UCRL-ID-126135

Post-Piledriver Concept Letter

G. C. Werth

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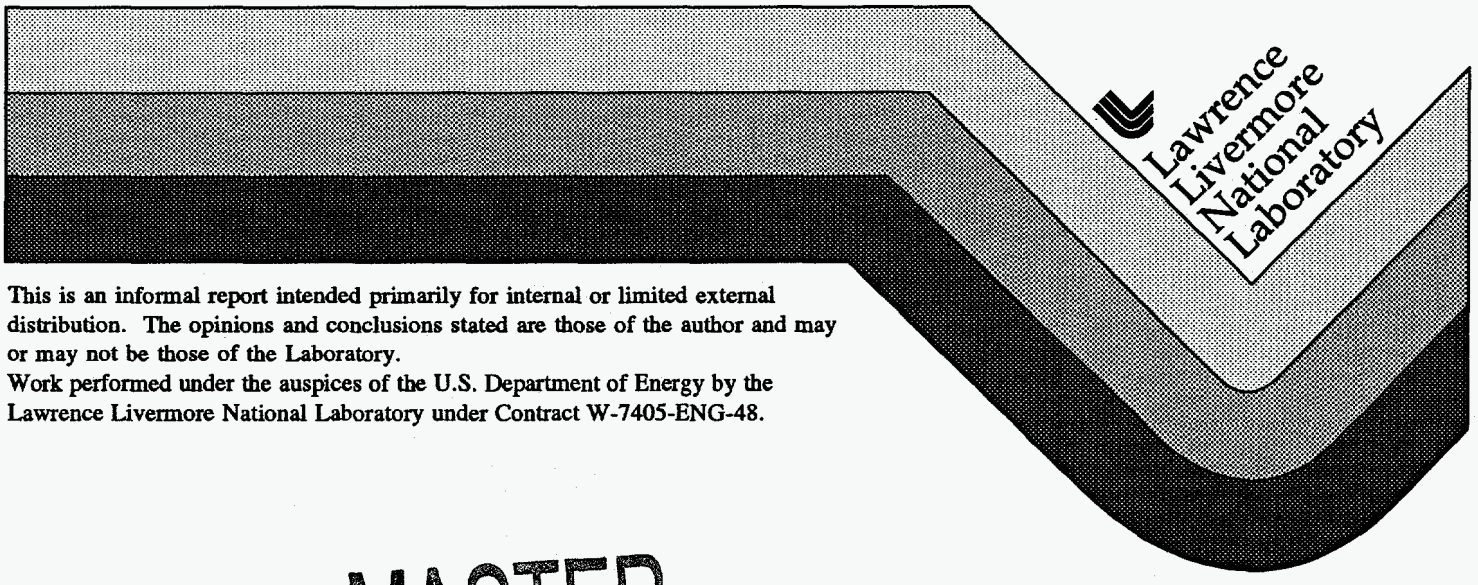
July 20, 1967



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UNIVERSITY OF CALIFORNIA

LAWRENCE RADIATION LABORATORY
P. O. BOX 808 L-13
LIVERMORE, CALIFORNIA 94550

73/330

July 21, 1967

[redacted]

Mr. John S. Kelly, Director
Division of Peaceful Nuclear Explosives
U. S. Atomic Energy Commission
Washington, D. C. 20545

Subject: Transmittal of Technical Concept for Post-Piledriver Exploratory Program

Dear John:

In response to your TWX of 20 July 1967 relative to the post-shot exploration of Pile Driver, the technical concept for this program is enclosed.

While our informal estimates indicated the cost should be well under $500 K, or the amount requiring formal project status, it is now apparent that from the formal NVOO cost estimates, full project status will be required. Your decision not to impede field operations currently underway in Phase I is appreciated and it is hoped that the necessary approval for Phase II will be forthcoming. It is our understanding that NVOO is processing a revised cost estimate based on this concept and will be forwarded to DPNE in a matter of days. It is our opinion, which has the concurrence of NVOO, that the changes will not be significant.

Sincerely,

RECEIVED
BY GLENN C. WERTH
JUL 26 1967
RADIATION LABORATORY
LIVERMORE

Glenn C. Werth
Associate Director

GCW:JT:ca
Enclosure: UOPKC 67-143, Rev. III

cc: J. Reeves, NVOO, w/encl.
J. Philip, SAN, w/encl.

[redacted]

[redacted]

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[redacted] DECLASSIFICATION STAMP ON REVERSE.

