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# HUGHES AIRCRAFT COMPANY

*Culver City, California*

11230298

Contract Nonr 821(00) Phases B, C, & D

Report No. 09-176-17

Copy No. 8

# PROJECT SHARK

Monthly Status Report No 17
1 November 1953

for
The Office of Naval Research
Department of the Navy

HUGHES AIRCRAFT COMPANY
Culver City, California

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# TABLE OF CONTENTS



# LIST OF ILLUSTRATIONS

## SUMMARY

During the period covered by this report, work was conducted on a cable payout technique, on a quarter-scale model of the mine, on the design of a half-scale wind tunnel model, and on the analysis of the guidance system.

Investigations were made of a cable payout technique in which the payout mechanism remained stationary on the bottom. After the equipment was fabricated, the device was subjected to tests. The results indicated that the noise generated from this arrangement was unacceptably high. The tests, furthermore, were complicated by an unexpectedly high level of background noise. Another technique, using a dragged loop stabilized by a streamlined sheave, will be tested at the same site. If there is a substantial improvement, a new test site, where there is less background noise, will be located for the final jump tests.

A quarter-scale model was built and successfully tested in vertical jumps to verify the prediction of dynamic stability in the new 21-inch diameter configuration. Work has started on the design of a half-scale wind tunnel model of the same configuration. This model will be used for the determination of accurate values of hydrodynamic parameters.

The analysis of the guidance system, using estimated values, progressed during the past month and is being carried ahead at the present time.

## PHASE B
## SELF-NOISE MEASUREMENTS

An amendment to the contract has been received that will permit as Task 8 of Phase D, the measurement of self-noise of a new body configuration. Further investigations along this line, including the determination of a suitable measurement technique, will henceforth be considered as part of the overall acoustic problem under Phase D. The final report on Phase B will be written as time permits.

## PHASE C
## THERMODYNAMICS OF
## BLOWING WATER BALLAST

The writing of the first draft of the final report for this phase is approximately 85 percent complete, and will be continued as time permits.

