CHAPTER 5

SCOPE OF REVIEW

In our examination we reviewed available records related to the determination of performance requirements for the Deep Submergence Rescue Vehicle and selected components and reports on reviews and studies of the rescue program. We also examined Navy regulations and written instructions governing project management and the development of new systems. We also conducted numerous discussions with personnel of the Project Office to obtain information not contained in the files and to supplement the documentary information. Our examination was performed primarily at the Deep Submergence Systems Project Office, Chevy Chase, Maryland.

APPENDIXES

DEPARTMENT OF THE NAVY
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20350

20 OCT 1970

Mr. Charles M. Bailey
Director, Defense Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Bailey:

The Secretary of Defense has asked me to reply to your letter of 28 July 1970 which forwarded the GAO draft report on the development management of the deep submergence rescue vehicle program. I am enclosing the Navy reply to the report.

Your letter also requested a security classification review of the report, and stated your desire to issue an unclassified report. The very few classified parts of the report are shown in the attached copy of the report. The report may be issued as unclassified, with those parts deleted. The GAO is authorized to forward the present report, classified as indicated, to committees and members of the Congress in accordance with the provisions of DOD Directive 5200.1.

Sincerely yours,

Charles A. Bowsher

CHARLES A. BOWSHER
ASSISTANT SECRETARY OF THE NAVY
(FINANCIAL MANAGEMENT)

Encl:
(1) Navy Reply to GAO Draft Report of 28 Jul 1970 on Deep Submergence Rescue Vehicle Program Indicates Need for Strengthening Management Control Over the Development Process (OSD Case #3150) (4)
(2) Copy of GAO Draft Report (4)

APPENDIX I

Navy Reply

to

GAO Draft Report of 28 July 1970

on

Deep Submergence Rescue Vehicle Program Indicates Need for Strengthening Management Control Over the Development Process

(OSD Case #3150)

I. GAO Findings, Conclusions and Recommendations

GAO reviewed the management of the DSRV (Deep Submergence Rescue Vehicle) because the actual development cost and time substantially exceeded the original estimates. The DSRV is a 35-ton submersible vehicle designed for rescue of personnel from disabled submarines. When needed, the Deep Submergence Rescue Vehicle would be transported by aircraft to a seaport near the disaster and carried to the site by a supporting surface ship or submarine. The vehicle would then shuttle between the disabled submarine and the supporting craft, rescuing up to 24 survivors each trip.

GAO inquired into the management controls to see whether the increases in development cost and time might have been more effectively controlled.

A. Findings. The GAO found that:

1. During the period 1964 to 1969, the estimated cost for the rescue vehicle program increased from $36.5 million for a twelve-vehicle system and one year of operation to $463 million for a six-vehicle system. This represents about a 1300 percent increase in cost in spite of a 50 percent reduction in the number of vehicles to be built.

2. Changes made in the design of the vehicle during this period necessitated a redesign of support craft and some of the supporting equipment with a corresponding increase in their costs.

Enclosure (1)

3. Although the Navy management system contains many controls, it does not require a positive formal decision from the Chief of Naval Operations prior to increasing the capabilities of a developmental system beyond those called for in the Specific Operational Requirement.

4. No thorough and well-documented analysis of the consideration given in the decision making process showing the effects these decisions would have on development cost and time or the cost benefits obtainable from the increased capabilities.

5. Little indication of specific approval by the top Navy echelons of many important decisions involving substantial development cost and time.

B. Conclusions. The GAO concluded that:

1. A substantial portion of the cost growth and program stretch-out exists because of the low original estimates established by the Deep Submergence System Review Group. GAO believes these low estimates were used when the system requirement was issued because the Navy did not conduct sufficient design, preliminary development and testing to provide a sound, factual basis for estimating realistic development cost and time. Accordingly, the decision to establish a firm requirement for the system was based on cost and time estimates obtained from a conceptual study instead of from design and engineering analysis.

2. A substantial portion of the increase in development cost and time is attributable to changes in the vehicle design undertaken to increase its capabilities beyond those stated in the requirement.

3. Although Project Office officials stated that representatives of the Office of the Chief of Naval Operations were fully informed of all pertinent matters by informal means, informal discussions do not assure that responsible persons are fully informed of the consequences of such proposed changes.

4. Formal approval by the Chief of Naval Operations of major increases in technical requirements would achieve more effective control over the development of major systems and provide greater assurance that benefits are carefully weighed against possible cost increases and development delays.