July 20, 1967

TECHNICAL CONCEPT

POST-PILEDRIVER EXPLORATORY PROGRAM

INTRODUCTION

This is the concept for a series of post-shot investigations at the Piledriver site, Area 15, NTS, to gain information on:

I. chimney geometry and associated wall rock conditions resulting from a deeply buried (1500-ft) nuclear explosion in granite;

II. the characteristics and distribution of rubble and radioactivity in the chimney;

III. data pertinent to in-situ leaching.

These categories define the three phases of this proposal in chronological order. The technical programs under Phases II and III will depend on the results of Phase I.

Presently, it is not known whether or not there has been a collapse of the Piledriver cavity. If collapse occurred, the predicted dimensions of the chimney, based on Hardhat experience, are expected to be 250 ft in diameter and 560 ft high. For the purpose of the following discussion, it is assumed this condition exists.

SUMMARY OF PROPOSED WORK

The DOD re-entry is being made through the original Hardhat-Piledriver shaft and emplacement drift. Since the Piledriver station and drift were backfilled with sand, it is expected that re-entry will proceed rapidly with little or no mining and ground support required. The currently estimated time of DOD completion is September 1967. Phase I will be initiated as soon as possible, but Phase II will not start until after the DOD has completed its post-shot study.

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TECHNICAL PROGRAM

PRE-PHASE I

As a first step, it is proposed that an LRL geologist study the current DOD work as it progresses taking photos, assessing shaft damage and earth movements, and studying the geology and hydrology as related to Plowshare's interest in Piledriver. An occasional inspection of the Hard-hat drift can be made as the DOD work progresses downshaft. There is no duplication of the work herein proposed and the DOD re-entry program.

PHASE I

1. Determine the properties and geometry of the chimney. Height and radius will be defined by a limited drilling and coring program as follows:

One vertical 8-inch ID drill hole, "A", from the surface will locate the chimney apex. Surface collar and casing able to withstand 40 psig, used in subsequent pressurization tests, will be installed from the surface down to and into competent rock. During drilling, permeability measurements of the country wall rock will be made: a) for the first 500 ft of drill hole, at approximately each 100-ft interval; b) from 500 ft on down, every 50 ft, as expedient and convenient to the drilling operation. No packers will be required for this part of the tests on drill hole "A". Increased permeability is expected to occur at a depth of about 500 ft, and contact with the top of the chimney is estimated at a depth of about 950 ft. If the results of the above integral permeability are ambiguous, packers will be used to control the measurements of permeability of the hole in 50-ft sections. As late as possible before the hole penetrates the chimney, low-level gamma and temperature logs will be run. Upon completion of the hole, a chimney gas sample will be secured, and density, caliper, temperature and downhole seismic logs will be taken. Depending on what appears appropriate, Caveman, Laval stereo-borehole, and/or TV camera surveys will then be made, and the dimensions and fracture pattern at the top of the chimney will be studied. The chimney void volume and

associated fractures and wall rock voids will be measured by the Boardman pressurization technique and the chimney volume calculated before the chimney is penetrated by the exploration drift.

PHASE II

1. Re-entry Exploration Drift and Drill Holes B and C:

It is proposed as part of Phase II of this project to extend the DOD Piledriver re-entry drift horizontally about 150 ft toward the chimney. A drill alcove will be located at this point. The elevation at the drift is about 100 ft above the Piledriver zero point. Continuation of Phase II will depend on confirmation in Phase I of the existence of a chimney. This drift will later be extended horizontally to the center of the chimney. Phase II can be started before DOD Post-Piledriver activities are complete. As this exploration drift is being extended, photographs will be taken of the working face and side walls in order to document the fracture pattern in the country rock near the chimney and visibly observe the size distribution of the rubble in place in the chimney. Samples for radiochemical analysis will be taken along this drift in the chimney area in order to establish that the chimney material is unclassified and can be treated as such.

About 200 ft of this extension drift would be in competent granite, and about 125 ft would be in the rubble inside the chimney. As in the Hardhat re-entry, this latter portion of the re-entry drift would require spiling and full ground support; the first 200 ft, on the other hand, could probably be unsupported. A standard cribbed 55° drawpoint will be installed at or near the center line of the chimney, above ground zero, for the purpose of removing several hundred tons of crushed chimney rubble.

The re-entry exploration drift will locate and establish a point on the chimney edge. Two short "NX" holes, B and C, both originating from the drilling station in the re-entry drift near the chimney edge will define the cavity bottom and upper shoulder of the chimney (see Fig. 1).

