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Blast Overpressure Research Program

***Kirtland Air Force Base
1951 – 1998***

Jaycor Technical Report J2997.74-99-106

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In compiling this brief historical overview, various reference documents were used including research summaries, facility descriptions, and material provided by the researchers themselves.

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SECTION I.

HISTORY

INTRODUCTION

The advent of nuclear blast caused a renewed interest in blast research in the United States. Thus, was the beginning of the Blast Overpressure Program at Kirtland Air Force Base, New Mexico. From the early 1950's through 1997, research on the biomedical, biological and biophysical effects of blast and shock was conducted. During this time, data essential to the understanding of the broad and complex nature of the biological effects of blast overpressure and impulse noise were obtained.

Under the leadership of Donald R. Richmond, Ph.D., Director, the Department of Comparative Environmental Biology (later known as the Biodynamics Laboratory) was established by the Lovelace Foundation for Medical Education and Research with its primary mission to conduct blast effects research. The research was under the direction of Clayton S. White, M.D., Director of Research, Lovelace Foundation and Robert K. Jones, M.D., Assistant Director of Research and Director, Blast Biology Program. Dr. Richmond directed the test site for the next 30 years. The staff of departments headed by I. Gerald Bowen, Physicist, E. Royce Fletcher, Ph.D., Physicist Edward G. Damon, Ph.D., Physiologist, John T. Yelverton, M.S., Physiologist, and Thomas L. Chiffelle, M.D., Pathologist, provided major contributions. This core of dedicated scientists and key staff members (William Hicks, Keith Saunders, Allie Shaw, Jess Hunley, Takeshi Minagawa, and Berlinda Martinez) worked as a research team for more than 30 years.

In 1989 through 1997, under the direction of Daniel L. Johnson, Ph.D., work directed toward the understanding of the auditory and nonauditory effects of impulse noise was conducted.

The Blast Overpressure Program (BOP) was operated under the aegis of the Lovelace Foundation for Medical Education and Research from 1951 through 1984, the Los Alamos National Laboratory from 1984 through 1989, and EG&G, Inc. (EG&G Mason Research, EG&G Special Projects and EG&G MSI) from 1989 through 1997.

The Atomic Energy Commission (now Department of Energy), Division of Biology and Medicine, provided primary funding from 1951 through 1964 for the investigative programs in biologic effects of nuclear blast waves. From 1960 and for the next two decades, the Defense Atomic Support Agency (later known as the Defense Nuclear Agency) provided major funding

support. Beginning in 1978 and continuing for the next 20 years, the U.S. Army Medical Research and Development Command, Fort Detrick provided the major source of funding.

From the early days of testing to simulate blast effects phenomena, the Blast Overpressure Program represented a national resource with the unique and proven capability to lead the world in the scientific study of blast effects and was used to conduct the most comprehensive work on blast biology in the world.

The primary mission of the research effort was to support programs of national interest by conducting research into the biological effects of exposure to blast overpressures. The experiments performed were designed to address some important military and civilian issues. The results obtained played a major role in the development of blast safety standards, the treatment of blast injuries, development of weapon systems, and tactics to deal with blast overpressure. For example, studies at the site examined the physical correlates of eardrum rupture, establishment of damage-risk criteria from blast, blast effects on U.S. Army tactical equipment crews, the definition of safe standoff distances for underwater explosions, and the biologic response to complex blast waves.

The safety and injury criteria developed from the investigations extending over 40 years have broad applicability and have contributed to the currently-accepted standards being used in government and industry. For example, work at the site was a key to the development of the Personnel Risk and Casualty Criteria for Nuclear Weapons Effects.

A major contribution was the development of the Nuclear Effects Slide Rule Computer in 1962, revised in 1965 and 1973.

Employing data obtained from experiments carried out at the Lovelace Foundation and tabulated for each of 13 animal species by Bowen et al., they developed an analytical framework that resulted in interspecies data scaling procedures. The data obtained from these studies enabled scientists to compile curves that related injury and mortality in relation to the maximum incident overpressure and positive duration of the blast wave. The Department of Defense, the Department of Energy, and many government contractors including the Department of Defense Explosive Safety Board used the Bowen curves for many years as a standard reference for predicting blast casualty and risk criteria.

Later work involved a systematic 8-year study for the Department of the Army to help establish the safe limits for heavy weapon noise using humans wearing hearing protection in the freefield and in enclosures. They also conducted tests to measure the physiological effects using animal models to determine the cause of physical injuries from blast overpressure and to evaluate methods for mitigating the hazards. The results of these studies added significantly to

In the area of translational effects, progress was impressive. For example, using data on over 20,000 missiles trapped during full-scale field operations at the Nevada Test Site in a way that could be recovered, weighted and the impact velocity of each determined, it was possible with the help of additional experimentation and analytical work in the laboratory to devise a model for predicting the overpressure-mass-velocity-distance-time relationship for blast-energized objects as small as tiny pieces of glass or as large as man. This pool of information relevant to weapons effects was published as "A Mathematical Model for Predicting the Displacement of Missiles and Man Exposed to 'Classical' Blast Waves" in June 1961. This was followed in 1961 by a fundamental paper entitled "Determination of Aerodynamic-Drag Parameters of Small Irregular Objects by Means of Drop Tests," covering the determination of aerodynamic-drag parameters of small irregular objects as well as those for biological subjects. In October 1963 a Weapons Test Report, "Secondary Missiles Generated by Nuclear-Produced Blast Waves," of monumental proportions was published in which data, obtained in three nuclear detonations during the 1957 test series at the Nevada Test Site and applicable to 18,000 blast-energized missiles were presented. These three papers helped form the basis for what is physically known today in the area of translational scaling to help predict potential tertiary blast hazards (displacement and impact).

Nuclear Field Tests Participation

From 1953 through 1957, members of the Lovelace staff participated in nuclear tests conducted by the Atomic Energy Commission. These tests included:

- 1953 -- Upshot Knothole
- 1955 -- Operation Teapot
- 1957 -- Operation Plumbbob

During the span of these tests, the biological effects of blast in underground air-raid shelters were studied. Also, anthropomorphic dummies were placed on the surface to evaluate the displacement hazard.

Nuclear Blast H.E. Simulation Field Tests Participation

Since 1960 through 1982, because of the moratorium for atmospheric testing of nuclear devices, the group participated on The Defense Atomic Support Agency-sponsored field tests under the auspices of the Tripartite Technical Cooperation Program (United Kingdom, Canada, and the United States) wherein TNT charges of 20, 50, 100, and 500 tons were used to simulate nuclear blasts. These shots were undertaken in the open terrain of the prairie at the Defence Research Establishment at Suffield, Canada; in the coniferous forest of Alberta near Hinton; and in the tropical rain forest in North Queensland in Australia at Iron Range. These simulations were used to confirm laboratory studies of model structures.

1961 Canada

In the 1961, 100-ton blast, the protection afforded by field shelters at various distances between 270 and 820 ft from a 100-ton surface burst was studied. The data obtained were compared to other values in the literature for short duration high-explosive pulses and with long duration.

1963 Australia

During Operation Blowdown in an Australian Forest, Lovelace researchers participated and studied the effects of blast debris, i.e., missile traps and dummies to correlate casualty production with the degree of forest blowdown.

1964-Snowball

On the Snowball Event in 1964, a 500-ton blast, Lovelace researchers participated on the U.S. biological effects trials, the U.S. experiments to study displacement and translation effects, and the impact velocity of steel spheres.

1966-Distant Plain Event

On the Distant Plain Event (1966), Styrofoam blocks were used to measure the kinetic energies associated with tree blowdown and tree fragments in the environment of a 50-ton blast in a coniferous forest. These data formed the basis for casualty and risk criteria for personnel in connection with a nuclear burst in forest terrain.

1968-Prairie Flat Event

On the Prairie Flat Event (1968), they evaluated the effects in rectangular two-man foxholes.

1970 Dial Pack Event

On the Dial Pack Event (1970) they determined the distances that dummies on the surface were displaced by the air blast. These distances were used to verify or modify an existing mathematical model for predicting blast displacement of personnel.

1972-Mixed Company Event

On the Mixed Company Event (1972), they measured the masses, velocities, and spatial densities of Plexiglas fragments inside ten helicopters at 1.2-, 2.3-, 3.5-, 5.0-, and 8.8-psi peak overpressures for the Ballistics Research Laboratory (BRL). They determined biological consequences of the fragments in subsequent laboratory studies. The Mixed Company Event also included a test to evaluate the blast displacement effects in foxholes using dummies and to obtain pressure-time records inside a foxhole in the far field.

1976-Dice Throw Event

On the Dice Throw Event (600-ton shot at White Sands Missile Range, 1976), dummies were used as human simulators and placed inside and around U.S. Army Weapons Systems (Tanks, APC, M109, etc.), inside C³ shelters, and in a drone helicopter to evaluate blast effects on the crews. A remarkable fact was that they designed and manufactured the dummies (more than 50). The results expanded the almost nonexistent database for blast effects on manned military equipment.