C. Recommendations. GAO recommends that SECNAV take actions which will require:

1. A sufficient body of design, experimental development work, and subsystem testing be provided prior to the promulgation of an end-item system requirement document to ensure the basis of fact necessary to authorize the follow-on full scale development and procurement of operational equipment and systems.

2. All significant technical changes which increase the capabilities of the item being developed beyond those specified be presented to the Chief of Naval Operations for his concurrence before development proceeds.

3. In presenting such technical change data to the Chief of Naval Operations, the developer also furnish analyses of any additional cost, delays, and increased capabilities to result from the change.

II. Summary of the Navy Position

The Navy considers the report to be, in general, factually accurate. The Navy does not concur in all of the conclusions of the report, but considers the management objectives implicit in the GAO recommendations to be generally sound. Comments concerning specific GAO statements are contained in Tab A.

Recommendation (1) is consistent with long standing Navy policy and with current DOD policy of "fly before buy," as expressed by the Deputy Secretary of Defense in his memorandum of 28 May 1970. Thus, OPNAVINST 3910.6, governing the Specific Operational Requirement (SOR), the requirement document which calls out Engineering Development, states, as a prerequisite to issuance of an SOR, that it must be established that there are no unacceptable technological risks, and that the necessary technology is at hand. It should be noted, however, that the decision as to what constitutes a "sufficient body," particularly of subsystem testing, must be made very carefully in accordance with good engineering judgment and the nature of the development in question. For example, in the case of shipbuilding, a too-broad requirement for subsystem testing could result in unacceptable lead time for the major system.

Recommendations (2) and (3) are concomitant. The Navy agrees that significant changes and their operational and financial consequences should be approved at sufficiently senior levels, consonant with the magnitude of the development in question. [See GAO note on p. 48.]

[See GAO note on p. 48.]

Since the time when the DSRV characteristics were evolved, new procedures have been instituted in the Department of Defense which provide more stringent controls. Of particular importance is the Development Concept Paper (DCP). DCP's are memoranda by which the Secretary of Defense expresses his decisions on the initiation of or changes to major R&D programs. The DCP makes explicit assumptions concerning the agreed upon problem or threat, the development time frame, priority, force levels contemplated, and measures of merit, or effectiveness, which will be used to evaluate and compare alternative systems. These thresholds establish the limits of changes which can occur before triggering a review of the program and a decision by the Secretary of Defense on action to be taken. There has been established within DOD a Defense Systems Acquisition Review Council consisting of the Director of Defense Research and Engineering and the Assistant Secretaries of Defense Comptroller, Installations and Logistics, and Systems Analysis. This council reviews weapons programs at three major transition points in the acquisition process, and when thresholds are breached. The DOD also conducts separate, detailed reviews of the management of these major programs early in the process to ensure that adequate management procedures have been established. Finally, the DOD instituted Selected Acquisition Report serves as the management tool by which acquisition programs are monitored on a regular basis. This report specifically deals with the source and the amount of both cost variances and schedule changes.

In addition, policies and procedures within the Naval Material Command have been established which provide for high level review. A recent reorganization of the Deputy Chief of Naval Material (Development) (DCNM(D)), 3 August 1970, established the Requirements Analysis Office (RAO) which is responsible for a thorough and meaningful review of all documents which respond to requirements (Proposed Technical Approach (PTA), R&D Planning Summary (DD 1634), Technical Development Plans (TDP)). This review results in a recommendation to CNM for his decision. When funded, the TDP or DD 1634 becomes the primary management control and reporting document for the life of the development. It is kept up to date on a continuing basis. Updated TDPs/DD 1634s must be submitted to the Director, Defense Research and Engineering (DDR&E) through the chain of command whenever a Program Change is approved. whenever a significant change occures in the status of the project, whenever a request for initiation of Engineering Development is submitted to DDR&E, and at least once a year by 1 April in order to assure that DDR&E has current information at the time of formal program guidance, program planning, budget estimates and apportionment requests.

The Navy believes that the necessary controls are contained in the Navy management system as it has evolved since 1966 and in changes currently in progress in DOD, and consequently that the action necessary to achieve the objectives of the GAO in strengthening management controls over the development process has been taken.

