UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

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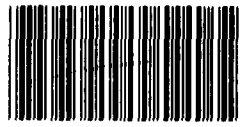
MISSION ANALYSIS AND
SYSTEMS ACQUISITION DIVISION

B-203330

NOVEMBER 17, 1982



The Honorable John R. Block
The Secretary of Agriculture

Dear Mr. Secretary:

Subject: Cost Increases, Technical Problems, and Lack of User Interest Make Continuation of Helistat Program Questionable (GAO/MASAD-83-4)

The Forest Service is developing a lighter-than-air vehicle consisting of a 343-foot-long blimp envelope with a frame which has four helicopters attached to it. (See enc. I.) After completing the development program in 1983, the Forest Service then plans to use this vehicle, called the Helistat, to demonstrate that aerial logging operations are economical in steep, inaccessible mountainous terrain.

When the Helistat program began in 1979, the estimated net cost was $6.7 million--it has subsequently increased to at least $31.7 million. The development was to require 28 months--it will now take at least 41 months. In addition, significant technical problems exist that must be resolved before the development program can be completed. Because the Forest Service has not developed a plan for resolving the technical problems and prepared a revised cost estimate, the final cost and completion are uncertain.

In our previous report on the program (MASAD-81-31, June 2, 1981), we noted that potential users saw little practical application for a vehicle of this type. The lack of user support, coupled with the dramatic increase in program cost, makes the continuation of the program questionable.

We have the following concerns.

--Estimated net cost of the program has increased 373 percent.

--Engineering problems have delayed the program and caused concern about the structural strength of the vehicle.

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--Scheduled milestones have not been met and the Forest Service has not established valid milestones.

--User interest and support is lacking.

--Projected program benefits are questionable.

BACKGROUND

The Helistat program was initiated in 1979 from an unsolicited proposal. The program's goal is to demonstrate the economic feasibility of aerial logging in steep mountainous terrain and remote, roadless areas which are economically and/or environmentally inaccessible for harvesting timber by other means.

The program is divided into two phases. The first phase involves development of the Helistat vehicle and the second phase involves conducting logging demonstrations at five sites in the Pacific Northwest and Alaska and one site on the east coast. The total cost of the program was estimated at $26.3 million, with $19.6 million to be returned to the Treasury through the sale of timber harvested in the demonstration, resulting in a net cost of $6.7 million for the program.

Because it lacked technical expertise, the Forest Service requested assistance from the Naval Air Systems Command. Through an interagency agreement, the Naval Air Development Center agreed to act as contract administrator and technical advisor for the program. The Navy also supplied a hangar for the Helistat's assembly and an extensive amount of government-furnished equipment, such as the blimp envelope, helicopters, and spare parts.

OBJECTIVES, SCOPE, AND METHODOLOGY

We undertook this review to follow up on the recommendations made in our prior report (MASAD-81-31, June 2, 1981). Although we had expressed concern about the management of the program in that report, the Secretary of Agriculture directed the Forest Service to proceed with the program as planned.

The objective of this review was to evaluate the current status of the program and the extent to which the problems had been resolved. We reviewed Navy and Forest Service program documents, correspondence, contract files, and other pertinent records and information. We discussed the program with knowledgeable officials from the Forest Service, the Naval Air Development Center, the Naval Air Systems Command, the Federal Aviation Administration, and consultants from the National Aeronautics and Space Administration and private industry. We also met with the contractor and toured the manufacturing and fabrication facilities.

In assessing current timber harvesting prices, we analyzed Forest Service records, studies made by the Office of Technology Assessment and the House Appropriations Committee's Surveys and Investigation staff, and discussed the current market with regional and headquarters officials of the Forest Service.

Information relating to the potential user's opinion of the Helistat was presented in our previous report. We did not do any additional work during this review.

Our review was performed in accordance with our "Standards for Audit of Governmental Organizations, Programs, Activities, and Functions."

We discussed a draft of this report with Forest Service and Navy officials and the contractor, and we have made changes and included their comments as appropriate in the body of the report.