1978 -Miser's Bluff

On the Miser's Bluff Event (100-ton shot at Planet Ranch, Arizona) dummies were used and placed inside bunkers, trenches, and in the open.

1982-Mill Race Event

On Event Mill Race (White Sands Missile Range, 1982), the database was expanded by obtaining data on the response of crew personnel inside the M-1 Battle Tank, the M-3 Infantry Fighting Vehicle, and the Chaparral Rocket Launcher.

Combined Injury

One of the most definitive experiments carried out to explore the combined effect of primary blast and combined injury were those carried out at the Lovelace Foundation. The Program in Selected Aspects of Weapons Effects was initiated in 1960 to maintain continuity of work stemming from field work carried out for the Atomic Energy Commission, Civil Effects Test Group, as well as activities of interest to the Civil Effects Branch of the Division of Biology and Medicine. The program was mostly concerned with the comparative effects data of biomedical interest, comparative evaluations of immediate effects including those which occurred in Hiroshima and Nagasaki. The main thrust of the research effort was in compiling a data base from which risk and casualty criteria could be formulated for personnel in open terrain, in field fortifications and in other areas published in the "Army Qualitative Research Requirements and for Nuclear Weapons Effects Information." During the 1964 through 1971 period, research to supplement the studies of the biological effects of blast alone, concerning the biomedical aspects of combined injury from exposure to sublethal doses of blast, ionizing radiation, and thermal burns was initiated and supported by the Defense Atomic Support Agency. Data compiled specifically involved mortality and morbidity, mechanisms of damage, degree of performance decrement, influence of shielding and the prognosis and therapy of animals subjected to either single or multiple forms of trauma. A better understanding of these underlying mechanisms led to more accurate casualty predictions and safety criteria for the effects of nuclear weapons and catastrophic explosions of a nonnuclear nature.

The Lovelace Foundation was also tasked by the Defense Atomic Support Agency to perform a combined injury literature survey, inclusive of years 1945 to 1965, to compile information pertaining to the biologic interactions resultant from the three basic stresses administered in combination, i.e., blast, radiation, and thermal. A total of 800 articles were collected, reviewed, and abstracted.

Repeated Blast

In 1978, the Lovelace blast research, sponsored by the U.S. Army, Walter Reed Army Institute of Research, was a collaborative effort directed toward defining the consequences of repeated blast exposures. In particular, to compile the damage-risk criterion for personnel exposed to multiple blasts in the form of muzzle or breech blast from modern weapons. To do so, sheep were given 5, 10, or 100 blasts from explosive charges ranging in weight from 0.25 to 8 lb. The durations from these charge weights corresponded to those produced by mortars, medium and large howitzers. Later, a review of the results of past investigations dealing with the effects of repeated blasts on animals was accomplished. Subsequently, a study was undertaken to define the effects of multiple blasts on sheep and swine to estimate the blast overpressure levels required to produce mortality and injury in man in relation to the number of blasts.

The research on repeated blasts yielded some important findings. First, they formulated and reported damage risk criteria for personnel exposed to repeated blasts. As these criteria showed, personnel would not receive nonauditory blast injuries from muzzle blast overpressures associated with today's weapons. These findings lifted constraints on crews training with the M198, 155-mm howitzer firing the top-zone rounds and the use of the UK 81-mm mortar in the open. Second, blast injuries in the upper respiratory tract and gastrointestinal tract at overpressures well below that necessary for lung injuries were formulated and reported.

Auditory Effects (Impulse Noise)

In 1984, a study entitled "Physical Measurements of Noise Attenuation of Hearing Protective Devices for Typical Impulse Noise" was conducted. Volunteers wearing hearing protectors were exposed to impulse noise below the Z-curve. Twelve volunteers were tested involving a total of 1200 blasts.

The emphasis of this research on auditory and nonauditory blast injuries from impulse noise was continued in 1989 through 1997 (see 1989-1997).

Fuel-Air Explosives Bioeffects

In 1964 through 1976, tests were run to determine the effectiveness of fuel-air explosives both at the BOP Test Site and in Panama. There was a growing interest in enhanced blast munitions: warheads that rely on blast overpressure as the damage mechanism and not the impact of case fragments. This laboratory undertook the task to determine the bioeffects of fuel-air explosives in open terrain, in tropical rain forests and grasslands (Panama, 1965 and 1967) for targets on the surface, in foxholes and bunkers, and inside armored vehicles for the Naval Weapons Center.

Underwater Blast Effects

In 1968, an underwater test facility, 30-ft deep, was constructed for the Naval Ordnance Laboratories (NOL) at the BOP test facility on Kirtland Air Force Base, NM. The sole purpose was to study immersion blast effects and, specifically, to determine the damage parameters for underwater blast waves. The results of these tests predicted the underwater blast effects on man in terms of charge weight and range. During 1969 through 1973, two major studies were conducted. The objectives of these studies were (1) to define near-field mortality and injuries from 1/8- to 8-lb charges at selected ranges and (2) to define far-field threshold and no-injury ranges. Two key reports detailed the results: "Underwater Blast Studies with Animals" and "Far-Field Underwater-Blast Injuries Produced by Small Charges." During 1973 and 1975, two studies were conducted for the Defense Nuclear Agency (1) to determine the relationship between fish size and their response to underwater blast and (2) to determine safe distances from underwater explosions for mammals and birds. These two studies were reported in "Safe Distances from Underwater Explosions for Mammals and Birds" and "The Relationship Between Fish Size and Their Response to Underwater Blast." In addition, a study was undertaken to determine the underwater blast levels that would be comfortable to an unprotected swimmer.

In 1975, a model was developed that predicted the response of personnel to underwater-blast impulse as a function of depth. This work sponsored for the Office of Naval Research was reported in "The Thoraco-Abdominal System's Response to Underwater Blast."

In 1976, a review of the literature on underwater blast effects in man, with particular reference to its pathology, pathophysiology, and therapy was published as "A Review of the Treatment of Underwater Blast Injuries."

Physics Department

In conjunction with the Blast Overpressure Department the major effort of the Department of Physics was the study of effects of airblast on mammals. These included the implosive compression of the thorax by the overpressures per se, the blast-induced displacement of the whole body followed by decelerative tumbling or impact, and the translation by blast winds of secondary missiles such as window-glass fragments that may strike the body.

They devised mathematical analogues of the thoraco-abdominal system to further the understanding of the observed responses of the biological system and of inanimate objects to the blast environment. From the model studies, scaling concepts evolved. These models have been used in computer simulations of animal experiments and in deriving scaling laws essential in analyzing interspecies data in such a way that they can reasonably be extrapolated to man.

These studies have led to the establishment and revision of safety and risk criteria for personnel exposed to either conventional or nuclear explosions.

Thus, as far as the significant elements of similarity exist, the results obtained from airblast studies with experimental animals have been used to predict the effects of man. In 1968, using the empirical data from studies conducted at Lovelace, damage-risk criteria for primary blast effects from classical Friedlander waves, often called the Bowen Curves, were established. These criteria were reported in the "Estimate of Man's Tolerance to the Direct Effects of Airblast" technical report to the Defense Atomic Support Agency.

They developed a theoretical model to predict the motion of objects translated by winds associated with classical blast waves produced by explosions. This model is described in the report entitled "A Model Designed to Predict the Motion of Objects Translated by Classical Blast Waves," dated June 1961.

The department participated with the Department of Comparative Environmental Biology in investigations of biological injury caused by exposure to various combinations of airblast, thermal radiation, and nuclear radiation. This included the interpretation of physical factors relevant to the experiments and the statistical analyses of the results. Also, they began a theoretical study to investigate the heat penetration of mammalian skin and subadjacent tissue resulting from exposure to transient doses of thermal radiation.

Historically, the department participated in the full-scale weapons tests in Nevada in 1953, 1955, and 1957. They studied airblast effects on operations in Australia (1963), Canada (1960), and the United States, where large-scale chemical (FAE) explosions were used to generate blast waves.

In the analytical side, the Nuclear Bomb Effects Computer was developed by the Lovelace Foundation researchers in 1957. The weapon effects data incorporated in the computer were taken from "The Effects of Nuclear Weapons." A means was found to condense and present range-yield effects data for 28 parameters on a circular slide rule. The computer was an important part of the 1962 and later editions of The Effects of Nuclear Weapons, edited by Glasstone for the Department of Defense and published by the Atomic Energy Commission (now the Department of Energy). In 1972, work was directed toward completion of the revised Nuclear Bomb Effects Computer for inclusion in the new edition of The Effects of Nuclear Weapons. It was determined that it would be inadvisable to attempt to hand draw a master copy of the slide rule because of the intricate design and the need for high accuracy. A computer program was developed such that the entire rule, except for the lettering, was designed using an automatic plotter controlled by a Bendix G-15 Computer programmed to compute the range-yield-effects for the 28 parameters. More than 100 checks were made involving all of the parameters that are

included on the rule evaluated over a wide selection of ranges and yields. Each check consisted of comparing an exactly calculated value with a value read by eye from the hand-made rule. A description of the Effects Computer, including sample problems and a discussion of limitations, was prepared and included with each of the manufactured slide rules.

