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UNIVERSITY OF CALIFORNIA

RADIATION LABORATORY
P.O. BOX 808
LIVERMORE, CALIFORNIA

December 18, 1953

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~~U.S. ATOMIC ENERGY COMMISSION~~
~~BY Kenneth Ball for J.J. Flaherty~~
~~DOCUMENT NO. CXXII- 12-811~~

Mr. J. J. Flaherty, Manager
San Francisco Operations Office
U. S. Atomic Energy Commission
200 Bush Street
San Francisco, California

Dear Mr. Flaherty:

The following is the proposed technical program of the DMA supported part of the University of California Radiation Laboratory for the period covering the calendar year 1954 and the fiscal year 1955. Figures in parentheses after each major heading give the approximate percentage of the direct technical personnel involved in each sub-program.

I. <u>LABORATORY BUILDUP (3%)</u>

Laboratory buildup still occupies a portion of the experienced scientists' time, working in cooperation with plant engineering and personnel. Many of the projects described below depend on facilities yet to be constructed.

II. <u>FUNDAMENTAL RESEARCH (15%)</u>

A. <u>Experimental and Theoretical Nuclear Physics</u>

This is a broad field of research being concerned largely with neutron physics and including measurement of scattering cross sections, inelastic cross sections, and various reaction cross sections in light elements (fuels), heavy elements (secondary reactions in tamper material), and medium elements (of interest in diagnostic work); some charged particle reactions of general interest are also being investigated.

B. <u>Magnetohydrodynamics</u>

Research in this field is at present largely theoretical and has as its objective understanding the interaction of plasmas with magnetic fields with particular application to the controlled thermonuclear reactor program.

C. <u>Radiochemistry</u>

Fundamental research in this field involves investigations of the properties of fission products and the distribution of fission products as produced by various energies of neutrons and research in the chemical and nuclear

[redacted]

properties of transplutonic elements. This latter research has been especially stimulated by the production of very high Z elements in thermonuclear explosions and also by the production of by-products from bomb tracer element preparation.

D. Equation of State and Hydrodynamics

Research in this field includes theoretical investigation of the properties of material at the very high pressures and densities attained in thermonuclear explosions and experimental investigations of equations of state in the low pressure range as produced in high explosive compressions. The theoretical part of this work is done partly by contract with the Rand Corporation. The experimental part will be done at our planned remote site when it becomes operational, and will use the equipment described below in III-F.

E. Opacity

Theoretical research on the opacity of materials in the very high temperature and densities attained in thermonuclear explosions will also be done. Part of this work is also being carried out by Rand under contract to us.

F. Mathematics

Research in this field is largely involved with investigating methods for solving the complex problems involved in the various [redacted] systems we are considering for application in two stage bombs.

G. Physical and Inorganic Chemistry

Studies of the properties and preparation of various [redacted] deuterides will be continued. The practical objective of this work is to produce a compressible material with as high an initial hydrogen density as possible.

H. Controlled Thermonuclear Reactor

Experiments concerning the possibility of containing very high temperature low density plasmas in which controlled thermonuclear reactions may take place will be increased in this time period. (Reference CEA-412 dated 10/26/53).

III. RESEARCH TECHNOLOGY - GENERAL (6%)

A. Accelerators and Accessories

The one-half million volt Cockcroft Walton is now successfully operating and will be used largely in connection with II-A above. The 90" cyclotron is under construction and when finished will also be used largely in connection

with II-A above. Various accessory gear is being developed and constructed, including neutron detectors, velocity selectors, reaction detectors of various sorts, gamma-ray spectrographs, etc.

B. Computers

UNIVAC has been in Operation since April, 1953 and is being maintained by our Electronics Engineering Group. Also in use at present are several IBM CPC units. We will be placing in service an IBM 650 on about September 1, 1954 and an IBM 701 on about April 1, 1954. The computing group is working on the problem of building up a library of sub-routines for use on all these machines.

C. Sub-Critical Facilities

A safe facility for checking the non-criticality of device assemblies and measuring critical masses has been designed and is expected to be available on about June 15, 1954. Several measurements of this kind have been made using temporary facilities; namely measurements of neutron multiplication have been made for the Upshot [redacted] Some of the equipment used in these measurements will be transferred to the permanent facility.