ESTIMATED COST OF THE HELISTAT PROGRAM HAS INCREASED 373 PERCENT

The original net cost of the Helistat program, $6.7 million, has increased to $31.7 million, or about 373 percent as shown in the following table. First, the estimated cost has increased from the $26.3 million projected in 1979, to $40.7 million--a 55-percent increase. This is due to an increase of about $5.3 million for the development phase and approximately $9.1 million for the demonstration phase. Because the remaining development work has not been clearly defined, the Navy has not been able to assess the validity of the revised cost estimate. Navy officials believe, however, that this cost could increase further. Second, the depressed timber market has reduced the anticipated revenue from timber sales during the demonstrations by $10.6 million--a 54-percent decrease.

	1979 estimate	Current estimate	Increase (decrease)
	(millions)		
Vehicle development phase	$12.5	$17.8	$ 5.3
Logging demonstration phase	13.8	22.9	9.1
Total cost	$26.3	$40.7	14.4
Less logging revenue	19.6	9.0	(10.6)
Net cost	$ 6.7	$31.7	$25.0

Vehicle development cost has increased and final cost undetermined

The estimated cost for the vehicle development phase was $12.5 million. According to recent cost estimates, however, at least $5.3 million more may be needed. In addition, the total cost to complete vehicle development is uncertain because the remaining work has not been clearly defined and the reliability of the revised cost estimate has not been determined.

A cost-plus-fixed-fee contract for $10.7 million was awarded to the Piasecki Aircraft Corporation in September 1980. 1/ The contract called for delivery of the vehicle at the contractor's facility in Lakehurst, New Jersey, tested and ready for operational use. Cost of the hangar facility and government-furnished equipment was absorbed by the Navy. In September 1982 the contractor requested another $1.7 million to complete the work under the contract.

In addition to this contract overrun, the Forest Service plans to spend $1.3 million for additional safety modifications to the vehicle. To complete the proposed test program on the vehicle, the Forest Service will have to spend another $2.3 million for instrumentation and qualification tests before the first logging demonstration. However, the Forest Service has not decided whether it will fund the proposed test program.

However, a number of unknowns could further increase the development cost. According to the Navy, a number of the analyses the contractor submitted were incomplete or erroneous. Other tasks required by the Navy are contested by the contractor and have not been resolved. Completion of these tasks may result in additional cost increases. Another cost increase could occur if any problems are experienced during static or flight tests and rework or modifications are needed.

The contractor provided a revised cost estimate for the development phase. However, it contained insufficient information for the Navy to determine if the costs were valid. Therefore, the Navy requested the contractor to provide a sufficiently detailed cost estimate for completion of the development effort. However, as of November 1, 1982, this had not been received. Thus, the Navy has not determined the validity of the contractor's latest estimate for the development phase.

1/A letter contract was awarded to Piasecki Aircraft Corporation in January 1980.

Logging demonstration cost increases and projected revenue decreases

The estimated cost of the logging demonstration phase has increased from $13.8 million to $22.9 million. In addition, the expected revenue from the sale of harvested timber has decreased from $19.6 million to $9.0 million. Thus, whereas the demonstration phase was originally estimated to result in a net profit of $5.8 million, it now appears that the demonstration phase could result in a net loss of $13.9 million as shown below.

	1979 estimate	Current estimate
	(millions)	
Cost of demonstration phase	$13.8	$22.9
Anticipated revenue from sale of timber	19.6	9.0 a/
Net profit or loss	$ 5.8	-$13.9

a/The Forest Service has not made any estimate for revenues from the Allegheny test.

The logging demonstrations will be done over a 3-year period. Originally, the demonstration phase included harvesting timber at six sites in the Pacific Northwest and Alaska. These sites were chosen because they would provide the opportunity to prove that the Helistat could perform environmentally safe logging operations in steep, inaccessible mountainous terrain.

Recently, the Forest Service eliminated one of the Northwest test sites and added a test site in the Allegheny National Forest on the east coast. Forest Service officials told us that this change was made to test the Helistat under controlled operating conditions before flying it to the Northwest for additional logging demonstrations. An estimated $9.1 million will be needed for technical support and program management, training the crew, preparing the Helistat, and flying it to and from the various logging sites, thus increasing the total demonstration cost to $22.9 million.