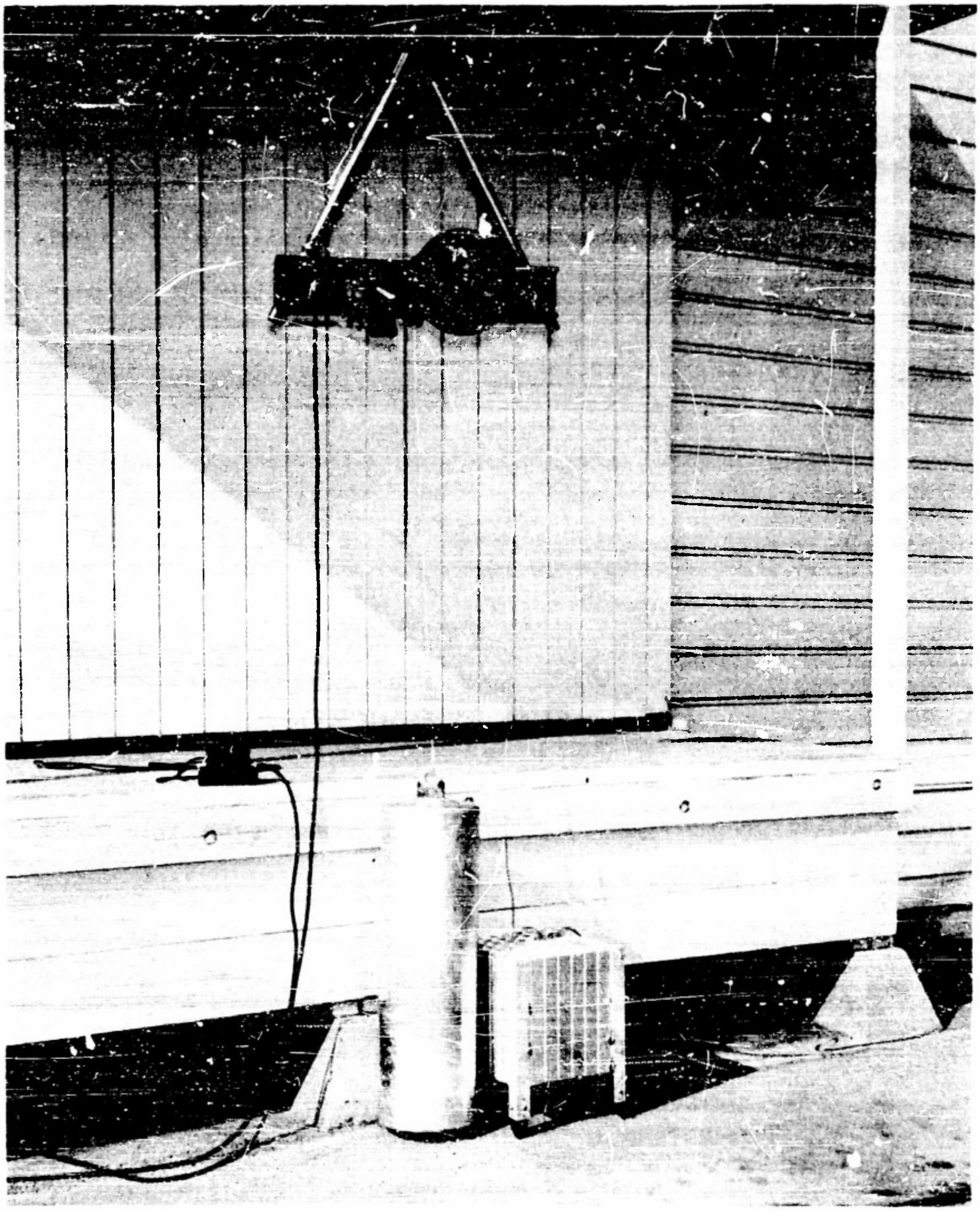

Figure 1. Equipment for Testing Cable Payout Mechanism

# PHASE D
# ANALYSIS AND SYNTHESIS OF HOMING SYSTEM

## Acoustics

Fabrication of accessory equipment for the evaluation of a new cable payout technique was completed during this report period, and tests were conducted on 26 and 27 October. The general arrangement of this equipment is illustrated in Figure 1, which shows the payout device into which the cable was inserted, the falling weight and the dropping mechanism. Figure 2 shows the installation at Morris Dam. The payout device was attached to a buoy and pulled to the bottom. The dropping mechanism was hoisted to the overhead line and stabilized with guy lines to the barges. The nose assembly with hydrophone and preamplifier was suspended at various depths alongside the cable, and its output cable was connected to the recorder on the barge.

The data from three drop tests has been analyzed, and the following observations made:

1. The present ambient noise level in the lake is higher than previously encountered, and in spite of the advantage in signal-to-noise ratio obtained by virtue of directivity in the hydrophone, the acceptability of this test condition is marginal.
2. The noise levels measured during the drop tests are appreciably above the measured ambient noise, and therefore excessive for an acceptable technique.

A different method, in which one end of the cable would be fixed at the surface, and the cable pulled in a loop of small radius behind the test

