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A Brief History of the First Efforts of the Livermore Small-Weapons Program (U)

Lawrence S. Germain

January 2, 1991

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PREFACE

This report is one in a CNSS series that surveys the development of nuclear weapons over the past forty-five years. The unifying themes throughout the series are the technical advances and failures associated with new weapon systems, and the creation of the stockpile.

Authors, titles, and report numbers are listed below.

William G. Davey, *Free-Fall Nuclear Bombs in the U.S. Stockpile (U)*, LA-11397

William G. Davey, *Nuclear Tests Related to Stockpiled Weapons Development (U)*, LA-11402

Lawrence S. Germain, *A Brief History of the First Efforts of the Livermore Small-Weapons Program (U)*, LA-11404

Lawrence S. Germain, *The Evolution of U.S. Nuclear Weapons Design: Trinity to King (U)*, LA-11403

Lawrence S. Germain, *A Review of the Development of Los Alamos Gnats and Tsetses before the 1958 Test Moratorium(U)*, LA-11749

Raymond Pollock, *The Evolution of the Early Thermonuclear Stockpile (U)*, LA-11748

Raymond Pollock, *A Short History of the U.S. Nuclear Stockpile 1945–1985 (U)*, LA-11401

(All reports are classified Secret Restricted Data)

A BRIEF HISTORY OF THE FIRST EFFORTS OF THE LIVERMORE SMALL-WEAPONS PROGRAM (U)

Lawrence S. Germain

ABSTRACT (U)

This report, one in a series concerned with the history of nuclear-weapon research and development, describes the evolution of the design of fissile nuclear explosives at the Lawrence Livermore National Laboratory from its inception in 1952 to the nuclear testing moratorium in 1958. Nuclear tests are used as the unifying thread for the description of this evolution. The most important families of nuclear devices are identified, their evolution is outlined, and the stockpile weapons that resulted are indicated.

INTRODUCTION

Using the nuclear test program as a framework, this report describes the evolution of the design of fission explosive systems at the Livermore Laboratory up to the 1958 nuclear test moratorium. To understand this evolution one must understand the goals and limitations of the Livermore program. What were they trying to do?

Before 1952, all U.S. nuclear-weapons design was centered at Los Alamos (then the Los Alamos Scientific Laboratory; now the Los Alamos National Laboratory). The establishment of nuclear-weapons design activities at Livermore (then the University of California Radiation Laboratory; now the Lawrence Livermore National Laboratory) in 1952 offered the first opportunity for interlaboratory competition in this area. The Livermore fission-weapons program in those years was based on the assumption that it was not to duplicate active Los Alamos programs.

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The official status of such a restriction is unclear, but it was the basis of operation at Livermore. At the same

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They all worked—some better than others—but several were of limited or no practical use.

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It did serve, however, as a learning experience for the Livermore Small-Weapons Group—mostly green Ph.D.s who were complete novices at weapons design. They developed and used two-dimensional calculations, gained experience with the properties and fabrication of high explosives and fissile materials, and gained experience in nuclear field-test operations.

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The story to be told is complex. In Part I, Livermore tests are described in chronological order because this gives the best indication of the development. This sequence can be confusing; thus, to assist the reader, the tests are described in Part II in terms of families that link together in a coherent way.

PART I: CHRONOLOGICAL DESCRIPTION

Teapot

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The Livermore Small-Weapons Program thus organized a three-prong attack for operation Redwing.

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Plumbbob

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Rainier was detonated on September 19, 1957, in a tunnel in Area 12. Rainier also gave its name to the mesa into which the tunnels were dug (Rainier Mesa) and to the volcanic rocks that cap that mesa (Rainier Mesa Tuff).

58A

As more and more weapons entered stockpile and came into the hands of people less knowledgeable about nuclear design, questions about the safety of nuclear weapons assumed more importance. One of the first questions to receive serious attention was one-point safety. The requirement was that no more than four pounds of nuclear yield should be produced as a result of the detonation at *any* one point in the HE, perhaps because four pounds is small compared with the amount of HE in the various devices.

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The design physicist was repeatedly scolded for presenting unpromising results. He was urged to make the system work. As a result, he took the most optimistic view of each of the several areas of uncertainty in the design—too optimistic, as it turned out. It was only the nuclear test that revealed the overly optimistic approach. In the absence of nuclear testing, the design errors might never have been uncovered.

If there were no tests to keep the system honest, nuclear designers could be pressured into certifying designs that would not work.

As a consequence of these concerns, a series of one-point tests was conducted at the NTS called Operation 58A, which included two safety tests, Venus and Uranus, of Livermore devices. These were carried out between Operation Plumbbob and Operation Hardtack.

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There were other Livermore tests in Operation Plumbbob to which the Livermore Small-Weapons Group did not contribute.

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All were fired on Bikini Atoll. Nutmeg and Hickory were fired off the west end of Eneman (Tare) Island. Maple and Redwod were fired on a barge south of Lomilik (Fox) Island. Aspen was fired on a barge 4,000 ft west-southwest of Nam (Charlie) Island. Dogwood was fired 4,000 ft southwest of Enjebi (Janet) Island.

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Quince and Fig were fired on Runit (Yvonne) Island in Eniwetok Atoll as close to the ground as pos-

DoE b(3)

sible—the standoff of a few inches being required by the device designers to ensure that the presence of the ground did not perturb the implosion. This near-ground test was required to accommodate a fallout experiment conducted by Sandia.

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There being no other NTS soil at hand, the Fig device was emplaced in the same location—radiation field or no. The Hamilton test was fired at the top of a 50-ft wood tower in Frenchman Flat, and Humboldt was fired atop a hastily constructed 25-ft wood tower in Area 3 of the NTS.

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Laboratory interest in small, clean, and relatively clean warheads led to the testing of several unique systems.

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PART II: FAMILIES

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In these figures, arrows indicate the progression from one test to another. Many of these arrows are labeled with a number, and a brief description of the change indicated by that particular arrow is given.

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Strike 3—and the most important strike. The two laboratories decided to assign the project to Los Alamos. In those early days, there was a rather civilized process known as the pie split. Every year the two laboratory directors and their staffs would meet to decide which tasks would be undertaken by each of the laboratories. The Livermore management always returned from these meetings in exultation, feeling that they had not just taken most of the pie but also the crumbs on the table. However, as time went on the Los Alamos projects remained rock solid while the Livermore projects seemed to fall away, possibly because Los Alamos was taking the mainline projects and Livermore was taking the far out ones. In due time, the pie split went away. The laboratory directors found it increasingly difficult to reach accord, and the Washington bureaucrats could not countenance such important decisions being made in the field.

(This writer was not present at the meeting and has heard two quite different stories about what happened.

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Bradbury said he was not interested. Several of his staff said they were interested. After a caucus, they agreed to the trade.

Story No. 2 is logical. Livermore badly wanted responsibility for a high-yield strategic warhead of their design. Only by having both the primary and secondary of a major strategic warhead identified as "designed in Livermore" could the Livermore Laboratory gain the status of a full partner in the nuclear-weapons design world. In fact, in subsequent years, Livermore made a special effort to gain responsibility for strategic nuclear weapons.

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