The Forest Service has not decided whether it will pursue the full test program. If it does not, some costs could be avoided.

To reduce the demonstration cost, the Forest Service expected to sell the timber harvested at the six sites for $19.6 million. The estimate was based on timber prices in 1979, a peak year in

timber sales. Since that time, prices have decreased. Because the Forest Service does not plan to update these figures until 1983, we took comparable Forest Service data on current timber sale prices and recalculated the estimated revenue for the five sites on the west coast. This resulted in a decrease from $19.6 to $9.0 million--54-percent less than the original projection. However, estimated revenues from the Allegheny test site should be added to the $9.0 million when the Forest Service determines what they will be. Forest Service officials believe that timber prices may increase. However, unless and until this happens, the Forest Service would receive only $9.0 million from the five sites on the west coast--54-percent less than what it had projected.

UNRESOLVED ENGINEERING PROBLEMS ARE A CONCERN

Problems in designing and building the Helistat have caused delays and raised concerns about the strength of the tubular, truss-like structure of the vehicle. The following problems were cited by the Navy, National Aeronautics and Space Administration, and/or Federal Aviation Administration officials.

--The concurrent design and fabrication of the Helistat's interconnecting structure has resulted in the rework of items; the redesign of tube ends and tube joint connectors to fasten the structure together; and the field fitting of tubes, tube ends, and connectors.

--Engineering analyses requested to ensure the strength of the structure have been incomplete and flawed.

--Poor quality workmanship practices have been used to build the interconnecting structure.

A material that would be lightweight, yet capable of withstanding vehicle stresses, was needed to build the interconnecting structure that attaches the four helicopters to the blimp. (See enc. II.) Aluminum tubes of different diameters are being used to build the structure. Since tube thickness, diameter, and material directly relate to the stresses it can tolerate, the design and building of the tubular, truss-like structure were of major consequence.

The Forest Service and the Navy allowed the contractor to design and construct the Helistat concurrently. For example, the contractor's master program schedule shows that the design of the interconnecting structure began in January 1981 and was to end in October 1982. The fabrication effort began in March 1981 and was to end in November 1982. Thus, this structure was being built long before the design was completed. Some of the other major components were also designed and built concurrently. This practice, according to a Navy official, has resulted in numerous

design changes, rework of fabricated items, and adjustments to structural members during assembly. These adjustments included shortening or lengthening tubing to fit, and cutting tubing so that the ends could be rotated for connecting and then placing a collar over the cut tube.

Before the critical design review, Navy officials expressed great concern about the amount of ongoing fabrication of the structural members. Navy officials attempted to comprehensively evaluate the Helistat design at the critical design review in March 1982. However, this review and subsequent information revealed that the engineering analyses supporting the design of the interconnecting structure were incomplete or erroneous. These analyses are crucial because the interconnecting structure is the frame to which the blimp and helicopters will be attached. It is a complex arrangement of tubing with various lengths, sizes, and geometric alignments. As a result of the Navy's evaluation, it was determined that the interconnecting structure was not fully designed, inadequately stress analyzed, and potentially inadequately engineered.

A National Aeronautics and Space Administration official who attended the critical design review stated that the insufficient analysis and incomplete documentation provided by the contractor had made it difficult for the Navy's technical monitors to decide whether the design was reasonably safe and had a reasonable chance of satisfying the Forest Service's requirements. Since the Navy lacked confidence in the design, it requested the contractor to make an analysis of seven critical joints of the interconnecting structure. At the time of our review, the Navy had received and reviewed two of the seven joint analyses. The results showed that the contractor's two analyses were done incorrectly. When analyzed by the Navy, they showed excessive stress on the joints. The contractor agreed to correct the analyses. However, as of November 1, 1982, the contractor had not submitted any revised analyses to the Navy.

In addition, the Navy has been dissatisfied with the quality of the contractor's workmanship, particularly in the fabrication of the interconnecting structure. Concern was also expressed by a Federal Aviation Administration official during visits to the construction site about the questionable workmanship practices of the contractor. Some of the problems Navy officials identified were

--poor welding,

--out-of-tolerance dimensions,

--spliced and patched tubes,

--scored and dented tube ends, and

--insufficient cleaning of bonded surfaces.