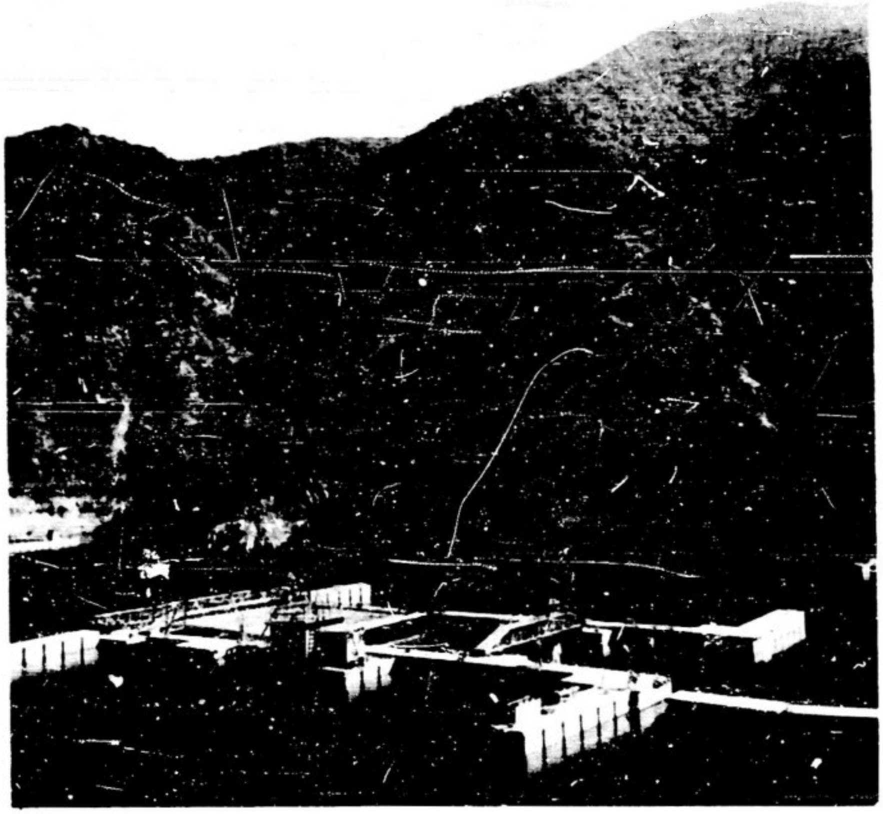

Figure 2. Test Installation at Morris Dam

vehicle, will be tried, The loop will be stabilised by a moving streamlined sheave. Evaluation tests will be conducted at Morris Dam with a falling weight, as in the previous tests. Additional required parts are in the process of fabrication. Efforts are also being made to locate a test site and facilities with an acceptably low background noise.

Hydrodynamics

Computations were made on the characteristics of a 21-inch diameter body of 6:1 slenderness ratio with inverse curvature of the afterbody and a one-caliber tail. The stability analysis indicated that with the center of gravity coincident with the center of buoyancy, dynamic stability could be realized with an optimum aspect ratio of the tail. To verify this conclusion, a quarter-scale balsa model, shown in Figure 3, was built. The model was tested at Stone Canyon Reservoir in vertical jumps from a depth of approximately 100 feet. A typical jump is shown in Figure 4, and it is evident that the model is dynamically stable. The design of a half-scale wind tunnel model has been initiated for the purpose of obtaining accurate hydrodynamic parameters for this configuration.

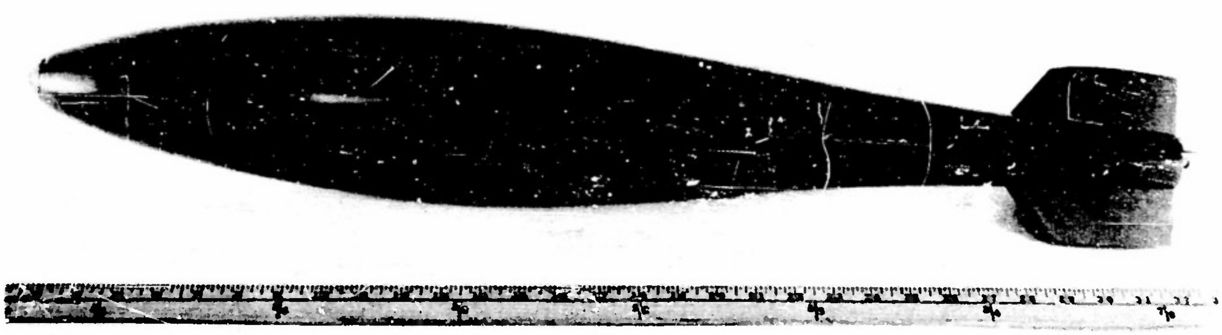

Figure 3. Quarter-Scale Balsa Model

System Studies

A preliminary inboard profile based on approximate weights and displacements of components showed that the center of gravity can be made coincident with the center of displacement in a reasonable arrangement. On this basis,