APPENDIX I

DETAILED COMMENTS

ON

SPECIFIC STATEMENTS

IN

GAO REPORT

DEEP SUBMERGENCE RESCUE VEHICLE
(OSD Case 3150)

Tab A

1. GAO Statement (Page 10) In its analysis of causes of growth in cost and time estimates in the DSRV program, GAO concludes that a substantial portion of this growth exists because of the low original estimates established by the DSSRG.

Navy Comment.

a. With respect to the various GAO statements in this report concerning DSRV cost growth and increases in development time, it is important to note that GAO has again used the February 1964 estimates of the Deep Submergence Systems Review Group (DSSRG) as the basis for comparison. In its reply to the GAO draft report of 23 May 1969 and again in its reply to the final GAO report to Congress (OSD Case #2950) of 20 February 1970, the Navy made the following statement concerning the actual basis for the approved DSRV program:

> By way of background, the Deep Submergence Systems Review Group (DSSRG) Report recommended as a long term rescue improvement, that the Navy develop, construct, and operate a fleet of 12 small submersible rescue vehicles. The Report, which was conceptual in nature, estimated that such a program would cost $36.5M over a five-year period. It is emphasized that the DSSRG Report, as a conceptual study, did not constitute the basis for the approved program. However, when such a program was subjected to engineering and design analyses, a more realistic cost of a seven-year program was estimated to be $119M, (in reality $139 million when taking into account the elimination of "shared research' caused by the deletion of the search vehicle in the final phase of the approval of the PCP (Program Change Proposal). This program, which was proposed as an entire Rescue System, including improved escape development, was approved by Deputy Secretary of Defense Vance on 7 October 1965. At the time of approval, this PCP was structured on the basis of a concurrent deep search vessel program with extensive common research and development. The effect of the decision to defer the search vehicle was to increase the cost of the rescue program from $119M to $139M.[1]

As indicated above, the DSSRG Report is not properly the cost reference point. This was a study aimed at requirements. Cost estimates were included to help the Chief of Naval Operations determine whether the concept looked sufficiently promising to proceed with further analysis. Following the DSSRG Report, further engineering analysis developed the cost and schedule

[1] GAO footnote. The $119 million includes supplemental systems, whereas the $100 million used in GAO's report is for the rescue system only

estimates reflected in the Program Change Proposal approved by the Deputy Secretary of Defense in October 1965. These numbers are considered realistic for the information available at that time.

b. It should also be noted that the GAO cost comparisons are based on a projected six-vehicle program. The Assistant Secretary of the Navy (Financial Management) letter of 19 August 1969 advised GAO that the Chief of Naval Operations, on 29 April 1969 directed that a DSRV force level study be made and that construction of additional DSRVs beyond the two then under construction would not be undertaken until and unless their usefulness justified their cost and that there was no provision in the Five Year Defense Program for additional DSRVs.

2. GAO Statement (Page 17). GAO also concludes that a substantial portion of the increase in development cost and time is attributable to changes in vehicle design undertaken to increase its capabilities beyond those stated in the SOR. Specifically cited are increases in operating depth and rescue capacity.

Navy Comment.

a. With regard to the question of depth, the DSSRG Report recommended an operating depth of 6,000 feet. The initial SOR specified a minimum requirement that the vehicle be capable of rescuing personnel at submarine collapse depth (collapse depth is classified and can be provided as required). The Navy's analysis indicated that the state-of-the-art in machining 7 foot HY 140 steel spheres of the desired weight for the DSRV pressure hull allowed a DSRV operating depth of 3,500 feet. The COR (Circular of Requirements) specified 3,500 feet but requested ideas from industry as to how a 6,000 foot depth capability could be achieved. LMSC (Lockheed Missile and Space Corporation) indicated that it had proprietary machining techniques which would achieve improved sphericity. Since the improved sphericity had not been demonstrated on the selected material, the Navy elected to specify a material thickness adequate to achieve 3,500 feet. LMSC did achieve its predicted machining performance, which resulted in a depth capability of 5,000 feet. This achievement did not involve a significant increase in the cost estimate. On the other hand, it did provide the capability of performing interim depth search operations, thus enabling cancellation of original plans for a separate 6,000 foot prototype search vehicle (included in SOR 46-16 of 8 October 1964) and a multi-million dollar saving to the Government.

