Mission Research Corporation

FIFTH QUARTERLY TECHNICAL PROGRESS REPORT, incorporating MILESTONE SCHEDULE/STATUS

Third Quarter, 1993

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Pittsburgh Energy Technology Center
Pittsburgh, PA 15236-0940

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Contract No: DE-AC22-92MT92012

Title: Evaluation of Using Cyclocranes to Support Drilling & Production of Oil & Gas in Wetland Areas

Contractor: MISSION RESEARCH CORPORATION
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US/DOE Patent Clearance is not required prior to publication of this document.
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I Executive Summary

The planned program falls under wetlands area research related to drilling, production, and transportation of oil and gas resources. Specifically the planned program addresses an evaluation of using cyclocraft to transport drill rigs, mud, pipes and other materials and equipment in a cost effective and environmentally safe manner to support oil and gas drilling and production operations in wetland areas.

The cyclocraft is a proven hybrid aircraft that utilizes aerostatic and aerodynamic lift. This type of aircraft has considerable payload capacity, VTOL capability, high controllability, low operating cost, low downwash and high safety. The benefits of using a cyclocraft to transport drill rigs and materials over environmentally-sensitive surfaces would be significant. The cyclocraft has considerable cost and operational advantages over the helicopter.

The planned program has the following objectives:

(a) Define transport requirements to support oil and gas operations in wetland areas.
(b) Develop a cyclocraft preliminary design capable of meeting transport and environmental requirements.
(c) Validate cyclocraft performance by conducting subscale free-flight tests.
(d) Determine ground support requirements for the cyclocraft operations.
(e) Determine environmental impacts of the operations.
(f) Evaluate the costs, risks and benefits associated with the cyclocraft operations.
(g) Prepare a prototype cyclocraft development plan.
(h) Transfer technology developed to all relevant organizations.

In 1992, Task 1, Environmental Considerations, and Task 2, Transport Requirements, were completed. In the first two quarters of 1993, Task 3, Parametric Analysis, Task 4, Preliminary Design, and Task 6, Ground Support, were completed. Individual reports containing results obtained from each of these tasks were submitted to DOE. In addition, through June 30, 1993, a Subscale Test Plan was prepared under Task 5, Subscale Tests, and work was initiated on Task 7, Environmental Impacts, Task 8, Development Plan, Task 9, Operating Costs, and Task 10, Technology Transfer.

The parametric analysis showed that a cyclocraft, having a payload capacity of 45 tons, was the most economic and would be able to transport all of the required equipment and materials. The
selected design has been designated H.1 Cyclocraft by MRC. The preliminary design report contains descriptions of the H.1 Cyclocraft and its subsystems; options available for the final aircraft design process; performance, geometry, weights and power data; logistics and considerations relating to cyclocraft operations in wetlands. The ground support report addresses the complete H.1 Cyclocraft system, i.e. it included the need personnel, facilities and equipment to support cyclocraft operations in wetland areas.

During the report period Task 8, Development Plan, and Task 9, Operating Costs, were completed and individual reports containing results of the analyses made were submitted to DOE.

The Development Plan addresses the development of a prototype H.1 Cyclocraft that is targeted for potential use in the transport of drill rigs, mud, pipes and other materials and equipment, in a cost effective and environmentally safe manner, in support of oil and gas drilling, production, and transportation operations in wetland regions of Louisiana. Specifically the report defines the engineering, design, fabrication, assembly, test and subsequent evaluations necessary to provide a flight proven H.1 Cyclocraft System for initial applications, under a limited FAA certification, in the wetland areas of interest. A four plus year development program is described, with associated discussions relevant to the MRC team that will pursue that program, its management, the projected schedule and costs, in addition to identification of the areas of risk and how the MRC team will obviate their possible effects.

Based on the results of the cost study made on operating a fleet of H.1 Cyclocraft in wetland areas and presented in the report, the following conclusions are drawn:

1. The costs associated with operating H.1 Cyclocraft, including all elements of the cyclocraft system, in support of oil and gas activities in wetlands, are projected to be very acceptable, provided adequate preparations in cyclocraft design and operation planning are made.