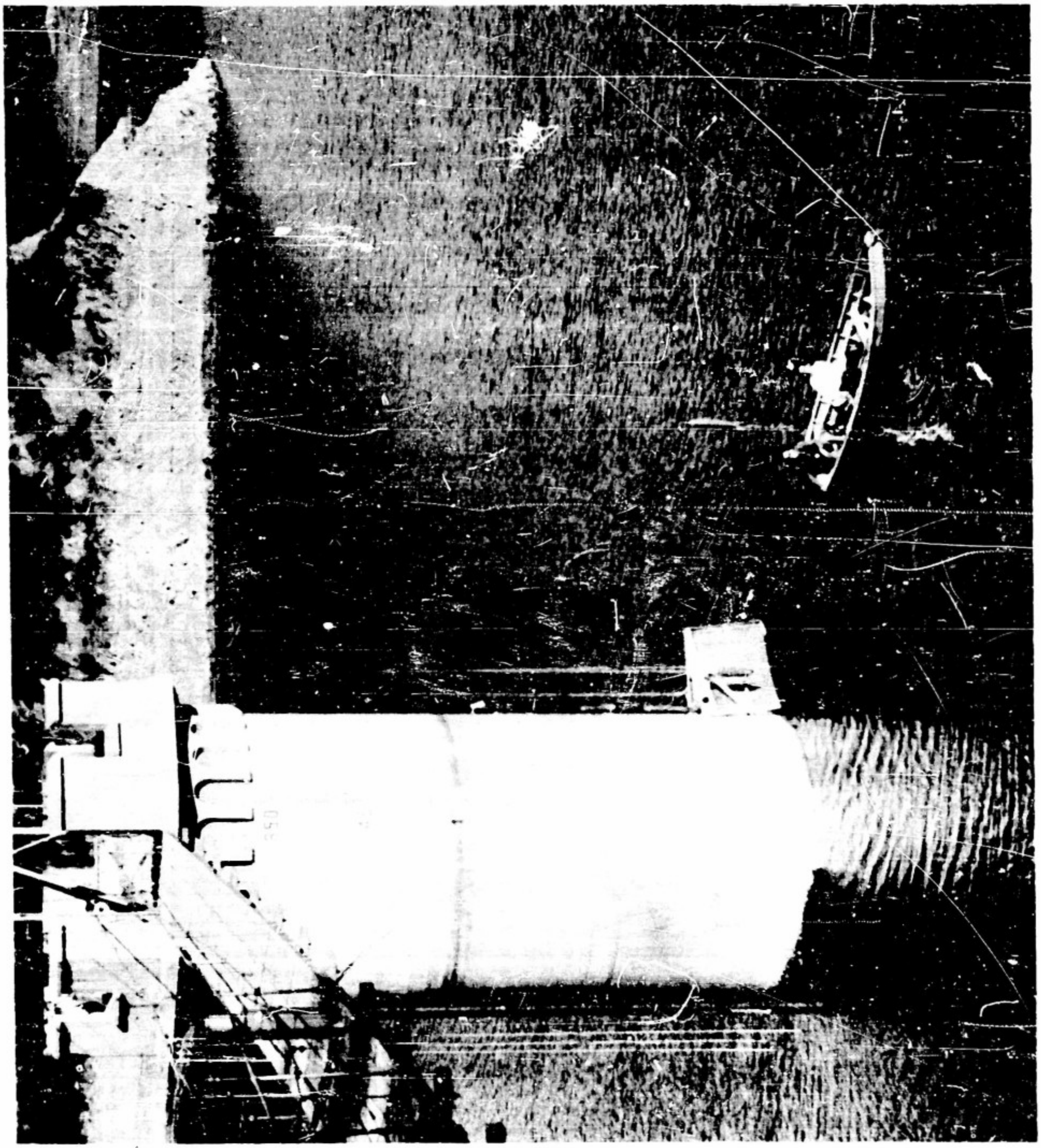

Figure 4. Jump Test at Stone Canyon Reservoir

estimates were made of moments of inertia. Tentative calculations were made of drag, speed, static and dynamic stability parameters, control effectiveness, lift, virtual mass effects, and maneuverability requirements. This information, along with general specifications on tactical requirements and environmental limitations, was supplied to the subcontractor on the system analysis. The immediate effort is to evolve a guidance system that will effect proportional navigation with these estimated parameter values. The problem will be set up on the computer equipment shown in Figure 5.

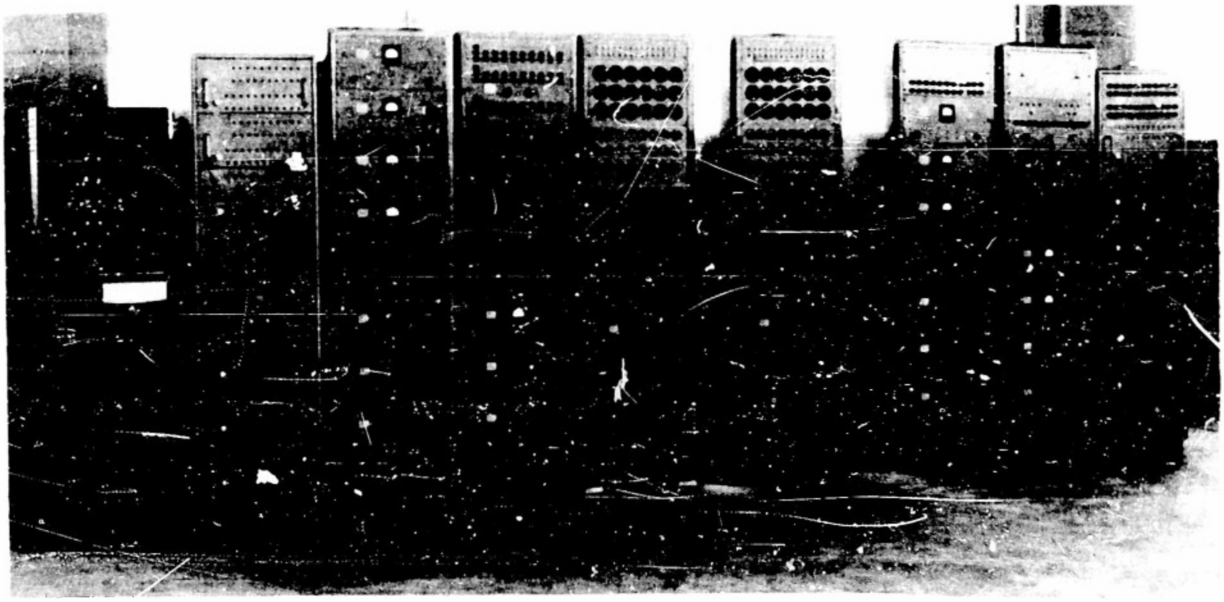

Figure 5. Computer Facilities for System Analysis

## PLANS FOR THE IMMEDIATE FUTURE

The fabrication of the additional hardware required for evaluation of the dragged loop technique is expected to be complete in another week, and tests are scheduled for the second week in November. Ambient noise readings will also be made in the Long Beach and San Clemente Ranges in anticipation of jump tests in those areas. Should the new technique prove to be unacceptable because of high self-noise, it will be necessary to reconsider the use of an on-board recorder for the jump tests.

The analysis of the homing system will be continued on the basis of preliminary estimates of hydrodynamic parameters until more accurate values have been derived from wind tunnel tests.