In 1965, their work describing the first thoraco-abdominal response to rapid pressure changes mathematical model was published. Later, in 1968, the lung model was modified to include two lung volumes and an additional mass to represent the mediastinal tissues located between the lungs in the thorax, and a single-lung version was developed in 1970.

Neurophysiology and Behavioral Science Program

Somewhat broader but related studies were also being conducted to investigate the neurophysiological and behavioral responses of subhuman primates to blast overpressure and ionizing radiation. The Defense Nuclear Agency supported these studies. The behavioral studies used unique training methods and tasks developed by Lovelace investigators, which tested for radiation-induced, blast-induced, or combined injury-induced short-term memory. These studies used subhuman primates as experimental subjects with a view to extrapolation of results to man. With this objective in mind, they designed a study to determine the decremental effects of radiation and blast on performance in monkeys. They trained monkeys to do a highly complex task, which required a short-term memory of various visual symbols. The measure of effect included not only the loss of ability to do the task but also changes in brain electrical activity and disturbances in a variety of cardiovascular physiological functions. Because of the difficult nature of the task, detecting disturbances at radiation exposure levels considerably below that seen with the use of simpler behavioral tasks were possible.

This department developed special tests of memory and decision-making abilities during complex performance tasks to assess the effects of aging on professional and retired pilots.

Also, studies included the effects of high-density electromagnetic fields on memory and performance in rats, and the establishment of a brain wave research laboratory for investigations of the neural correlates of behavior in both humans and animals.

Additional studies were conducted to delineate the biochemical alterations that occur when animals received combined forms of trauma such as ionizing radiation, air blast or thermal radiation exposure.

1984 through 1988

Operated for the U.S. Army Medical Research and Materiel Command (through the Department of Energy) By Los Alamos National Laboratory, Life Sciences Division Biodynamics Laboratory

Studies designed to study the nonauditory effects of exposure to blast overpressure begun under the aegis of the Lovelace Foundation were continued under the Los Alamos National Laboratory, Life Sciences Division, for the Walter Reed Army Institute of Research.

Biological Response to Complex Blast Waves

These studies included continued experiments to determine the biological consequences of certain components of the complex airblast waves inside structures. The data gleaned from these experiments were used as input to test a lung model.

Biophysical Response to Impulse Loading in the Freefield

A study was also conducted to evaluate the relationship between the freefield overpressure signal and the actual force loading on a shape, chest wall deformation, wave propagation, and attenuation properties of the lung. The data from this study was used as input to construct a mechanistically based procedure for translating environmental conditions into estimates of injury to air-containing organs. Animals and an anthropomorphic shape were exposed to freefield blast.

Biophysics of Low-Level Complex Blast Waves

In another study, conducted to obtain data on the biophysics of low-level complex blast waves, sheep were exposed to single or multiple low-level complex blast waves within enclosures.

Behind Armor Effects

Studies with an overall objective to develop an armored fighting vehicle vulnerability model that included crew member incapacitation from behind armor effects such as overpressure, heat, toxic gases, and flash were also conducted at the BOP Test Site. The direct blast effects produced by shaped-charge warheads and by detonating bare explosive charges inside enclosures were investigated.

1988 Through 1997

Operated for the U.S. Army Medical Research and Materiel Command By EG&G Mason Research Institute, EG&G Special Projects, and EG&G Management Systems Inc., BIOPHYSICS OPERATION

Studies designed to define the safe limits (auditory and nonauditory) for exposure to weapons noise was conducted at the Blast Overpressure Test Site, Kirtland Air Force Base. The main goal of the research was to produce a sufficient database from which new and valid blast overpressure exposure limits for multiple blasts for freefield and reverberant environments could be derived. Over an eight-year period, data were gleaned which showed that soldiers protected by earmuffs and earplugs similar to those now being fielded (CAPS/ACAPS) could tolerate blast levels well above the limits in MIL-STD-1474D for weapons fired in the open such as towed howitzers, ground-mounted mortars, and shoulder-fired weapons. A study was completed for shoulder-fired antiarmor weapons from an enclosure with similar results. The following studies were completed from 1989 to 1997:

Walk-Up Study

The Walk-Up Study represented a 5-year effort (1989 through 1993) conducted to investigate the effects of high-intensity impulse noise on human volunteers in the freefield (1-m distance, 3-m distance, and 5-m distance). Five major groups of volunteers were given a series of exposures to one of three impulse types and to three types of hearing protection. The results of this study can be found in the final report entitled "Walk-Up Study, Task Order 1" dated September 1974. (See Section IV - Bibliography.)

Biological Response to Complex Blast Waves

This study was designed to establish an injury prediction curve using severity of injury indices and smoothed peak pressure for complex blast waves. Three different enclosures were tested: 3.05 x 1.52 x 2.44 m (113 m³), 3.05 x 2.44 x 2.44 m (18.1 m³), and 4.88 x 3.05 x 2.44 m (36.3 m³). The results are reported in the final report entitled "Biological Response to Complex Blast Waves, Task Order 2," dated October 1993. (See Section IV - Bibliography.)

Nonauditory Damage Risk Assessment for Simulated Weapons Fired from an Enclosure, Parts I and II

This study was conducted to simulate a reverberant wave environment like that produced from firing an antitank weapon from a room with a volume of 18.2 m³. Anesthetized sheep were used as the test subjects. Part I of this study was designed to establish the subthreshold for 1, 3 and 12 exposures. A series of 1 shot; 3 shots, 2.5 minutes apart; or 12 shots, 2.5 minutes apart

exposures were used. Part I of this study established the subthreshold for 1 exposure and 3 exposures, however, the subthreshold for 12 exposures was not found. Part II, established the subthreshold for 100 exposures, 1-minute apart. The results of this study are reported in the final reports "Nonauditory Damage Risk Assessment for Simulated Weapons Fired from an Enclosure, Task Order 4, (Part I)" dated November 1997 and "Part II: Nonauditory Damage Risk Assessment for Simulated Weapons Fired 100 Times from an Enclosure, Task Order 5" dated October 1997. (See Section IV - Bibliography.)

Firing from a Bunker Simulation Study and Nonlinear Earplug Study

This 2-1/2 year study, using military volunteers, was undertaken to establish realistic safe limits for heavy weapon noise while wearing hearing protection (RACAL® muff and two types of nonlinear earplugs) from one to three exposures of reverberant waveforms obtained from a rocket launcher out of an enclosure. The final report "Task Order 1: Firing from a Bunker Simulation Study and Task Order 4: Nonlinear Plug Study," dated February 1997 presents the results of this study. (See Section IV - Bibliography.)

Nonauditory Damage Risk Assessment for Simulated 155mm Self-Propelled Howitzer Muzzle Blast

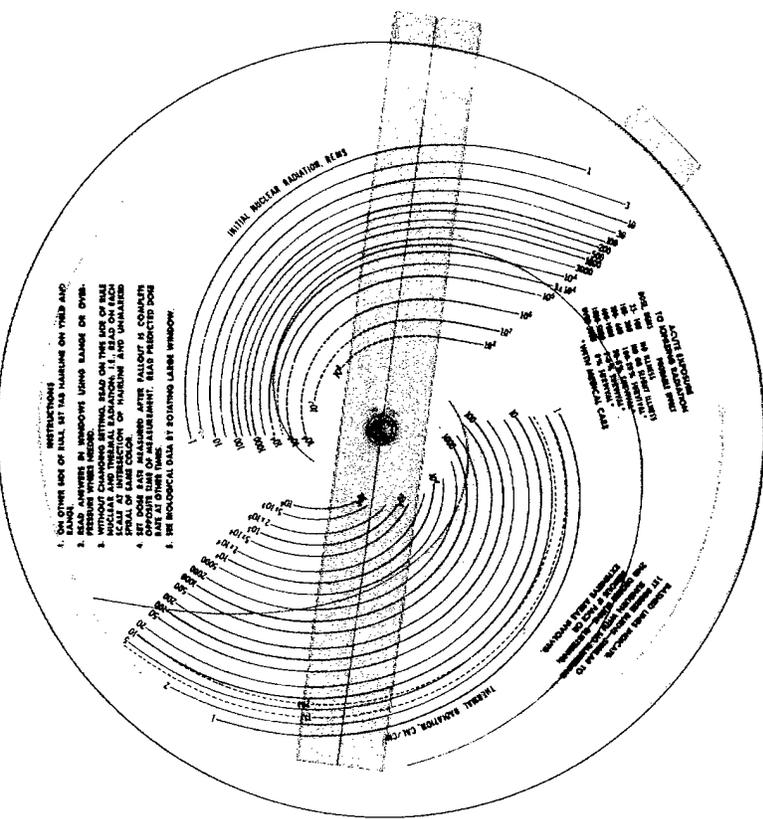
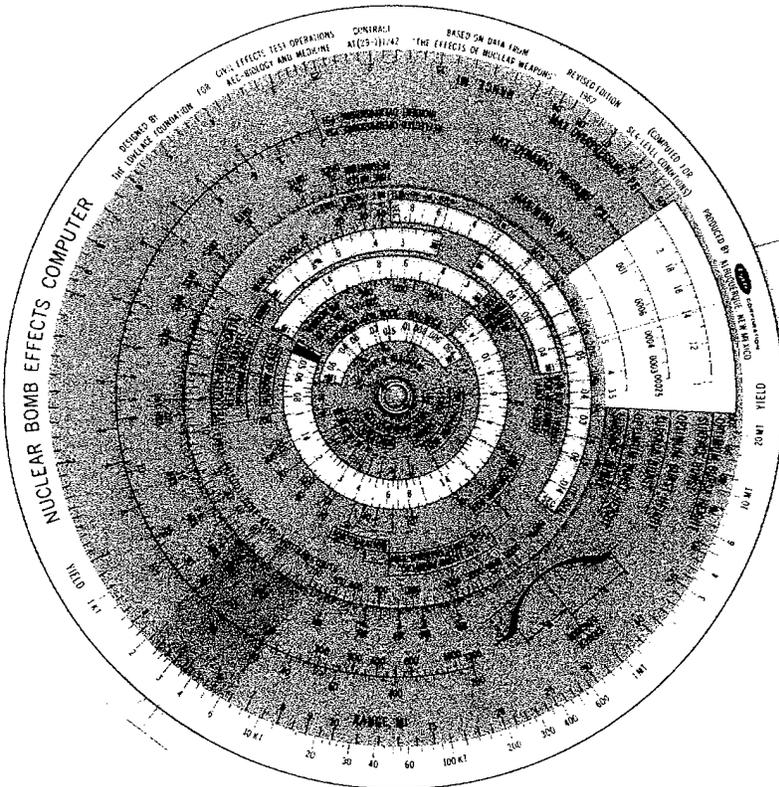
This study established the nonauditory injury subthreshold in a simulated muzzle blast environment like that produced when firing an M109 155mm self-propelled howitzer (SPH) with one or more hatches open. Anesthetized sheep were used for each exposure condition. The results of this study were reported in the final report entitled "Task Order 2: Nonauditory Damage Risk Assessment for Simulated 155mm Self-Propelled Howitzer Muzzle Blast" dated May 1997. (See Section IV - Bibliography.)