2. In comparison with heavy-lift helicopters, e.g. MI-26, the H.1 Cyclocraft System’s operating costs would be extremely low, i.e. probably less than 15%. This suggests that the economy of cyclocraft operations would result in it operating in a much broader range of applications, than for heavy-lift helicopters, which can only be used very sparingly.

3. Opportunities exist for reducing the projected H.1 Cyclocraft operating costs further. Specifically appropriate measures in the design of the cyclocraft and its cargo handling system, together with care in operations selection and planning, could result in lower costs than those for the basic scenario.

4. Particular opportunities for cyclocraft operating cost reductions are associated with minimizing cargo handling times and limiting transport flight distances, while maintaining a high load factor.

In addition to completing Tasks 8 and 9, work was continued on Task 5, Subscale Tests, Task
7, Environmental Impacts, and Task 10, Technology Transfer. A Summary Annual Report was prepared and submitted to DOE and preparation of the Final Report was initiated.
II Introduction

A major contributor to the U.S. Department of Energy’s Enhanced Oil Recovery (EOR) Research Program would be the development of a means to extract oil and gas from wetland areas in a cost effective and environmentally safe manner. Past activities have resulted in significant adverse environmental effects and the US Government has affirmed no net loss of wetlands as a national goal.

Traditionally the helicopter, with its vertical take-off and landing (VTOL) capability, has been used for transport of drill rigs by air when surface transport is prohibitive. The helicopter is not a satisfactory solution however because of its poor operating economics, limited payload, limited adverse weather capability, poor reliability/maintenance, poor safety and high downwash.

The cyclocraft is a proven hybrid aircraft that utilizes aerostatic and aerodynamic lift. This type of aircraft has considerable payload capacity, VTOL capability, high controllability, low operating cost, low downwash and high safety. The benefits of using a cyclocraft to transport drill rigs and materials over environmentally-sensitive surfaces would be significant. The cyclocraft has considerable cost and operational advantages over the helicopter.

The planned program falls under wetlands area research related to drilling, production, and transportation of oil and gas resources. Specifically the planned program addresses an evaluation of using cyclocraft to transport drill rigs, mud, pipes and other materials and equipment in a cost effective and environmentally safe manner to support oil and gas drilling and production operations in wetland areas.

In the current program, which has a projected completion date of 30 November, 1993, it is planned that a careful evaluation of the applicability of the cyclocraft, in the support of oil and gas drilling and production operations in wetland areas, will be made. The program was initiated in June, 1992 and no progress, other than program preparation, was accomplished in the Second Quarter of 1992. In the Third and Fourth Quarters of 1992, and the First and Second Quarters of 1993, the following ten tasks were addressed:

Task 1. Environmental Considerations
Task 2. Transport Requirements
Task 3. Parametric Analysis
Task 4. Preliminary Design
Task 5. Subscale Tests
Task 6. Ground Support
Task 7. Environmental Impacts

Task 8. Development Plan

Task 9. Operating Costs

Task 10. Technology Transfer

Tasks 1, 2, 3, 4, and 6 were completed and Tasks 5, 7, 8, 9 and 10 and were initiated prior to June 30, 1993.

Under Task 1, Environmental Considerations, the activities comprised a) compiling a historical overview of oil and gas activities and impacts in wetland areas; b) compiling information on present wetland access practices; c) cataloging past and present environmental impacts of oil and gas operations in wetland areas; d) identification of marsh habitat considerations and e) identification of forested wetland considerations.

Specific activities for Task 2, Transport Requirements, comprised defining requirements for transporting drill rigs over wetland areas, including options for drill rig breakdown; defining requirements for transport of materials, including mud, to support drilling operations in wetland areas; defining requirements for transport of materials, including pipes, to support production operations in wetland areas; defining cyclocraft operational requirements based upon the results obtained and developing criteria for evaluating cyclocraft operations in wetland areas.