D. Cryogeny

A temporary cryogenic facility has been set up and has been used in connection with the [redacted] device. A permanent facility has also been designed although final details concerning what, if any, cryogenic problems are most important clearly has to wait until after the completion of the Castle program. Due to this uncertainty the laboratory has had to plan on being prepared to go either way, i.e., be able to produce test devices heavy in cryogeny or having only enough to do normal back-up work required in a balanced research laboratory.

E. Chemical Engineering

Methods for fabricating, handling, and storage of the various complex thermonuclear fuels will be investigated. These combinations include various mixtures of Li^6D, D, Oy, Tu, Bi, CD_2, etc.

F. High Explosive Facility

We are planning and designing a facility in which we can perform certain experiments involving compressibility and the like of various materials by H.E. equipment for making pin shots and equipment for taking fast X-ray photographs of collapsing systems is being built and will be installed in the facility, which is to be located at a remote site. The X-ray pictures should

make a satisfactory substitute for the RaLa type of measurement as applied to the various small weapons designs which we are contemplating.

G. Reactor

A reactor of the swimming pool type is being designed and should be in operation towards the end of this period. This reactor is for use in connection with detector calibrations and weapons design problems.

H. Radiochemistry

Curium 242 has proved to be a very useful bomb tracer in connection with large yield explosions. We have constructed and operated a temporary set up for purifying Curium from pile exposed Americium. A permanent facility for handling this and similar materials will be set up. The amount of activity handled in connection with Operation Castle was [redacted] This can probably be considered as typical for use in future tests.

DELETED

I. Instrumentation

Development of electronic gear for use in connection with A, D, F, G, and H above will be continued.

J. Analytical Chemistry

This group performs a large number of small analytical jobs for all other divisions and groups of the project.

IV. RESEARCH TECHNOLOGY - DIAGNOSTICS (6%)

A. Detectors

Detectors for the various radiations encountered in nuclear explosions (gamma rays, neutrons, visible light, etc.) will be further developed along with calibration equipment for use with them.

B. Photomultipliers

Work on the development of improved photomultipliers will be continued in conjunction with RCA. Special emphasis will be placed on obtaining large output currents and small dispersions in the electron transit time.

C. Electronic Recording Systems

Development of the various electronic recording apparatus will be continued and will include development of light, compact, fast oscilloscopes, log amplifiers, log attenuators, photomultiplier stabilizing circuits, fast linear amplifiers, etc.

D. Electronic Telemetering

Fast broad band telemetering systems will be further investigated. These are important in connection with doing diagnostic experiments on shots where the information must be transmitted over open water. A good telemetering system could also be used to replace the presently used coaxial transmissions line, vacuum pipes, helium boxes, etc.

E. Fast Photography

Streak cameras and framing cameras of the type developed by LASL will be further developed. The use of various kinds of electronic shutters will also be investigated.

F. Nuclear Plates

Further application of the use of nuclear plates (as in Phonex) will be investigated.

G. Radiochemistry

Radiochemical detectors have proved to be a useful means for determining certain of the partial yields in thermonuclear reactions. Further applications of this technique will be investigated. Some work on sampling methods may also be done.

H. Magnetic Transit Time

The technique of using the changes induced in previously existing static magnetic fields by the rapid motion of conducting materials in an imploding system will be investigated for use in connection with measuring the interesting part of the transit time in small weapons implosions systems.

I. Remote Diagnostic Measurements

We will make further investigations concerning the possibility of making remote diagnostic measurements by techniques such as observing the Teller light, Electromagnetic signals, use of large phosphors, reflections of radar by fireball, bhangmeter, and other techniques which may be suggested. These techniques are of special importance in connection with small, simple overseas operations.

V. THERMONUCLEAR WEAPONS RESEARCH (20%)

A. DELETED

DELETED The device has been designed so as to give information concerning how this type of implosion geometry works. (Reference Document Number CXXII-6)

Design and fabrication of DELETED is complete. Final assembly and firing will take place in Operation Castle.

B. DELETED

DELETED It is intended to be the prototype of a family of weapons using the same implosion system.

Design and fabrication of DELETED is complete. Final assembly and firing will take place in Operation Castle.

C. Equilibrium Reactions

Theoretical investigation of the burning of various fuel combinations in various geometries will be continued.