Nonauditory Damage Risk Assessment for Simulated Muzzle Blast from a 120mm M121 Mortar System

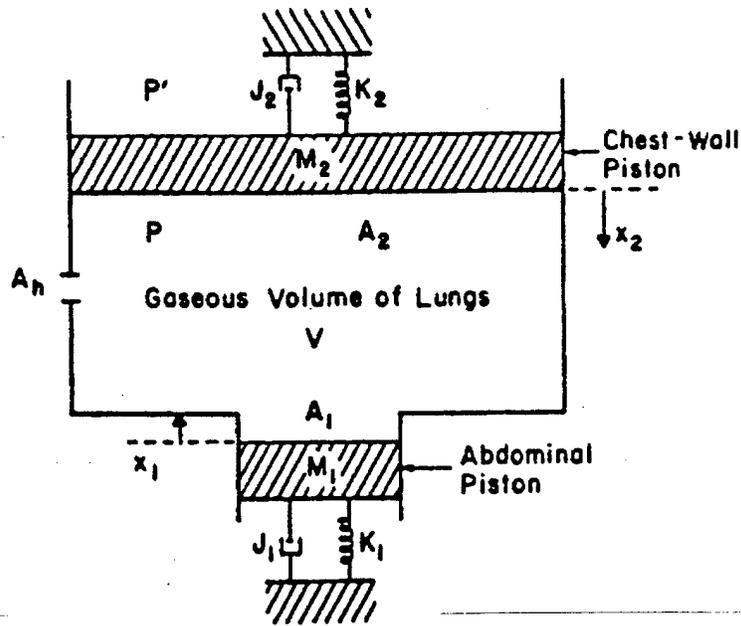
This study was undertaken to establish the subthreshold, threshold, and suprathreshold for nonauditory injuries in a simulated muzzle blast environment like that produced when firing a 120mm M121 mortar system. Anesthetized sheep were subjected to 6 or 50 exposures of simulate muzzle blast waves in 1.5- to 3.0-dB increments. The results of this study were reported in the final report entitled "Task Order 2: Nonauditory Damage Risk Assessment for Simulated Muzzle Blast from a 120mm M121 Mortar System" dated September 1997. (See Section IV - Bibliography.)

SUMMARY OF BLAST RESEARCH PROGRAM,
KIRTLAND AIR FORCE BASE, NEW MEXICO, 1951-1998

AREAS OF RESEARCH	1950	1955	1960	1965	1970	1975	1980	1985	1990	2000	
Effects of Nuclear Weapons <i>(Department of Energy)</i>	Missiles - Field Tests - Design and Production of NEW Slide Rule Computer										
Effects of Airblast <i>(Defense Nuclear Agency)</i>	Duration - Threshold Lung - Model Thorax - Ambient Pressure - Treatment Physiology - Combined Injury										
H.E. Simulation Field Tests <i>(Defense Nuclear Agency)</i>		Canada - Australia - Snowball - Distant Plain - Prairie Flat - Dial Pack - Mixed Company - Dice Throw - Miser's Bluff - Mill Race - Direct Course - Minor Scale									
Effects of Fuel-Air Explosives <i>(Naval Weapons Center)</i> <i>(Sandia National Laboratories)</i>		Laboratory and Field Tests									
Quantity-Distance Studies <i>(DOE-ESB)</i> <i>(U.S. Army/BRL/AMC)</i> <i>(U.S. Army Aero. Sys. Div.)</i>		Glass Effects - Eskimo Glass Effects - Helicopter Plexiglas Weapons System SCSS Bird Canopy - AFM-80 French Shelter									
Effects of Underwater Blast <i>(Naval Surface Weapons Center)</i> <i>(Office of Naval Research)</i>		Far-Field - Near Field									
Auditory and Nonauditory Effects of Multiple Blast <i>(U.S. Army Medical Research and Materiel Command)</i>							M198 Repeated Blast - Threshold Laryngeal - Double Peak Pressure-Impulse - Mortar - Lung Inflation - Human Walk Up - Complex Blast Waves - Kevlar Jackets Tranparenchymal - Multiple Blast - Auditory and Nonauditory Effects (Freefield and Reverberant Environments)				



P01805
 Figure 1. Nuclear Bomb Effects Computer, First Edition. (From Fletcher, E. R. et al., "Nuclear Bomb Effects Computer (Including Slide-Rule Design and Curve Fits for Weapon Effects" and "The Effects of Nuclear Weapons," 1962.)



Model Equations

$$M_1 \frac{d^2 x_1}{dt^2} + J_1 \frac{dx_1}{dt} + K_1 x_1 = A_1 (P' - P)$$

$$M_2 \frac{d^2 x_2}{dt^2} + J_2 \frac{dx_2}{dt} + K_2 x_2 = A_2 (P' - P)$$

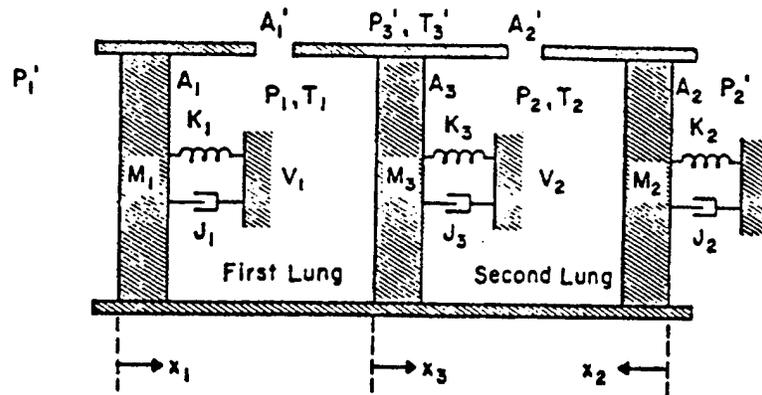
$$\frac{dP}{dt} = -\gamma \frac{P}{V} \frac{dV}{dt} \pm$$

$$\frac{1.334 \times 10^7 A_h}{V} \sqrt{|P' - P|} \text{ cgsu}$$

$$V = V_0 - x_1 A_1 - x_2 A_2$$

P01807

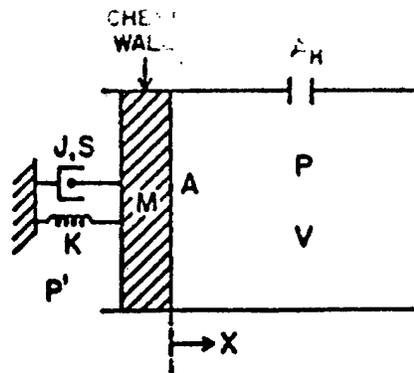
Figure 3. A Single-Lung Volume Mathematical Model. (From Bowen, I. G. et al., "A Fluid-Mechanical Model of the Thoraco-Abdominal System With Applications to Blast Biology," 1965.)