The scope of the work accomplished under Task 3, Parametric Analysis, was to modify the existing computer-based cyclocraft design model to be representative of the subject application. The model was then to be used to determine the most cost effective cyclocraft design, by studying a broad range of operational parameters. Specifically, different values of maximum payload capability and operating time between refuels, were evaluated. From these trade-off studies, the most economic cyclocraft design was selected.

In Task 4, Preliminary Design, the results of Tasks 1, 2 and 3 were used to define the selected cyclocraft configuration more precisely. Specifically the task included preparation of descriptions of the H.1 Cyclocraft and its subsystems; identification of the options available for the final aircraft design process; preparation of performance, geometry, weights and power data; and analysis of logistics and other considerations relating to cyclocraft operations in wetlands.

The report on the work accomplished in Task 6, Ground Support, contains a determination and description of the ground support requirements for the heavy lift cyclocraft operations in wetland areas. In the report all phases of the operations are addressed. The requirements for base facilities are defined; these comprise a Home Base, Forward Bases, Truck/Barge Landings and Inland Barges for Poly Pipe. The Home Base location is to be the Unifab complex at New Iberia, Louisiana, where the cyclocraft will be assembled. The report also defines the specific equipment and personnel required at each location to support the operations.
During the Third Quarter of 1993, the intent was to:

(a) Complete Task 8 and 9.

(b) Continue Tasks 5, 7 and 10.

(c) Initiate preparation of the Final Report.
III Project Description

The scope of the planned evaluation program is to include a determination of the environmental impact of operating cyclocraft in wetland areas. In addition, validation of the aircraft’s operational capabilities will be obtained, through subscale flight tests. A planned long-term development program is included, to address sponsorship of the production of heavy-lift cyclocraft. A technology transfer program is planned, to ensure that the results obtained from implementation of the program, will be communicated to all government agencies, educational institutes and business entities, that might benefit from the program.

The proposed program has the following objectives:

(a) Define transport requirements to support oil and gas operations in wetland areas.

(b) Develop a cyclocraft preliminary design capable of meeting transport and environmental requirements.

(c) Validate cyclocraft performance by conducting subscale free-flight tests.

(d) Determine ground support requirements for the cyclocraft operations.

(e) Determine environmental impacts of the operations.

(f) Evaluate the costs, risks and benefits associated with the cyclocraft operations.

(g) Prepare a prototype cyclocraft development plan.

(h) Transfer technology developed to all relevant organizations.

Mission Research Corporation is utilizing its cyclocraft technology base of theoretical and empirical data, to accomplish the planned program of evaluation of the cyclocraft in the support of drilling and production of oil and gas in wetland areas. Because of the significant potential applications of a heavy-lift cyclocraft, opportunities will be explored for cost-sharing for the prototype aircraft development.

It was planned that accomplishment of the program would be completed by 30 November, 1993, but due to delays in completing Tasks 5 and 7, a request has been made to extend the completion date to 28 February, 1994, with no added costs. Table 1 shows the revised completion dates for each remaining program task and deliverable.
IV Project Status

1. Task 1, Environmental Considerations

On October 31, 1992, a final report of the work accomplished under Task 1, Environmental Considerations, Reference 1, was submitted to the Department of Energy. The work, which was performed by Louisiana State University (LSU), addressed five subtasks as follows:

   1.1 Overview of Oil and Gas Activities
   1.2 Present Wetland Access Practices
   1.3 Past Environmental Impacts
   1.4 Marsh Habitat Considerations
   1.5 Forested Wetland Considerations

The summary of the LSU Report is as follows:

"The oil and gas industry has operated productively in the coastal zone since 1921. Oil and gas fields have been developed in all coastal habitats in Louisiana, including barrier islands, open water and bays, salt, brackish, intermediate and fresh marshes, swamps and bottomland hardwood forests. Historically 75% of all leased acreage has fallen within the coastal zone. The coastal zone now carries 50% of the leasing in the state and more than one-half production. This area has contributed $12 billion of more than $28 billion in state revenues generated from oil and gas activities. This accounts for more than 40% of the state's mineral revenues which have been generated in one-sixth of its area.