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Drill hole B should penetrate the chimney near the lower edge of the cavity in such a way as to sample the region inside the chimney in the puddle glass. Full core recovery is requested from both holes. Part of F core may be classified material (see Part 4 to follow). Laval camera surveys will be run on holes B and C to determine parting and fractures in that area. In addition, the orientation of selected sections of cores from hole B from the region outside the chimney will be determined. During drilling, these holes will be pressurized, and permeability measurements will be made under controlled conditions. Gamma and temperature logs for holes B and C will also be run. Comparison will be made between these post-shot data and similar pre-shot data from both Hardhat and Piledriver.

2. Determination of the size distribution of the rubble in the nuclear chimney in the area near the center, in the area near the chimney edge, and at some point higher in the chimney well above the Piledriver zero point:

A total of twelve samples would be required: four (A, B, C and D) from each of the three locations. Each sample should weigh about twenty tons. Two samples, C and D, from each location will be set aside for treatment as described under sections 3 and 4 to follow.

The remaining two samples, A and B, from each location will each be separated into the 16 (or fewer, as deemed reasonable) different-sized fractions used by the U. S. Army Corps of Engineers, WES, in their screen analyses of NTS rubble. Each of these 20-ton samples will be spread out, one at a time, for photography and limited hand sorting in a protected, covered area on the surface. The minus-7-inch fractions will be separated by passage through a portable screening plant at the surface, with no mud loss or dusting, and with communition held to a minimum. Each fraction must be air-dried, weighed, and treated separately and the size distribution determined.

The samples from the area high in the chimney should be taken only after several hundred tons of rubble have been withdrawn from the drawpoint--the exact moment to be determined by the person responsible for

technical direction of this project. This chimney rubble is not expected to be security-classified material, nor should it be sufficiently radioactive to demand special handling.

Two additional intermediate 20-ton samples may be taken at 40-ft intervals as the mining of the drift progresses through the chimney rubble. Likewise, one additional intermediate 20-ton sample will be taken as the draw-down of rubble progresses in the center of the chimney. These reserve samples will be set aside and preserved for future reference, if needed.

3. Determination of the gross radioactivity distribution in the chimney rubble:

One sample, C, from each location will be dried, weighed and the plus-7-inch sizes separated by hand. The minus-7-inch fractions will be crushed and ground and representative duplicate 100-gram samples prepared for analysis.

All of the reject will be combined with the plus-7-inch fraction and again representative duplicate 100-gram samples prepared for analysis.

These 12 sample duplicates for both plus- and minus-7-inch fractions from the 3 locations will be analyzed for Sr^{90}, and tritium gamma pulse height scan will be used to determine other prominent radionuclides.

4. Determinations of specific activities on surfaces of rubble:

The fourth sample, D, from each location will be hosed off and thoroughly washed to remove surface slimes and fines. The slimes and fines and wash water will be all recovered. The finely divided particulate matter will be separated from the wash water, dried, weighed, and assayed. This dried particulate will be radiochemically analyzed for strontium; pulse height scan of this material will also be made for cesium and other gamma activities. The soluble radionuclides in the wash water will also be determined.

5. Determination of the device yield by radiochemical analyses of a core sample from hole B:

Los Alamos (C. Brown) has indicated that they will do the analysis providing a proper sample is supplied. A fission product analysis will be performed by LRL in order that a material balance can be attempted.

6. Measurement of the permeability of the country wall rock as a function of distance from ground zero along the re-entry drift adjacent to the chimney:

Forty 50-ft-deep, 3-inch-diameter long-holes drilled in the sides of the drift will be packed off, pressurized, and have flow measurements made. These data will be compared with similar data from the Hardhat re-entry drift previously reported (UCRL-14292, Boardman/Skrove).

7. Determination of microfracturing, density, porosity, and permeability of pieces of rubble and cores from different locations and distances from zero point.

PHASE III

1. A series of laboratory-scale batch leaching tests on selected Piledriver rubble samples to establish:
   a. acid consumption
   b. solubility of selected radioactive nuclides in acid or acid ferric-sulphate leach
   c. the results of film percolation leaching versus flood leaching
   d. solubility of selected radionuclides in crude oil
   e. the leachability of the thorium contained in granite and if it can be recovered from chimney rubble by the ORNL solvent extraction process.
2. The design and estimation of the cost of a one-tenth scale commercial pilot plant:

There will be a Hazards Control safety program which will include a continuing surveillance for radiological safety on all working areas underground. Activity levels of "ores" and solutions must be monitored continuously.

TIME AND COST ESTIMATE

The drilling of the vertical hole A from the surface should start as soon as possible. The mining work would start when the DOD relinquishes the re-entry drift now being planned for the DOD post-shot evaluation of Piledriver but not before drill hole A and the pressurization tests are complete.

