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PHASE II DESIGN STUDY OF HYDROACOUSTIC IMPULSE SOURCE FOR DEEP --ETC(U)
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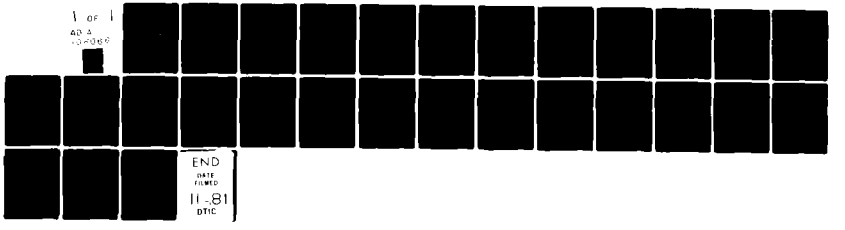

1.0 INTRODUCTION

This report summarizes the results of the second phase of a design study of the DEEPSHOCK impulse sound source for use in a deep-towed seismic profiling system. This phase of the program focused on the oil-backed impulse source identified in the first phase of the source development program. (See Reference 1.)

The plan for Phase II included the development of a dynamic computer model to quantify acoustic output of the proposed source and hardware selection based on given constraints.

Included herein is a description of the source operation, a summary of the computer model and design iteration task, a description of the source evolution, and a detailed description of the source with layout drawings and materials list.

3.0 SUMMARY OF COMPUTER MODEL AND DESIGN ITERATION

A brief summary of the computer model operation is included here. A more detailed description is included in Appendix A.

The computer program models the motion of the radiating piston by calculating its acceleration due to the forces acting on it. These forces are the differential pressure across the piston times the area, and a velocity dependent loss term. The differential pressure varies with time as the valve (latch seal) is opened and, as the piston accelerates inward increasing the internal sphere pressure. The direction of force then switches when the piston enters the dashpot and it decelerates to a stop. The program outputs the far-field pressure waveform as well as other key performance indicators.

This program was run with various sphere sizes and valve configurations, and compared with available hardware required to work within the desired constraints. These constraints, as set forth early in the program, were:

- o In-air weight $\leq$ 2000 lb
- o 3.4 km minimum operating depth
- o 30 kW maximum power input topside
- o 172 dB re 1 uPa^2 . sec/Hz @ 1 m peak spectral level
- o 200 to 700 Hz bandwidth

Due to higher than expected loss terms in the flowpath, the desired output could not be obtained within the confines of the weight constraint. Section 4.0 describes the detailed

The motor, as previously described, is a 2300 V, 1 Ø, 60 Hz, 10 hp motor and it drives a Lucas PM-500 axial piston pump at 1800 rpm. A pump mount will be designed by Hydro-acoustics Inc. to mount the motor-pump assembly together. The end of the power supply will house the manifold for the hydraulic components. These components are listed in Appendix B.

The vessel wall is 16" o.d. corrosion resistant steel pipe, ¼-inch thick. The motor-pump manifold group will be assembled on rails with plumbing and electrical connections made to the end plate. The cylinder, with its equalizing boot, will then be assembled by sliding it over the assembly and bolting to the end plate.

The electronics and starting relay will be housed in a pressure vessel maintained at atmospheric pressure with a 9 o.d. and ½-inch wall thickness. Power and telemetry signals will be fed in on a two-pin bulkhead connector and separated once inside. Separate feedthroughs will then be used to carry power and operational signals into the oil-filled power supply vessel.

The acoustic output of this source is shown in Figure 5.1. As can be seen, the peak spectral level is 168 dB re 1 uPa^2 . sec/Hz @ 1 m at 275 Hz. The bandwidth covers the range from 150 to 500 Hz.

Other relevant characteristics of this source are covered in the second column of Table 4.1.

Table 1. Constant Coefficients for the Model

M_P	Fixed mass associated with the piston
R_P	Damping resistance for piston
D_P	Diameter of piston
D_V	Diameter of latch seal
A_V	Effective fixed orifice area for inflow port
L_{US}	Upstream inertance of boot cavity and boot acoustic load
H_D	Minimum height of latch cavity
V_S	Volume of oil-filled sphere
P_H	Pressure head
DELTA P	Initial pressure differential
B	Bulk modulus of fluid in the source
R	Density of fluid in the source
C_V	Valving coefficient for the fluid in the sphere

velocity before its motion is terminated in a dashpot. Design parameters for the acoustic source and results of computer simulation are included.