The results of Task 1 provided a basis for the cyclocraft parametric analysis and preliminary design, performed under Tasks 3 and 4 respectively.

2. Task 2, Transport Requirements

Work under Task 2, Transport Requirements, was also completed in October 1992. A report on the acquisition of data on the transport requirements to support oil and gas drilling and production operations in Wetland Areas, Reference 2, was also submitted to DOE in early November. The report contains data acquired from a large number of sources. The data acquired shows compatibility between the payloads to be carried and cyclocraft capabilities.

The Task 2 report is broken down into eleven major sections, as follows:

   1. Introduction
   2. Oil and Gas Drilling in S. Louisiana
   3. Considerations for Cyclocraft Operation
   4. Drill Site Preparation
   5. Inbound Transportation Requirements
6. Liquid Supply Requirements
7. Non-Liquid Supply Requirements
8. Outbound Requirements
9. Production Transportation Requirements
10. Summary Transportation Requirements
11. Conclusions.

3. Task 3, Parametric Analysis

This task was initiated in July 1992, the parametric analysis was completed in December 1992 and a report on the methodology and results of the analysis, Reference 3, was submitted to DOE in January 1993. Modifications were made to the algorithms in the computer-based Parametric Design Model, to reflect the type of operations to be performed by cyclocraft in support of oil and gas drilling and production operations in wetland areas.

Application of the design model was broken down into two phases. In Phase I, runs with the modified computer model were made, for nine parametric combinations. From the results of the Phase I study, two conclusions were drawn:

1. There is no economic benefit in utilizing a cyclocraft that has a payload carrying capability greater than the minimum value of 90,000 lb.

2. The most economic cyclocraft would have a relatively low endurance, i.e. less than 8 hours.

Based upon the results of the Phase I study, it was decided to limit the Phase II work to the minimum acceptable payload of 90,000 lb. Because Phase I results indicated that the optimum cyclocraft would not be encumbered with a large fuel weight, the additional values of endurance selected for study, to determine the optimum fuel weight at a payload of 90,000 lb, were 2 hours, 3 hours, 5 hours and 6 hours.

From the results of the Phase II work, the cyclocraft that has an endurance of 5 hours was shown to be most economic in the defined support mission. This parametric design was selected as baseline for future work.

4. Task 4, Cyclocraft Preliminary Design

This task was initiated in October 1992 and completed in May 1993. The selected cyclocraft design, designated H.1 Cyclocraft, was defined. A report, Reference 4, that contained the results of the preliminary design work, was prepared and submitted to DOE.

The basic requirements postulated for the operation of the H.1 Cyclocraft in wetland areas are summarized below:
1. Operation of the H.1, together with the deployment of its support systems, must result in no long-term adverse impact on the wetlands environment.

2. The H.1 must be able to transport all items of standard equipment and materials that are utilized in oil and gas drilling and production operations, without resorting to expensive and time-consuming breakdown of components.

3. The H.1 shall be able to pick-up and deposit its payloads while in a hover mode of operation.

4. The H.1 shall perform its support operations at a cost that is acceptable to industry.

5. The H.1 shall be able to operate from any cleared level area, without the provision of expensive facilities and/or support equipment.

6. The H.1 shall be able to avoid or withstand all adverse weather conditions that may exist in the designated areas of operation.

7. The risks associated with developing the H.1 Cyclocraft, so that it will perform its defined duties in a reliable and economic manner, shall be minimal.

The MRC approach was to ensure that the H.1 Cyclocraft fully meets all of the above mandatory requirements, together with design optimization that provides for minimum operating cost.