The contractor challenged the poor workmanship concerns, stating that these items are actually work-in-progress and that, before static testing begins, all corrections and/or replacements will be made. The Navy is negotiating with the contractor regarding these corrections and replacements, but no final resolution of these concerns has been achieved.

LITTLE CONFIDENCE EXISTS IN CURRENT SCHEDULE

The Forest Service had planned to take delivery of the Helistat after a 28-month vehicle development program. However, the contractor's most recent estimate calls for delivery in June 1983--a delay of 13 months. Within the last year, the contractor has changed the delivery date five times. These incremental slips in the vehicle development program provide little confidence in the validity of the current completion date of June 1983.

The cause of the delay is contested. Navy officials attribute the schedule changes primarily to the contractor's practice of assembling the interconnecting structure before the design was firm. This practice, according to the Navy officials, caused delays because the contractor had to then disassemble many portions of the Helistat structure for rework. The contractor, however, blames the slippage on the nonavailability of material such as tubing and the Navy's requirements for numerous analyses and reports.

Concern about the unrealistic schedule and lack of progress being made in the program has been expressed by both the Navy and an independent consultant used by the Forest Service to evaluate the program.

POTENTIAL USERS NOT INTERESTED IN USING HELISTAT FOR LOGGING OPERATIONS

The Forest Service did not contact potential Helistat users before beginning the Helistat program. Potential users we contacted during our previous review saw little opportunity for Helistat use and rated the concept poor as a timber harvesting method.

Also, during our previous review we contacted 4 forest industry associations and 32 potential private industry users to obtain some input on industry's perception of the program. Even though our contacts did not represent a random sample of the universe of potential Helistat users and may not be representative of all potential users' views, the results point out the potential lack of user interest in this logging concept.

Their overall assessment of the Helistat concept as a method for harvesting timber in steep, mountainous terrain was poor.

--Thirty-three said the preferred method for harvesting this timber would be to use cable systems or heavy lift helicopters.

--Eleven said the Helistat will not be usable much of the time because of bad weather and high winds in the mountainous terrain.

--Twenty commented that only a small percentage of timber in the Pacific Northwest is economically inaccessible for harvesting, and four of these said the Forest Service makes this small amount inaccessible by setting higher, more costly standards for road building in National Forests than are used on private forest lands.

--Another five said all the timber is accessible using current timbering methods.

Forest Service officials stated that most of the private forest lands already have roads, and are therefore accessible with conventional harvesting techniques. Private industry in their opinion, is not motivated to fund new development programs such as the Helistat.

PROJECTED BENEFITS OF THE PROGRAM ARE QUESTIONABLE

According to the Forest Service, the use of the Helistat will greatly expand the amount of timberland that can be logged from the air. It anticipates that up to 5 billion board feet of additional timber could be made available by using a fleet of second generation Helistat-type vehicles. However, the successful completion of the current Helistat program will not result in a fleet of vehicles, or even a prototype for later production, it will only demonstrate the concept.

Another more costly development program will be necessary to develop a vehicle that can be produced and sold to logging companies. According to Navy officials, a new research and development program would take about 5 years to complete. The Forest Service said that in November 1980 a contractor estimated that development of a prototype that could be produced would cost $100 million.

We believe it is unlikely that potential users will fund the cost of this follow-on development program. During our survey of potential users, we found only 1 user out of 32 that was willing to contribute to the funding of the Helistat program. We also believe that it is unlikely that private industry would develop a new vehicle with its own money based on expected future sales of the vehicle. This would leave the federal government with the cost of funding any follow-on development program.

With the reduced demand for timber and the decreased level of housing starts projected for the next decade, we believe it is questionable that costly logging of inaccessible timber areas is justified. However, Forest Service officials told us that the Helistat would not be available for commercial application for at least 10 years and that timber demand in the next decade may justify development of the vehicle.