- | | |
|---------------------------------|--------------------------------|
| A_i : Effective Area | J_j : Damping Factor |
| A_i' : Effective Orifice Area | K_i : Spring Constant |
| M_i : Effective Mass | P_i : Internal Air Pressure |
| V_i : Gaseous Volume | P_i' : External Air Pressure |
| x_i : Displacement | T_i : Internal Temperature |
| | T_i' : External Temperature |

P01808

Figure 4. A Two-Lung Volume Mathematical Model. (From Bowen, I.G. et al. "Biophysical Mechanisms and Scaling Procedures Applicable in Assessing Responses of the Thorax Energized by Air-Blast Overpressures or by Nonpenetrating Missiles," 1968.)



- | | |
|--|-----------------------------------|
| A : Effective area | P : Internal air pressure |
| A _H : Effective orifice area | P' : External air pressure |
| M : Effective mass | K : Spring constant |
| V : Gaseous volume of lungs | J : Damping factor |
| X : Displacement | S : Power of velocity to which |
| V ₀ : Gaseous volume at zero displacement | the damping force is proportional |
| γ : Polytropic exponent for gas in lungs | t : Time |

MODEL EQUATIONS

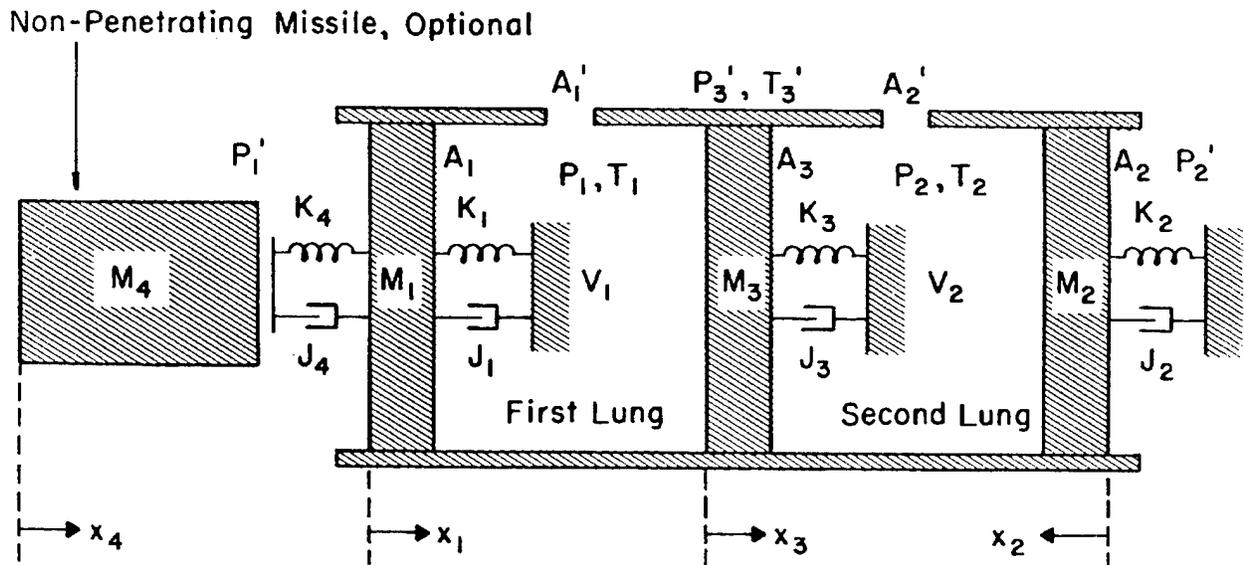
$$M \frac{d^2 X}{dt^2} + J \left| \frac{dX}{dt} \right|^S \frac{dX}{dt} + KX = A(P' - P)$$

$$\frac{dP}{dt} = -\gamma \frac{P}{V} \frac{dV}{dt} + \frac{1.334 \times 10^7 A_H}{V} |P' - P|^{1/2} \frac{P' - P}{|P' - P|} \quad \text{cgsu}$$

$$V = V_0 - AX$$

P01809

Figure 5. A Fluid-Mechanical Model of the Thorax (Incorporating a Single Gaseous Volume). (From Fletcher, E.R., "A Model to Simulate Thoracic Response to Air Blast and to Impact," 1970.)



- | | |
|---------------------------------|--------------------------------|
| A_i : Effective Area | J_i : Damping Factor |
| A_i' : Effective Orifice Area | K_i : Spring Constant |
| M_i : Effective Mass | P_i : Internal Air Pressure |
| V_i : Gaseous Volume | P_i' : External Air Pressure |
| x_i : Displacement | T_i : Internal Temperature |
| | T_i' : External Temperature |

P01810

Figure 6. A Mathematical Model of the Thorax to Simulate Fluid-Mechanical Responses to Rapid Changes in Environmental Pressure and to Nonpenetrating Missile Impact with the Chest Wall. (From Bowen, I. G., et al., "Biophysical Mechanisms and Scaling Procedures Applicable in Assessing Responses of the Thorax Energized by Air-Blast Overpressures or by Nonpenetrating Missiles, 1966.)

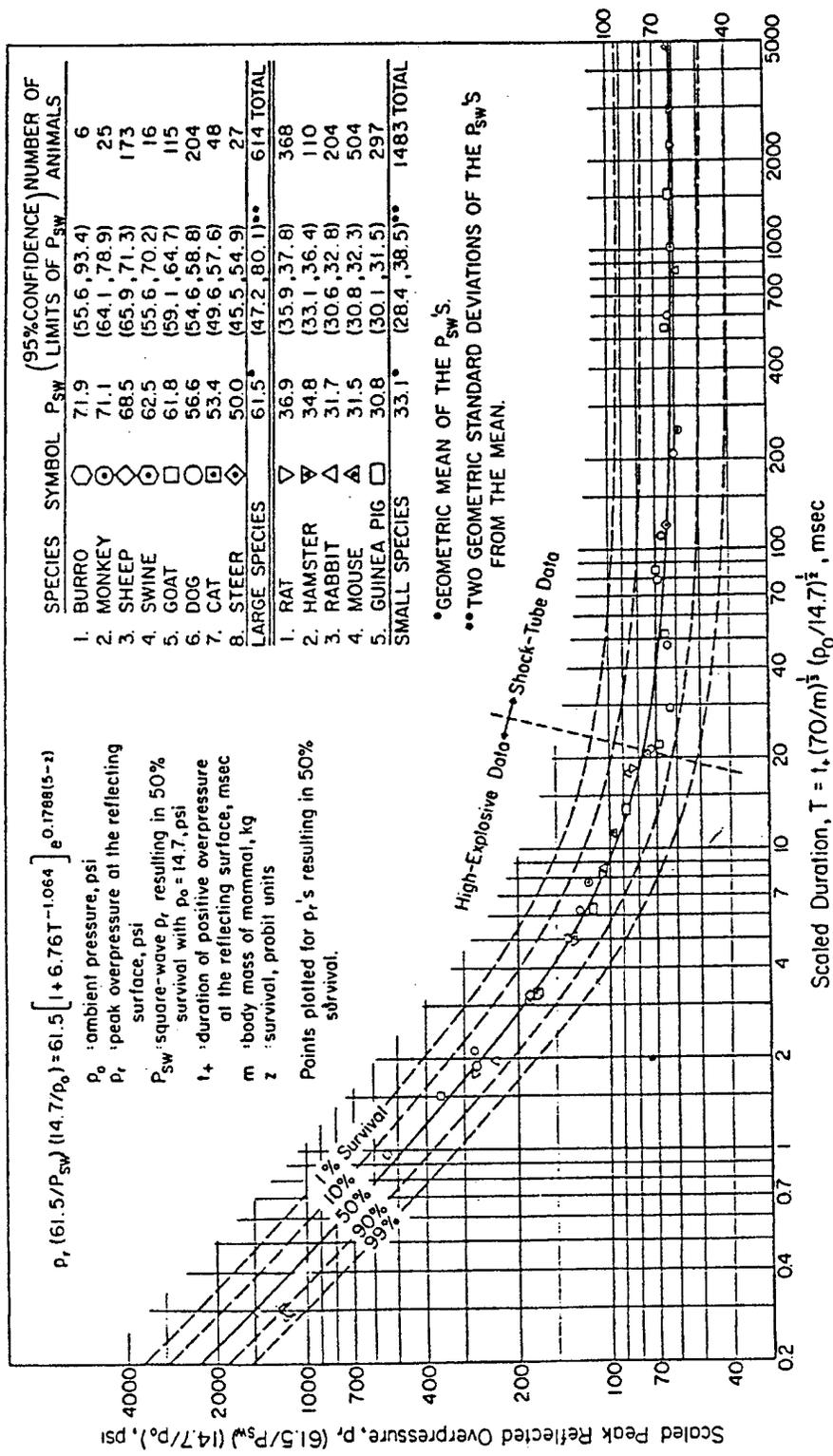


Figure 7. Survival Curves (24-hour) Applicable to Sharp-Rising Blast Waves Derived from the Analysis of Data for 13 Mammalian Species. (From Bowen, I. G. et al., "Estimate of Man's Tolerance to the Direct Effects of Air Blast, 1968.)