The selected H.1 Cyclocraft configuration has a payload capacity of 45 tons, an endurance between refuels of 5 hours, an altitude capability of 2,000 feet and a maximum airspeed of 68 mph. Note that cyclocraft technology could provide operational capabilities far in excess of those of the H.1, but the latter rather modest capability results in the most economic support operations. The H.1 Cyclocraft has the following major design characteristics:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum weight</td>
<td>128.2 tons</td>
</tr>
<tr>
<td>Empty weight</td>
<td>77.6 tons</td>
</tr>
<tr>
<td>Overall cyclocraft length</td>
<td>345 feet</td>
</tr>
<tr>
<td>height</td>
<td>170 feet</td>
</tr>
<tr>
<td>width</td>
<td>151 feet</td>
</tr>
<tr>
<td>Aerostat volume</td>
<td>3,637,230 cubic feet</td>
</tr>
<tr>
<td>Installed power</td>
<td>5,404 SHP</td>
</tr>
</tbody>
</table>

5. Task 5, Subscale Tests

In this task, there are three subtasks, i.e. modification of the existing dual-rotor, remotely-controlled, 42 ft cyclocraft to be more representative of the H.1 Cyclocraft design, flight checks
of the controllability of the modified cyclocraft and flight testing to simulate the H.1 Cyclocraft performing its support role in the wetlands.

Task 5 deals with the use of the 42 ft cyclocraft, that was designed and manufactured under the USAF contract, to demonstrate the viability of the dual-rotor cyclocraft for wetlands operations. This cyclocraft is the first of the dual-rotor configuration to be flight tested. Initiation of Task 5 was delayed for two months because the 42 ft subscale cyclocraft was still being used for the USAF program. The task was initiated in June 1993 and the activities in the report period were limited to modification of the craft and the preparation of a Test Plan, Reference 10.

The three basic objectives associated with the Subscale Model Test Program are as follows:

(a) To demonstrate the feasibility of operating a dual-rotor cyclocraft.

(b) To acquire additional data that can provide a basis for the design of future dual-rotor cyclocraft.

(c) To demonstrate the potential operational capability of heavy lift cyclocraft.

The current cyclocraft design, which was based on a small unmanned cyclocraft for the USAF, is not representative of the heavy lift H.1 Cyclocraft in one basic respect. Heavy lift cyclocraft generally utilize a higher proportion of aerodynamic lift than those that have no need operate with and without a payload. During cyclorotor tests made under the USAF-sponsored program, the aerodynamic lift was measured at 29 lb per cyclorotor, at a cyclorotor speed of 24 rpm. The cyclorotors were designed for 30 rpm operation, but because of a mismatch between the propeller design and the electric motors, inadequate propeller thrust was obtained to provide the necessary torque for the design speed of 30 rpm.

In the DOE program it was planned to replace the existing 24 inch diameter propellers, two of which are mounted on each cyclorotor, with 55 inch diameter propellers. Analysis projected that this would result in achieving the cyclorotor speed of 30 rpm, which in turn would provide for a total aerodynamic lift from 58 lb to 92 lb, for the two cyclorotors. Fixed pitch propellers were retained, because of the limited range of airspeed at the propeller locations during flight.

The larger diameter propeller was designed and four units were manufactured. The new propeller was tested on the cyclocraft successfully. The new propeller was run at 980 rpm, i.e. close to the design speed of 1,000 rpm, and absorbed 880 watts of power. The latter represents almost the maximum power available, demonstrating a good match between motor and propeller.

It is planned that further tests will be made of the cyclocraft with the modified cyclorotors. The purpose of these tests is to run the complete cyclorotor assembly as a functioning unit. The computer controlling the wing incidence algorithms and the lead or lag of the cyclic pitch on the wings will be set for nominal lift. The cyclorotor will be run over a range of speeds and power
settings. The wing will be tufted to determine the maximum angle of attack, without flow separation, and to study the flow pattern over the wings. It is further intended to run a quantitative test will be performed on the modified cyclorotors to determine the efficiency of the cyclorotors, by measuring the aerodynamic forces attainable in terms of power input. The wing incidence algorithms will be adjusted to obtain maximum lift force. Tests will include determination of the effect of lift vector rotation on side force. The effect of downwash on the lower wing will also be measured and tests will be run to determine if variation of the incidence algorithm on the lower wing can be used to reduce downwash effects.