CONCLUSIONS

The estimated cost of the Helistat program has increased from $26.3 million to $40.7 million. Due to the recent drop in timber prices, the revenue from the sale of timber harvested during the program will not be $19.6 million as projected, but could be as little as $9.0 million. Thus, the program that was estimated to cost $6.7 million when it began, may now cost over $31.7 million.

Engineering and technical problems have caused significant delays and concern about the structural strength of the vehicle.

As of November 1, 1982, the Navy had not received sufficient information from the contractor to assess the validity of the revised development cost or schedule, and there was no agreement as to when and how the technical problems previously identified could be satisfactorily resolved. Neither the Navy nor the Forest Service have any firm agreement from the contractor regarding these matters.

Potential users see little opportunity for Helistat use and rate the concept poor as a timber harvesting method.

Based on the cost increases, technical problems which may result in still more cost increases, and serious questions about the usefulness of Helistat for timber harvesting, we believe there is a serious question as to whether the program should be continued. A thorough reassessment is essential before proceeding further.

RECOMMENDATIONS

We recommend that the Secretary of Agriculture direct the Forest Service to

--determine the scope of work required to resolve the technical problems and complete the development phase of the program,

--determine the cost of completing the development phase and the logging demonstrations,

--determine the estimated revenue from timber sales,

--establish valid schedule milestones,

--identify the benefits which justify the program's cost, and

--determine whether completion of the Helistat program is justified.

If a decision is made to continue the program, we recommend that the Secretary of Agriculture tell the Congress of the current cost, schedule, and technical status of the program and the basis for concluding that the program should be continued.

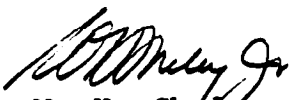
. . . . .

As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this letter to the Director, Office of Management and Budget; the Chairmen, Senate Committees on Appropriations, Governmental Affairs, and Agriculture, Nutrition, and Forestry; the Chairmen, House Committees on Appropriations, Government Operations, and Agriculture; and the Secretaries of Defense and the Navy. Copies will also be provided to the Commanders of the Naval Air Development Center and the Naval Air Systems Command, and the Administrator of the Federal Aviation Administration.

We would appreciate being informed of the action you plan to take in response to our recommendations. If you have any questions or wish to discuss this report, please contact Klein Spencer on 275-4580 or Rae Ann Sapp on 275-4541.