P01811

SECTION II.

BLAST OVERPRESSURE TEST FACILITY - KIRTLAND AIR FORCE BASE -

From the beginning this research complex played an important role in the study of military weapons effects. During World War II until 1946, the University of New Mexico, Physics Department, was asked to undertake studies on defense against aircraft. Today, the study is commonly referred to as "The Navy's Proximity Fuze Project." The experimental range for these studies was located in this very same research complex. It maintained an administration building, warehouses, a wood-working shop, an automotive shop, a dining hall, and guard barracks, and, of course, quarters for the horses that were used to patrol the area. In fact, most of the buildings described below were part of that complex.

In 1910-1920 the ranch and residence that was later to become part of the Blast Overpressure Test Facility was built. In the late 1930-1940 time period, title transferred to what was then known as Manzano Air Force Base. In 1949-1951 title transferred to the Sandia National Laboratories. After World War II, from 1951 through 1984, the Lovelace Foundation for Medical Education and Research assumed management of the facility for the Atomic Energy Commission. In 1984 to 1988, the Los Alamos National Laboratory for the Department of Energy assumed management of the site. In 1988 to 1998, EG&G Inc. assumed management of the site for the U.S. Army Medical Research and Materiel Command. In 1998, the U.S. Army terminated their lease with Kirtland Air Force Base.

In 1998, the historians assigned to preserving the history of Kirtland Air Force Base were successful in having the research complex designated as an historical site. Actions were implemented to preserve and restore the original buildings.

RESEARCH COMPLEX

The Blast Overpressure Test Facility was located on 96 acres on the southeast section of Kirtland Air Force Base-East, Albuquerque, New Mexico. It consisted of a research complex, a shock tube area, a high-explosive test area, and an underwater blast area.

The research complex consisted of the 2600-square-ft headquarters building (9051) that contained office and laboratory space and a photographic laboratory. Building 9053, 1200 square ft, housed the necropsy operations. Building 9040 was used primarily for office space and laboratories. Building 9045 initially housed the veterinary offices, small animal surgery, and small animal quarters and was later used to provide a recreation facility for the Walk-Up studies that

began in 1988. Also included within the compound, but no longer in use since the early 1970s, were a 720-square-ft primate holding facility and a building containing kennels. Building 9099, 2030 square ft, housed the primate conditioning laboratories and later was used as a storage area.

In 1988-1989, facilities to support the Walk-Up Study to study low-level blast exposures to replicate weapons noise were constructed and included a 3300-sq-ft control building that housed the data acquisition and analysis systems; six automated audiometric test booths; a physical attenuation (white-noise) test room, a medical examination room with spirometry, blood pressure testing, and a recreation room for subjects. An explosive preparation building of reinforced concrete with a 200- sq-ft berm was also constructed.

EXPERIMENTAL ANIMAL SUPPORT AREA

The experimental animal support area consisted of outdoor pens and a portable building for indoor pens. Also, within this complex (not used since the early 1970s) was a 2500-square-ft building (9041) that served as a surgery and recovery area; a 2200-square-ft building (9045) provided outside dog runs. Building 9040 housed a complete necropsy laboratory.

SHOCK TUBE AREA

In late 1957, the capability to carry out significant experimentation to study the effects of long-duration air blast waves on a routine basis was sharply enhanced with the installation of the first shock tube facility of its kind at Kirtland Air Force Base. For many years, the blast simulation facilities at the BOP Test Site consisted of four shock tubes ranging in size from 1 to 6 ft in diameter. The descriptions of these shock tubes were excerpted from "Blast and Shock Simulation Facilities in the United Kingdom, Canada, and the United States," DASA Data Center Special Report 1627, April 1965.

12-Inch-Diameter Shock Tube

The 12-inch shock tube had a circular cross section with a 2.5-ft-long compression chamber. The expansion chamber of this tube could be pressurized or evacuated to test blast-response of small animals while at reduced or increased ambient pressures.

24- x 40-Inch-Diameter Shock Tube

This shock tube was 70 ft long, 17 ft 5 inches high with a 40.5-inch diameter compression chamber and a 22-ft test section. The compression chamber had an area reduction from 40.5 to 23.5 inches in diameter at the diaphragm station. This shock tube was used for interspecies studies in which dose-response curves were compiled for six species exposed on the endplate to reflected shock waves of 350- to 400-ms durations. Incident shock waves measured at the endplate were between 4 and 20 psi with corresponding reflected shocks of 8 to 58 psi. The associated driver pressures ranged from 17 to 170 psi. Shock waves of over 500-ms duration were recorded with the tube fired open ended, using 12-inch-diameter tubing as the expansion section attached to the large 40-inch-diameter driver.

24-Inch-Diameter Shock Tube

The 24-inch shock tube was 80 ft long and 23.5 inches in diameter with a uniform cross-sectional area throughout its length. The duration of the overpressures in the test section ranged from 40 to 60 ms. The 24-inch shock tube was used in a number of geometries including those for model-foxhole studies and multi-step-loading studies. With one configuration that consisted of a 1-ft-driver and a 15-ft driver section with a cross-shaped test section opened laterally, 3- to 4-ms duration reflected pressure were assessed.

42- by 72-Inch-Diameter Shock Tube

The overall length of this shock tube was 179 ft. The 15-ft-long compression chamber was 42 inches in diameter as was the first 125 ft of the expansion chamber, after which the diameter increased to 72 inches over a 9-ft conical section. The 72-inch-diameter test section was 30 ft long and was closed with a blind flange.

3.5- by 10-Foot-Diameter Shock Tube

The overall length of this shock tube was 300 ft. The first 174-ft portion was 3.5 ft in diameter and increased to 6 ft in diameter over a 9-ft transition section. The next 60-ft portion was 6 ft in diameter and the distal 57 ft was 10 ft wide. The 10-ft-wide portion was roughly hemispherical in cross section and the remainder of the tube was circular. The shock tube was always fired with the distal end of the 10-ft-wide section open.

The support facilities included:

A 4000-sq-ft building containing a calibration shock tube and the 24-inch air-driven shock tube.

- A 4000-square-ft Quonset building that included an 800-square-ft weather shield and a 150-square-ft control van used for pressure-time instrumentation.
- A 4000-square-ft Quonset building that housed the welding and shop operations.

HIGH-EXPLOSIVE BLAST AREA

The original shot pad, used during the 1950s and early 1960s, was located 0.5 mile south of the building complex very near the Lovelace Inhalation Toxicology Research Institute (the construction of which necessitated the move).

A new shot pad area, Shot Pad 2, was constructed in 1964 on behalf of the Naval Ordnance Test Station (Naval Weapons Center), China Lake, CA., to provide a dust-free surface for camera viewing of fuel-air explosions. The area consisted of a concrete pad, 98 x 60 ft with inlaid 4- x 5-ft slab of 6-in.-thick armored plate; an above ground bunker, for recording pressure-time measurements; a magazine used to store high explosives; and a trailer used in the preparation of high explosives prior to use in blast experiments. Shot Pad 2 was also used for firings using high-explosive charges ranging from 0.125 to 64 lb. This shot pad was used continuously to support subsequent studies to accommodate various test simulators to create controlled high explosives blast overpressure waves.