6. Task 6, Ground Support

Task 6 was initiated in April 1993 and completed in June 1993. A report, Reference 6, containing the results of the work accomplished under this task, was submitted to DOE in June 1993. The report contains a determination and description of the ground support requirements for the heavy lift cyclocraft operations in wetland areas. In the report all phases of the operations are addressed. The requirements for base facilities are defined; these comprise a Home Base, Forward Bases, Truck/Barge Landings and Inland Barges for Poly Pipe. The Home Base location is to be the Unifab complex at New Iberia, Louisiana, where the cyclocraft will be assembled. The report also defines the specific equipment and personnel required at each location to support the operations.

7. Task 7, Environmental Impacts

This task was initiated in May 1993 by Louisiana State University (LSU), under subcontract to MRC, and the projected completion date is has been slipped to October 31, 1993. LSU has been given the detailed results of Tasks 1, 2, 3, 4, 6, 8 and 9, to provide a basis for the determination of environmental impacts. No results from Task 7 were available at the end of the report period.

8. Task 8, Development Plan

Task 8 was started in May 1993 and completed in August, 1993. The completed development plan, Reference 8, was submitted to DOE in August 1993. The main body of the plan is arranged in eight sections, as follows:

1. Introduction
2. Background
3. Objectives/Approach
4. Ground Rules/Assumptions
5. Prototype H.1 Cyclocraft System Definition
   5.1 Airborne Platform
   5.2 Ground Support Equipment
6. Development Activities
   6.1 Baseline Package
6.2 Program Go-Ahead

6.3 Program Management
6.4 Engineering
6.5 Design
6.6 Fabrication and Assembly
6.7 Test and Evaluation
6.8 FAA Certification
6.9 Reports

7. Program Risks
8. Program Costs

The Development Plan addresses the development of a prototype H.1 Cyclocraft that is targeted for potential use in the transport of drill rigs, mud, pipes and other materials and equipment, in a cost effective and environmentally safe manner, in support of oil and gas drilling, production, and transportation operations in wetland regions of Louisiana. Specifically the report defines the engineering, design, fabrication, assembly, test and subsequent evaluations necessary to provide a flight proven H.1 Cyclocraft System for initial applications, under a limited FAA certification, in the wetland areas of interest. A four plus year development program is described, with associated discussions relevant to the MRC team that will pursue that program, its management, the projected schedule and costs, in addition to identification of the areas of risk and how the MRC team will obviate their possible effects.

9. Task 9, Operating Costs

Task 9 was initiated in May 1993 and was completed in August 1993, at which time a report, Reference 9, containing results of the cost study, was submitted to DOE.

The operating costs associated with the H.1 Cyclocraft operating in a baseline scenario were addressed in Task 3. In Task 9 a more complete study was made of the costs to be incurred in the H.1 Cyclocraft support of oil and gas activities in wetlands. The scope of the H.1 Cyclocraft operating cost study was based on perturbations about the basic scenario. The six operating parameters that were perturbed, to determine their individual impact on the H.1 Cyclocraft operating cost, were as follows:

(a) Number of cyclocraft in fleet
(b) Number of operational days per annum
(c) Number of operational hours per day
(d) Average payload carried
(e) Cargo handling time per round trip
(f) Average distance payload is carried
The values assigned to the operating parameters that were perturbated in the sensitivity studies, together with the baseline scenario values, are tabulated below:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Value</th>
<th>Other Values Studied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cyclocraft</td>
<td>6</td>
<td>2, 4, 8, 10, 12</td>
</tr>
<tr>
<td>Number of Days per Annum</td>
<td>180</td>
<td>120, 150, 210, 240</td>
</tr>
<tr>
<td>Number of Hours per Day</td>
<td>10</td>
<td>6, 8, 12</td>
</tr>
<tr>
<td>Average Payload, tons</td>
<td>40.5</td>
<td>32, 35, 38, 42, 44</td>
</tr>
<tr>
<td>Cargo Handling Time, min/rt</td>
<td>15</td>
<td>10, 12.5, 17.5, 20</td>
</tr>
<tr>
<td>Distance Payload Carried, mil</td>
<td>15</td>
<td>5, 10, 20, 25, 30</td>
</tr>
</tbody>
</table>

Based on the results of the cost study made on operating a fleet of H.1 Cyclocraft in wetland areas and presented in the report, the following conclusions were drawn:

1. The costs associated with operating H.1 Cyclocraft, including all elements of the cyclocraft system, in support of oil and gas activities in wetlands, are projected to be very acceptable, provided adequate preparations in cyclocraft design and operation planning are made.

2. In comparison with heavy-lift helicopters, e.g. MI-26, the H.1 Cyclocraft System's operating costs would be extremely low, i.e. probably less than 15%. This suggests that the economy of cyclocraft operations would result in it operating in a much broader range of applications, than for heavy-lift helicopters, which can only be used very sparingly.

3. Opportunities exist for reducing the projected H.1 Cyclocraft operating costs further. Specifically appropriate measures in the design of the cyclocraft and its cargo handling system, together with care in operations selection and planning, could result in lower costs than those for the basic scenario.

4. Particular opportunities for cyclocraft operating cost reductions are associated with minimizing cargo handling times and limiting transport flight distances, while maintaining a high load factor.

10. Task 10, Technology Transfer

Technology transfer work has been implemented since the early months of the program. In general the work falls under four categories:

(a) Meetings and telephone discussions with personnel whose work could be favorably impacted by H.1 Cyclocraft operations in wetlands, e.g. oil companies, permit authorities, drilling
companies, aircraft operators and dredging companies.

(b) Distribution of technical reports that contain the results of the individual tasks accomplished, to interested personnel, including those noted in (a).

(c) Presentation of papers at relevant symposia. One paper, Reference 7, was presented in April 1993; another was planned for presentation in 1994, at the annual meeting of the Society of Petroleum Engineers, but was not accepted by the papers committee.

(d) A symposium is planned for October or November, 1993, at which the Principal Investigator will present detailed results of the current DOE-sponsored program to all relevant personnel, including state and federal governmental, business and academic, should adequate interest be demonstrated.

11. Task 11, Reports

During the third quarter of 1993, monthly and quarterly status reports were submitted to DOE in accordance with the terms of the contract. In addition the following technical reports, which contains the results of Tasks 8 and 9 activities respectively, were submitted to DOE in August, 1993:


In addition, in July, 1993 the Principal Investigator made a status report to the DOE Contractor’s Review Meeting held at Fountainhead Resort and Conference Center. Further, the following report was prepared and submitted to DOE in July, 1993:


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V Milestone/Schedule Status

The planned and actual completion dates for each of the program milestones are presented in Table 1. The table shows that through the Third Quarter of 1993, twelve milestones were accomplished, i.e. Management, Schedule and Cost Plans, Environmental Considerations, Transport Requirements, Parametric Analysis, Preliminary Design, Ground Support, Subscale Test Plan, Development Plan, Operating Costs, First Program Review, Annual Technical Progress Report and Revised Management, Schedule and Cost Plans. The only scheduled milestones not accomplished were the Task 5, Subscale Tests, and Task 7, Environmental Impacts.