Tab A

b. Both the DSSRG Report and the SOR contemplated a vehicle that would accommodate 12 to 14 people. The Request for Proposal was issued with a pressure hull design of two spheres joined by an access trunk. One of these spheres was to house the crew and equipment and the other was to house 12 to 14 rescuees. Before the contract was written, the change to the three sphere concept was made to permit an injured rescuee to be loaded on a stretcher. This could not have been accomplished under the COR configuration. The contractor also proposed converting the access trunk to an additional rescue sphere, thereby increasing the payload to 24 rescuees per trip. This conversion reduced the mission time, reliability requirements, power requirements, etc., thereby effecting operating cost savings. There were also forecast cost savings resulting from the use of the same tooling for all three spheres instead of special tooling for a smaller mid-sphere.

c. The increase in operating depth and the addition of the third sphere were not major factors in the cost growth of this program. More significant were such causes as inability to use off-the-shelf items in the deep ocean environment; unforeseeable problems in new technology development; and schedule slippages and stretch-outs as a result of design problems, late subcontractor deliveries, interface definition, and test program extensions as well as escalation in the cost of labor and material.

3. GAO Statement (Page 21). GAO indicates that changes made in the design of the vehicle necessitated a redesign of support craft and some of the supporting equipment with a corresponding increase in their costs.

Navy Comment. Selection of the three-sphere concept with the resulting increase in DSRV length took place early in the design of the Submarine Rescue Ship (ASR) and was included in the contract design for the ship. Subsequent weight growth of the DSRV did necessitate redesign of handling equipment and modifications to the ASR. However, a significant portion of this weight growth did not result from vehicle design changes undertaken to increase its capabilities.

4. GAO Statement (Pages 15,16). GAO reports that it found no thorough and well documented analysis showing the effects that decisions to change the rescue vehicle would have on the development cost and time or the cost benefits attainable from the increased capabilities.

Navy Comment. Generally, and in each of the cases cited, careful analyses were made of the impact of the changes on the DSRV

itself. However, formal cost-effectiveness analysis of the impact on the whole system was not conducted.

5. GAO Statement (Pages 15, 16, 24). GAO reports, also, that it found little indication of specific approval by the top Navy echelons of many important decisions involving substantial development cost and time.

Navy Comment. During the critical initial phase of the DSRV, a high degree of urgency generated by the Thresher disaster was present. A Steering Task Group to obtain rapid approval of system parameters was established and met regularly. The CNO and the CNM were represented. This group reviewed and approved all important decisions. In addition, cognizant OPNAV and NAVMAT personnel were kept informed of and participated in the decision-making process through day-to-day contacts, staff meetings, and regularly scheduled briefings. The Project Manager reported program status directly to the Chief of Naval Material and met with him on a weekly basis.

GAO note: Deleted comments relate to matters discussed in the draft report but which have not been discussed in this final report.

Tab A

PRINCIPAL OFFICIALS OF THE DEPARTMENT OF DEFENSE AND THE DEPARTMENT OF THE NAVY RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
Melvin R. Laird	Jan. 1969	Present
Clark M. Clifford	Mar. 1968	Jan. 1969
Robert S. McNamara	Jan. 1961	Feb. 1968
DEPUTY SECRETARY OF DEFENSE:		
David M. Packard	Jan. 1969	Present
Paul H. Nitze	July 1967	Jan. 1969
Cyrus R. Vance	Jan. 1964	June 1967
Roswell L. Gilpatric	Jan. 1961	Jan. 1964
DEPARTMENT OF THE NAVY		
SECRETARY OF THE NAVY:		
John H. Chafee	Jan. 1969	Present
Paul R. Ignatius	Sept. 1967	Jan. 1969
Charles F. Baird (acting)	Aug. 1967	Sept. 1967
Robert H. B. Baldwin (acting)	July 1967	Aug. 1967
Paul H. Nitze	Nov. 1963	June 1967
Fred Korth	Jan. 1962	Nov. 1963
CHIEF OF NAVAL OPERATIONS:		
Adm. Elmo R. Zumwalt, Jr.	Oct. 1970	Present
Adm. Thomas H. Moorer	Aug. 1967	Sept. 1970
Adm. David L. McDonald	Aug. 1963	July 1967

	Tenure of office	
	From	To
DEPARTMENT OF THE NAVY (continued)		
CHIEF OF NAVAL MATERIAL:		
Adm. Jackson D. Arnold	July 1970	Present
Adm. Ignatius J. Galantin	Mar. 1965	June 1970

U.S. GAO Wash., D.C.