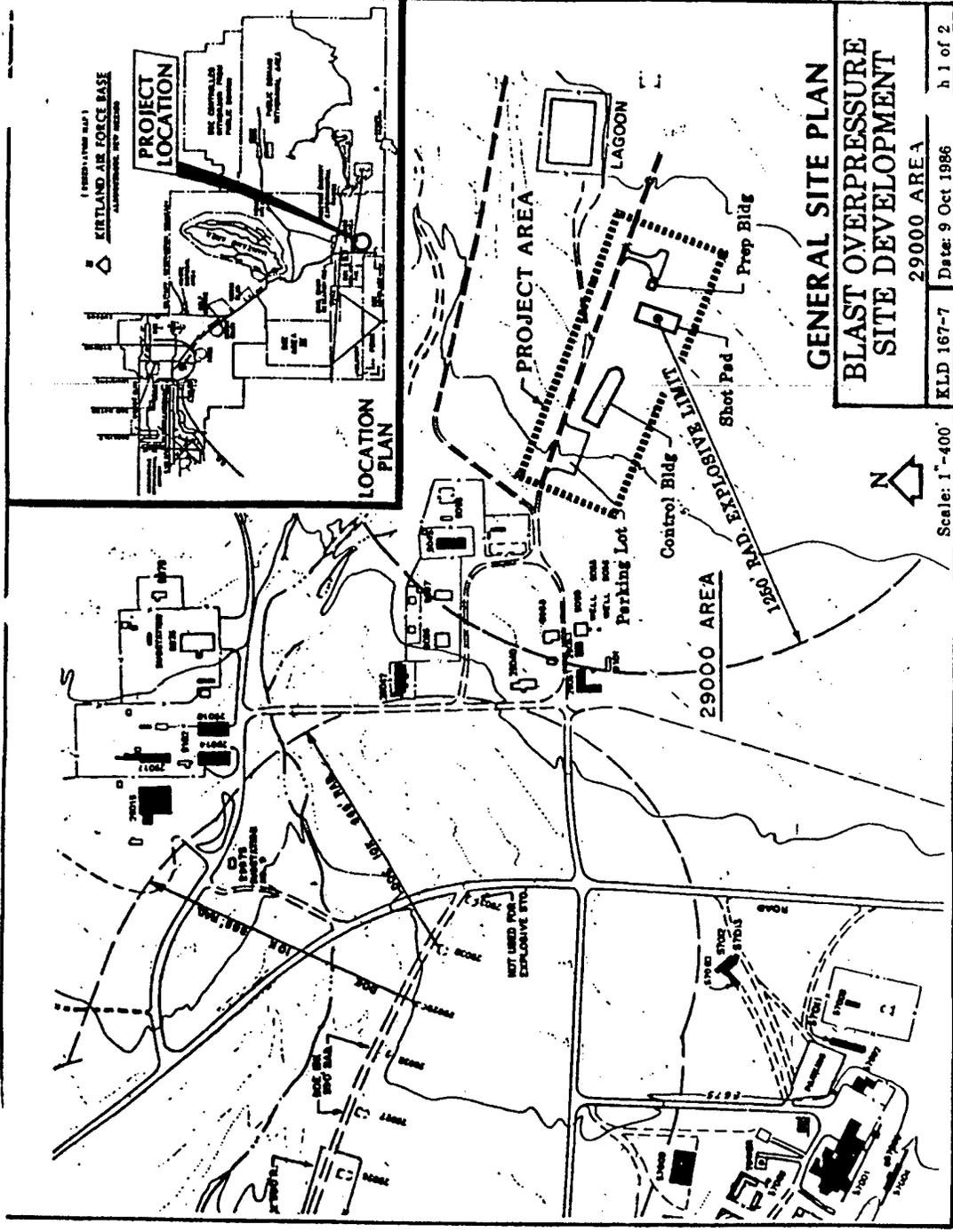
In 1988-1989, a shot pad, designated as Shot Pad 1, Walk-Up Study Pad, was constructed. The test area consisted of a concrete shot pad, 30 x 70 ft; a reinforced-concrete preparation building, 14 ft 4 in. x 16 ft x 10 ft 9 in. high; and a concrete ready-charge storage pad, 30 x 10 ft.

UNDERWATER TEST POND

The facility also included an underwater test pond completed in 1968 under the sponsorship of the U.S. Naval Ordnance Laboratories. The test pond measured 220 x 150 ft at the water surface and was 30 ft deep over its 30- by 100-ft center portion. The entire pond was lined with black polyvinyl plastic 20 mils thick. A 6-inch-thick layer of sand was located beneath the plastic in the 30-ft-deep bottom portion. The sides of the pond had a 2-to-1 slope. Two sets of rigging spanned the pond. The main rigging consisted of a grid 14 x 24 ft and the other grid was 5 x 10 ft. The test pond contained approximately 3.2 million gallons of fresh water.

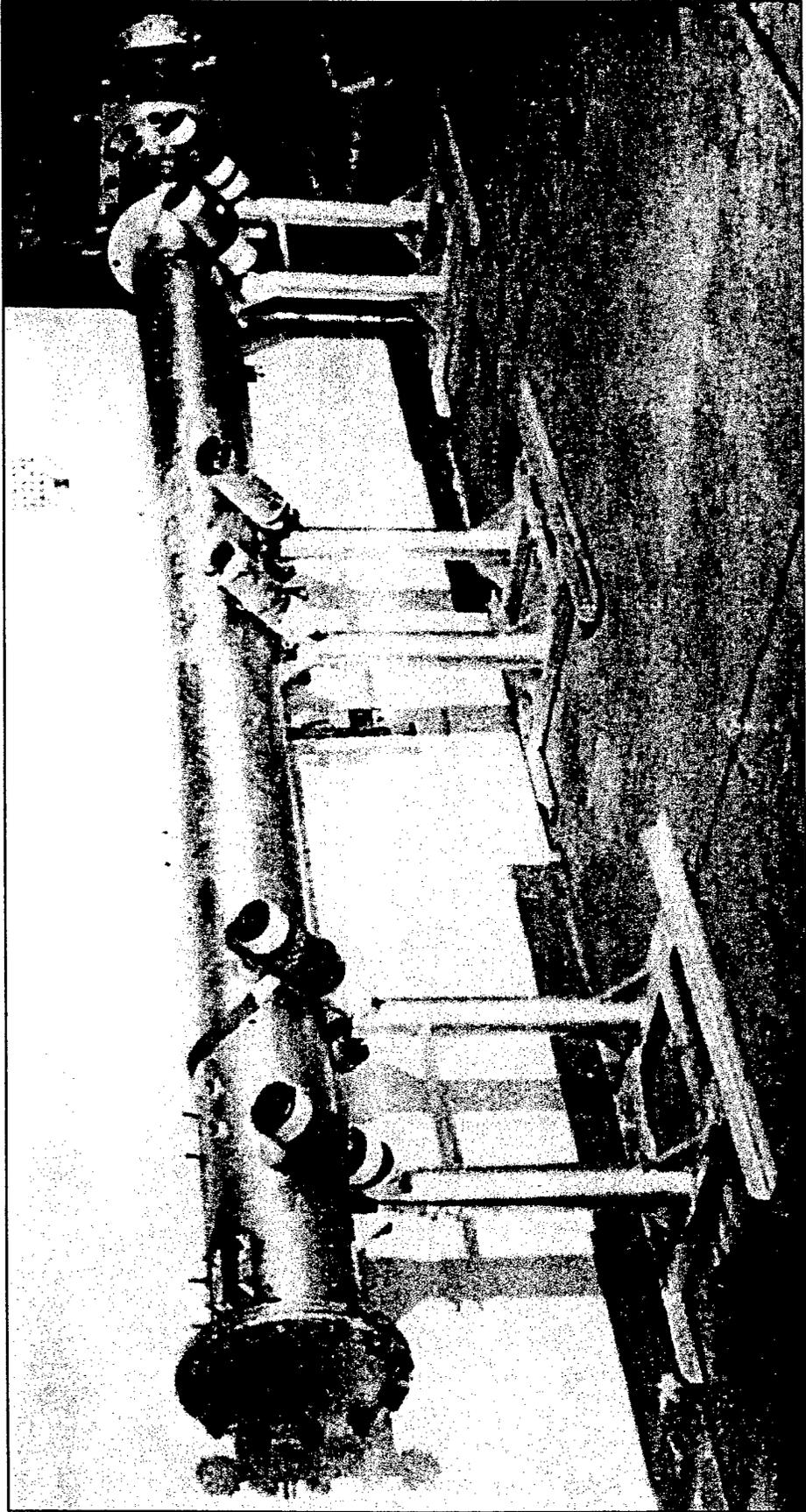


Figure 8. View of Blast Overpressure Test Site Administrative Building (circa 1970).