TABLE 1. MILESTONE SCHEDULE/STATUS

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<thead>
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<th>Element Code</th>
<th>Description</th>
<th>Planned Completion Date</th>
<th>Actual Completion Date</th>
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<tr>
<td>1</td>
<td>Environmental Considerations</td>
<td>9-30-92</td>
<td>10-15-92</td>
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<tr>
<td>2</td>
<td>Transport Requirements</td>
<td>9-30-92</td>
<td>10-31-92</td>
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<tr>
<td>3</td>
<td>Parametric Analysis</td>
<td>12-31-92</td>
<td>1-15-93</td>
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<tr>
<td>4</td>
<td>Cyclocraft Preliminary Design</td>
<td>4-30-93</td>
<td>5-10-93</td>
</tr>
<tr>
<td>5.A</td>
<td>Subscale Test Plan</td>
<td>5-31-93</td>
<td>6-29-93</td>
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<tr>
<td>5.B</td>
<td>Subscale Tests</td>
<td>10-31-93*</td>
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<td>6</td>
<td>Ground Support Requirements</td>
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<td>6-15-93</td>
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<td>7</td>
<td>Environmental Impacts</td>
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<tr>
<td>8</td>
<td>Prototype Development Plan</td>
<td>9-30-93</td>
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<td>9</td>
<td>Operating Costs</td>
<td>10-31-93</td>
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<td>10</td>
<td>Technology Transfer Seminar</td>
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<tr>
<td>11.A</td>
<td>Management, Sched &amp; Cost Plans</td>
<td>6-30-92</td>
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<td>11.C</td>
<td>Program Review</td>
<td>7-31-93</td>
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<td>11.D</td>
<td>Annual Technical Progress Report</td>
<td>7-31-93</td>
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<td>11.F</td>
<td>Revised Mgt, Sched &amp; Cost Plans</td>
<td>9-30-93</td>
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<td>11.H</td>
<td>Final Report</td>
<td>11-30-93</td>
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* Note that the planned completion date of this event has been revised.
VI Planned Activities

The following activities are planned for the Fourth Quarter, 1993:


2. Complete Task 7, Environmental Impacts, being performed by the Coastal, Energy and Environmental Resources Center, Louisiana State University.

3. Continue Task 10, Technology Transfer, by making presentations to industrial and governmental personnel on the operational attributes of the H.1 Cyclocraft and its applicability in wetland areas.

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VII Summary

A report that contained the results of Task 8, Development Plan was completed and submitted to DOE. The plan addresses the development of a prototype H.1 Cyclocraft that is targeted for potential use in the transport of drill rigs, mud, pipes and other materials and equipment, in a cost effective and environmentally safe manner, in support of oil and gas drilling, production, and transportation operations in wetland regions of Louisiana. Specifically the report defines the engineering, design, fabrication, assembly, test and subsequent evaluations necessary to provide a flight proven H.1 Cyclocraft System for initial applications, under a limited FAA certification, in the wetland areas of interest. A four plus year development program is described, with associated discussions relevant to the MRC team that will pursue that program, its management, the projected schedule and costs, in addition to identification of the areas of risk and how the MRC team will obviate their possible effects.

Also during the report period Task 9, Operating Costs, was completed and a report containing the results was submitted to DOE. The report shows that the costs associated with operating H.1 Cyclocraft, including all elements of the cyclocraft system, in support of oil and gas activities in wetlands, are projected to be very acceptable, provided adequate preparations in cyclocraft design and operation planning are made. Further, in comparison with heavy-lift helicopters, e.g. MI-26, the H.1 Cyclocraft System’s operating costs would be extremely low, i.e. probably less than 15%. This suggests that the economy of cyclocraft operations would result in it operating in a much broader range of applications, than for heavy-lift helicopters, which can only be used very sparingly.

Additional work during the report period comprised the continuation of Task 5, Subscale Tests, Task 7, Environmental Impacts, and Task 10, Technology Transfer. Preparation of the Final Report was initiated during the report period.

Because of the delay in the completion of Tasks 5 and 7, the contractor has requested a no-cost three month extension for program completion.
VIII Report Distribution List

Three copies of this document are submitted to the following address, in accordance with the terms of the contract:

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IX References


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