D. Experimental Investigation of Equilibrium Reactions

DELETED Experimental investigation involving the interaction of fast neutrons with DELETED systems will be started when sufficient (several kilograms) Li^6 becomes available for this purpose.

E. High Temperature Research

Experimental measurements such as the measurement of opacity and observations of certain hydrodynamic effects may be made in connection with mock-up shots at the Nevada Proving Ground.

F. Application to Intermediate Range

Investigation of methods of using Li^6 in connection with producing highly efficient explosions of less than one megaton yield will be carried out. For example, the DELETED type of system in which Li^6 DELETED DELETED than as a thermonuclear fuel will be further investigated.

G. Special Primary

Development of a primary atomic bomb designed specifically for use in connection with the two-stage thermonuclear type weapon will be attempted.

VI. SMALL WEAPON RESEARCH

Investigation of the use of hydrides alone and in combination with metals in various geometries including guns (6" to 11" diameter), spheres (12" to 18" diameter), [redacted] has been recently started and will continue throughout this period. At present this research is proceeding on a rather broad front, but may be expected to narrow down to several specific possibilities during this time. Pin shot and X-ray photograph experiments using the equipment described in III-F above will be performed using dummy cores. Measurements of the critical masses of interesting combinations will also be made using the facilities described in III-C above.

[redacted]

VII. SPECIFIC WEAPONS ENGINEERING AND DEVELOPMENT (10%)

A. [redacted]
B. DELETED

These devices are now being designed as extensions of the [redacted] into a larger [redacted] and a smaller [redacted] yield range. (Reference CXXII-9 and BY-1903) They are intended as weapon prototypes and will be provided with ballistic cases and timing and firing systems by the Sandia Corporation. The first version of [redacted] will weigh in its air drop form about 19,000 pounds. Further development on a case and on the use of a special primary should bring this weight down to 15,000 pounds. Likewise, the [redacted] in its first air drop form will weigh between 6,000 and 7,000 pounds. Further development on its case and the use of special primary should bring the weight down to about 3,000 pounds.

[redacted] is tentatively scheduled for completion at about the end of Calendar 1954 and [redacted] is tentatively scheduled for completion about the middle of calendar 1955.

C. Special Primary

The development of special primary bomb specifically for use in connection with two-stage thermonuclear weapons should lead to a considerable reduction in the weight of such devices. Several ideas have been suggested and will be further investigated theoretically. It is hoped that it will be possible to test fire such a device in Operation Teapot.

D. Small Spherical Bomb
E. Gun [DELETED]

Engineering has begun on these devices. They are tentatively scheduled for completion in time for testing during Operation Teapot and are described above under VI.

VIII. LARGE SCALE TEST PARTICIPATION (20%)

A. Castle

UCRL participation in Operation Castle involves the firing of the [DELETED] (V-A and B) and the performing of a number of diagnostic experiments in connection with these two shots: Ganex, Tenex, Alpha of primary, Radiochemistry, Phonex, Fast Photography. In addition, UCRL is performing the Ganex, Tenex, and Alpha measurements for the LASL [DELETED] shot.

B. Teapot

UCRL participation in this operation is not yet frozen. Tentative plans are to make three shots in connection with the small weapons program (possibly two spherical implosions and one shot of either gun type or [DELETED] type), one or two shots of thermonuclear mock-ups (similar to the [DELETED] of Operation Upshot), and one shot of the special primary discussed in VII-C above. Various diagnostic experiments will be performed.

IX. SMALL SCALE TEST PARTICIPATION (5%)

A. QAD

UCRL is proposing to test the [DELETED] (VII-B) in a very small and simple Pacific operation (Reference: See BY-1902). It is proposed that these weapons be air dropped and that diagnostic experiments consist of either fireball measurement or bhangmeter measurement of yield, plus radiochemical tracer experiments.

B. Small Weapons Test Shots

UCRL has at present no definite plans for making test shots of small weapons except in Operation Teapot; however, it may be advisable in connection

with the small weapon program to make independent small scale operations involving perhaps only one shot each at the Nevada Proving Ground.

Yours very truly,

Herbert F. York

HERBERT F. YORK

HFY:emc

ORIGINAL SIGNED BY
E. O. LAWRENCE

Approved by Ernest O. Lawrence

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