Sincerely yours,



W. H. Shedley, Jr.
Director

Enclosures - 2

ENCLOSURE I

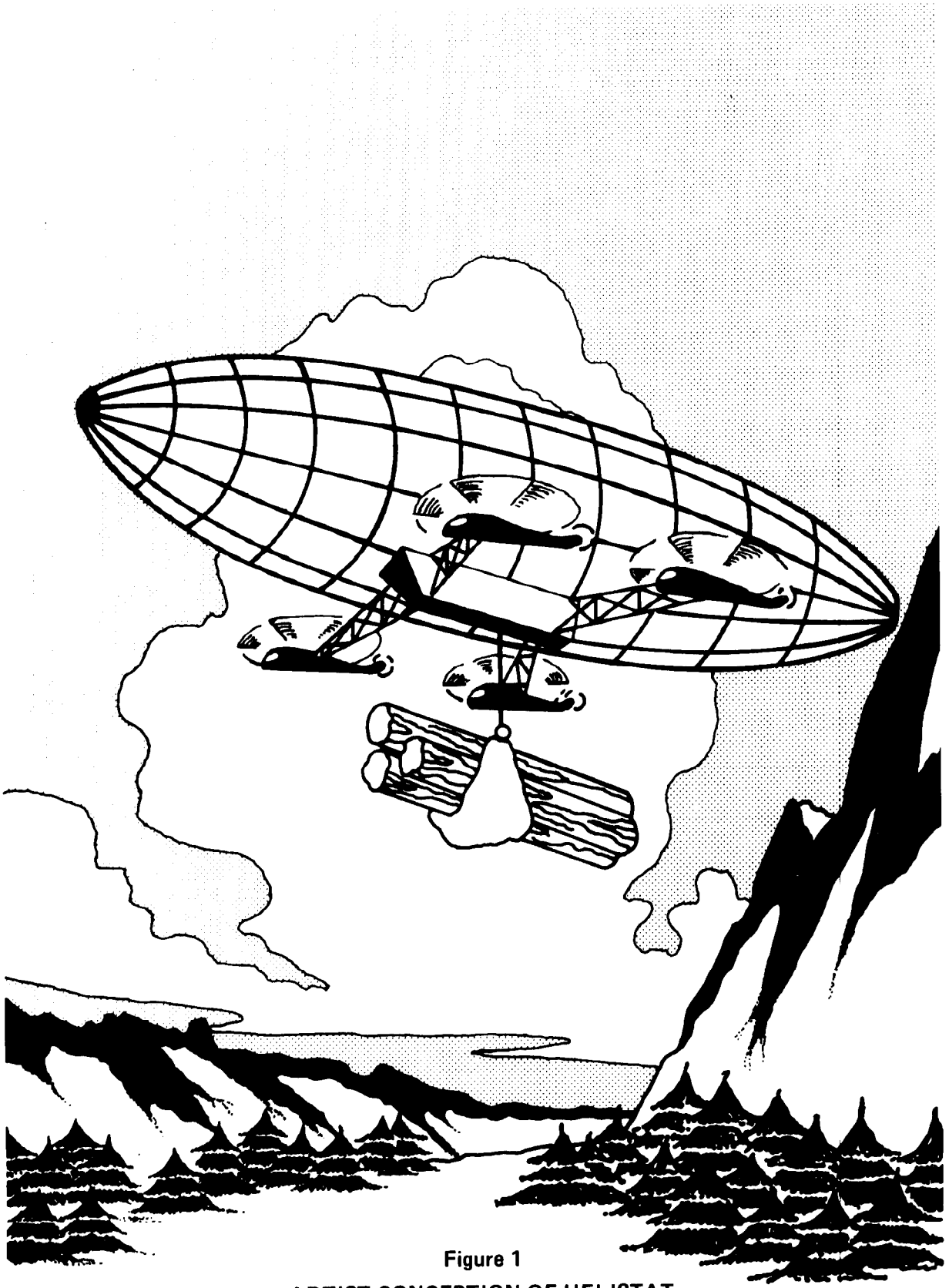
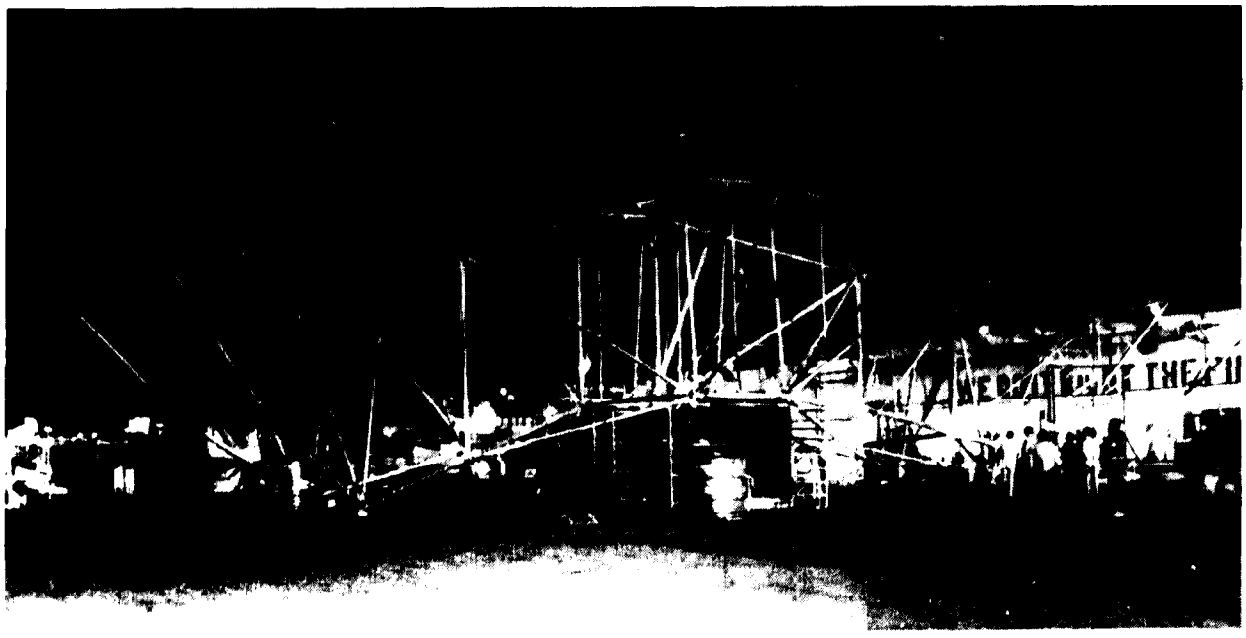