On the basis of information currently available, it is the opinion of LRL that this project as proposed will provide information on radioactivity, permeability, size distribution, and precautionary industrial hygiene necessary for commercial processing of radioactive rubble.

DDR:mc

SUBJECT	SKETCH	JOB ORDER INFORMATION	JOB NO.	TAG NO.
	LAWRENCE RADIATION LABORATORY		SERIAL NO.	NO. REQD.
DRAWN BY	[redacted]		DATE ISSUED	DATE REQD.
DATE / BUILDING NO. / ROOM NO.	APPROVED BY / DATE		DELIVER TO	

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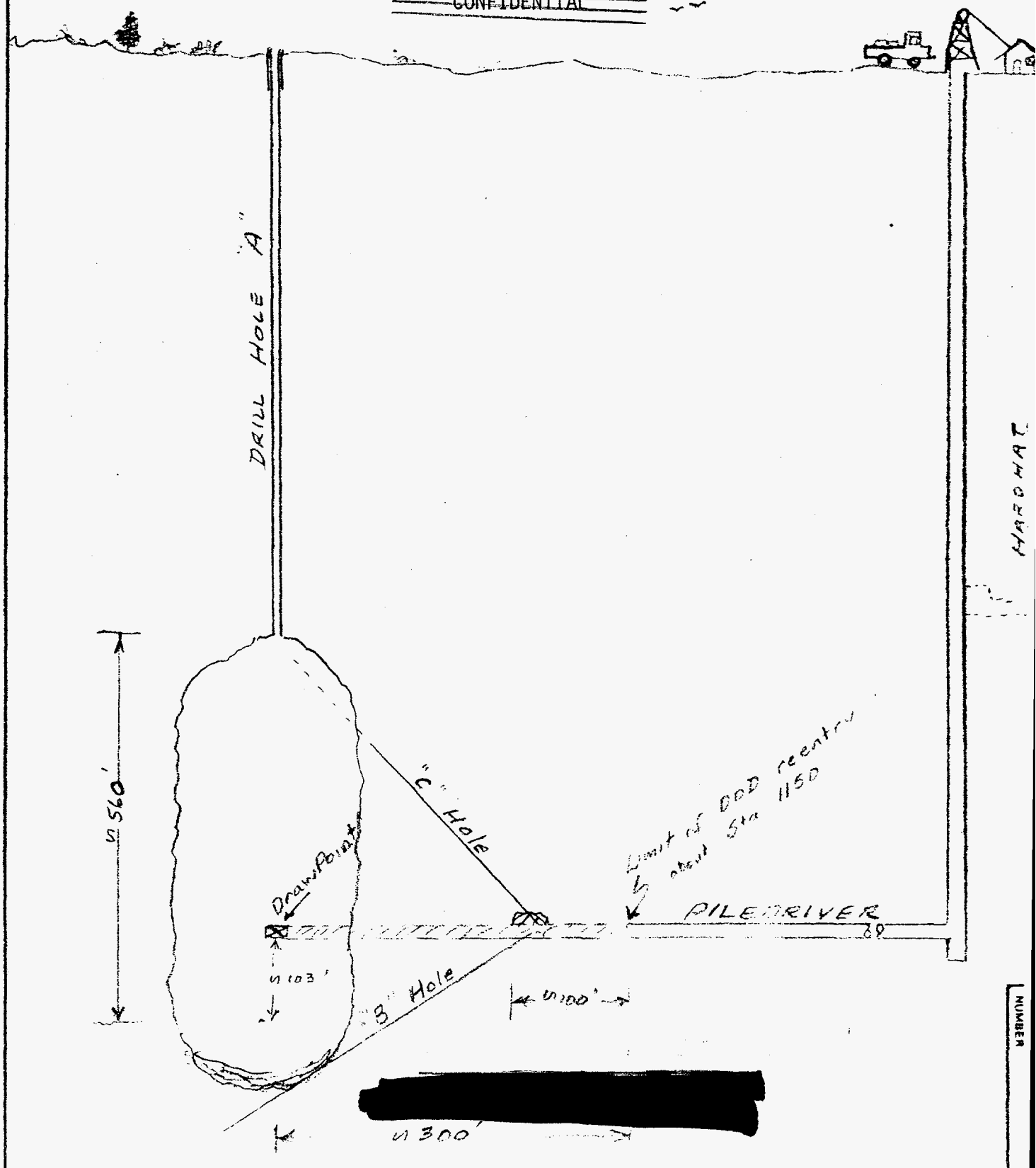

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FIG 1.

NUMBER

RL-112