Figure 1

ARTIST CONCEPTION OF HELISTAT

ENCLOSURE II

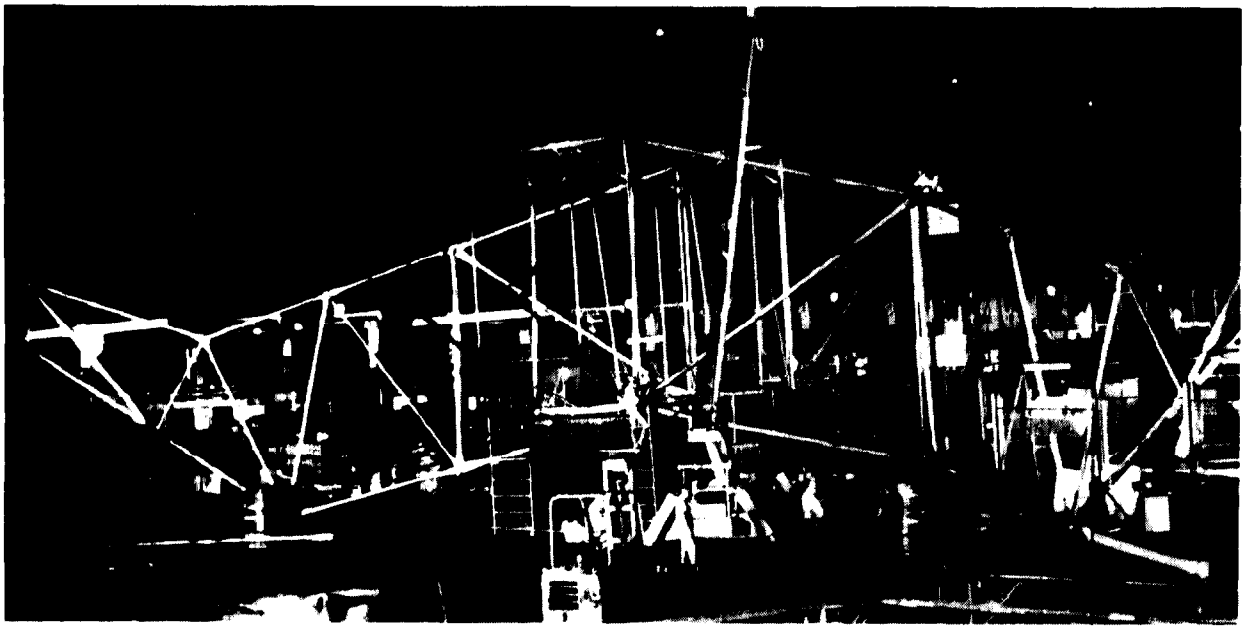
FIGURE 2



SOURCE: PIASECKI AIRCRAFT CORP.

HELISTAT INTERCONNECTING STRUCTURE UNDER CONSTRUCTION AT LAKEHURST, N.J. NAVAL AIR ENGINEERING CENTER, SHOWING THE RADIAL ARMS ATTACHED TO THE CENTER GONDOLA WHICH IS PLACED ON TOP OF AN 8' X 8' X 40' INTERNATIONAL STANDARD SHIPPING CONTAINER.

FIGURE 3



SOURCE: PIASECKI AIRCRAFT CORP.

3/4 VIEW, HELISTAT INTERCONNECTING STRUCTURE