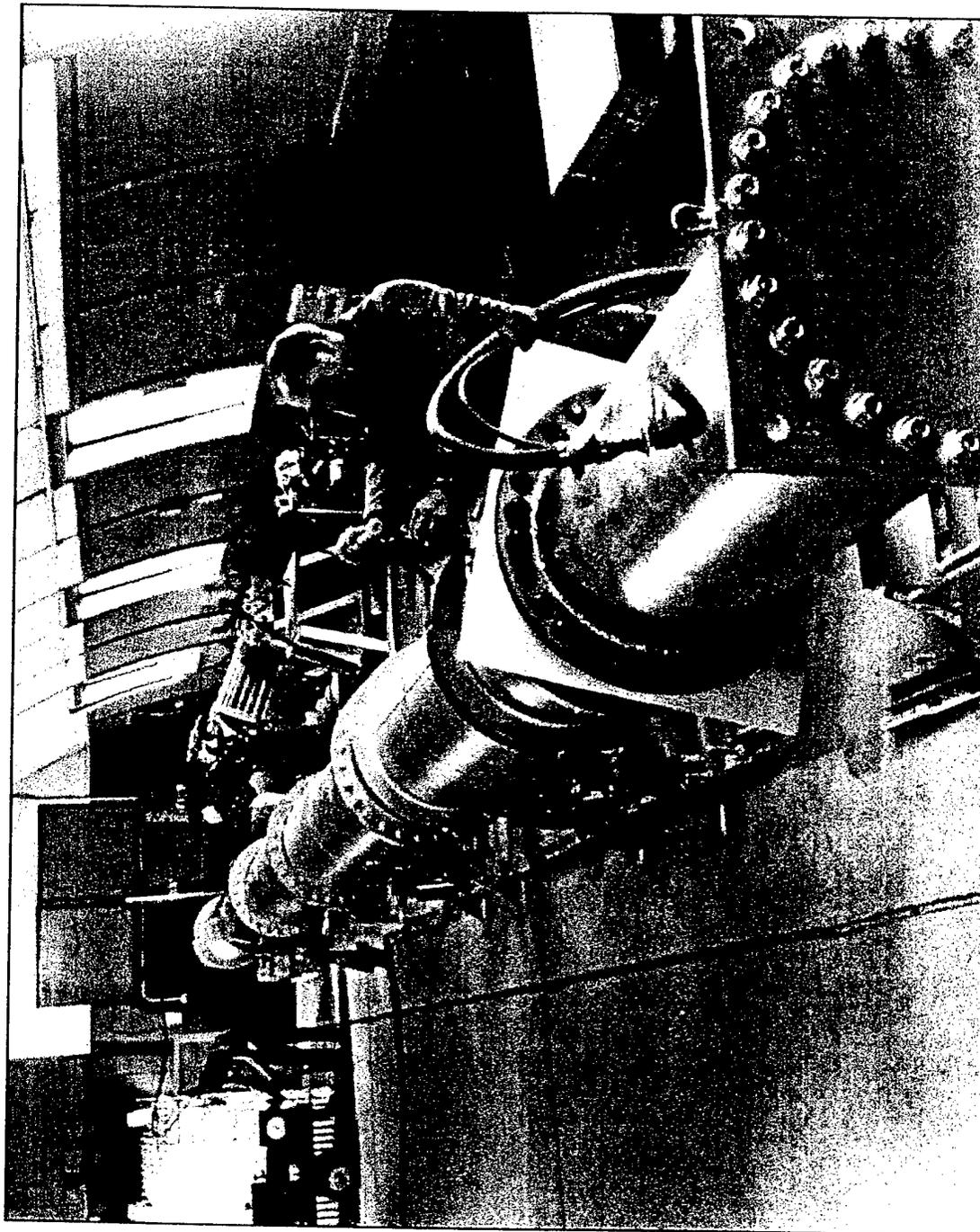
P01812

Figure 9. Location of Blast Overpressure Test Site, Kirtland Air Force Base, New Mexico.



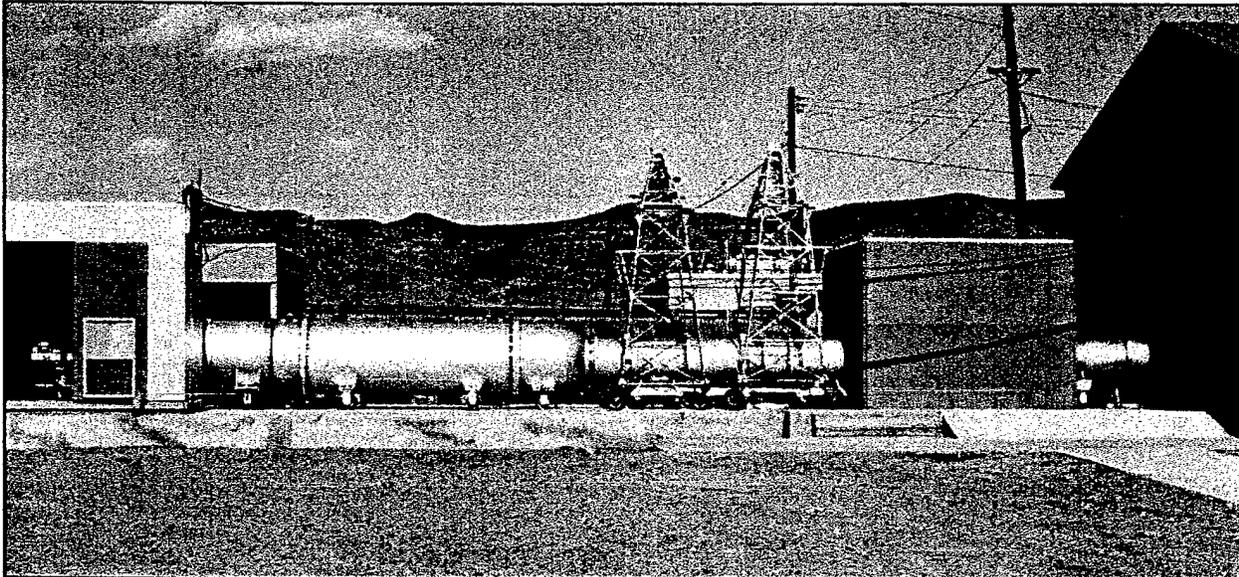
P01813

Figure 10. View of 12-Inch Diameter Shock Tube.



P01814

Figure 11. View of 24-Inch Diameter Shock Tube.



P01815

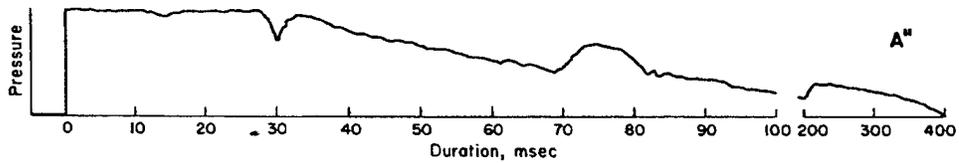
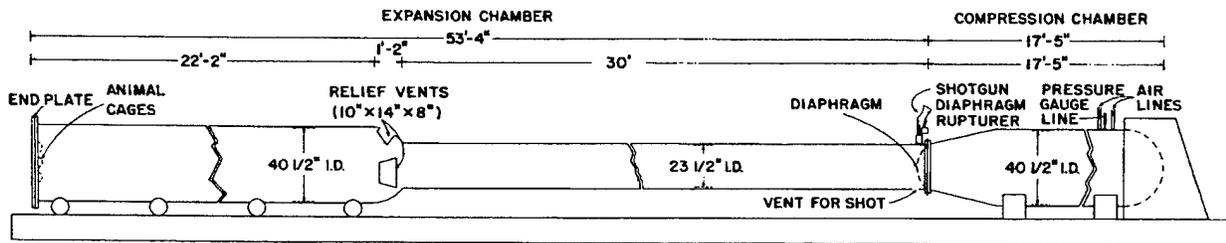
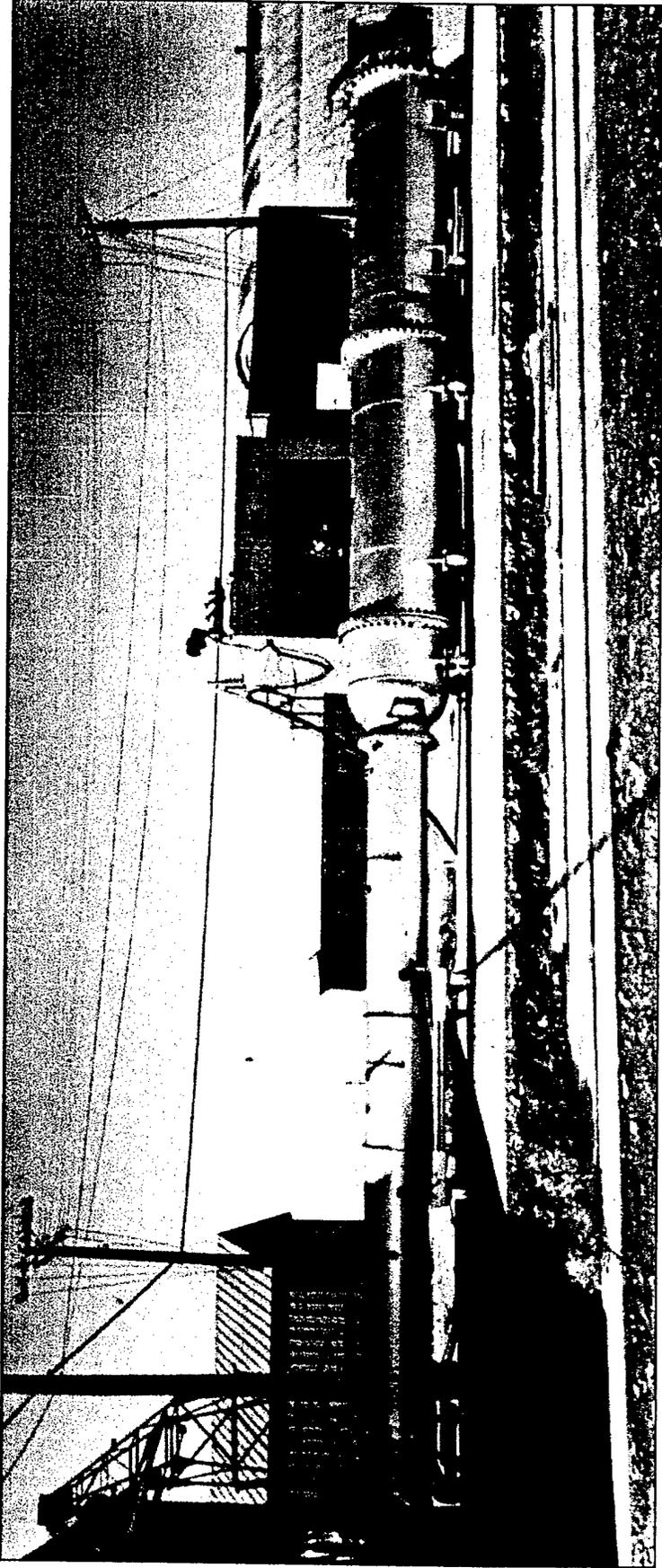
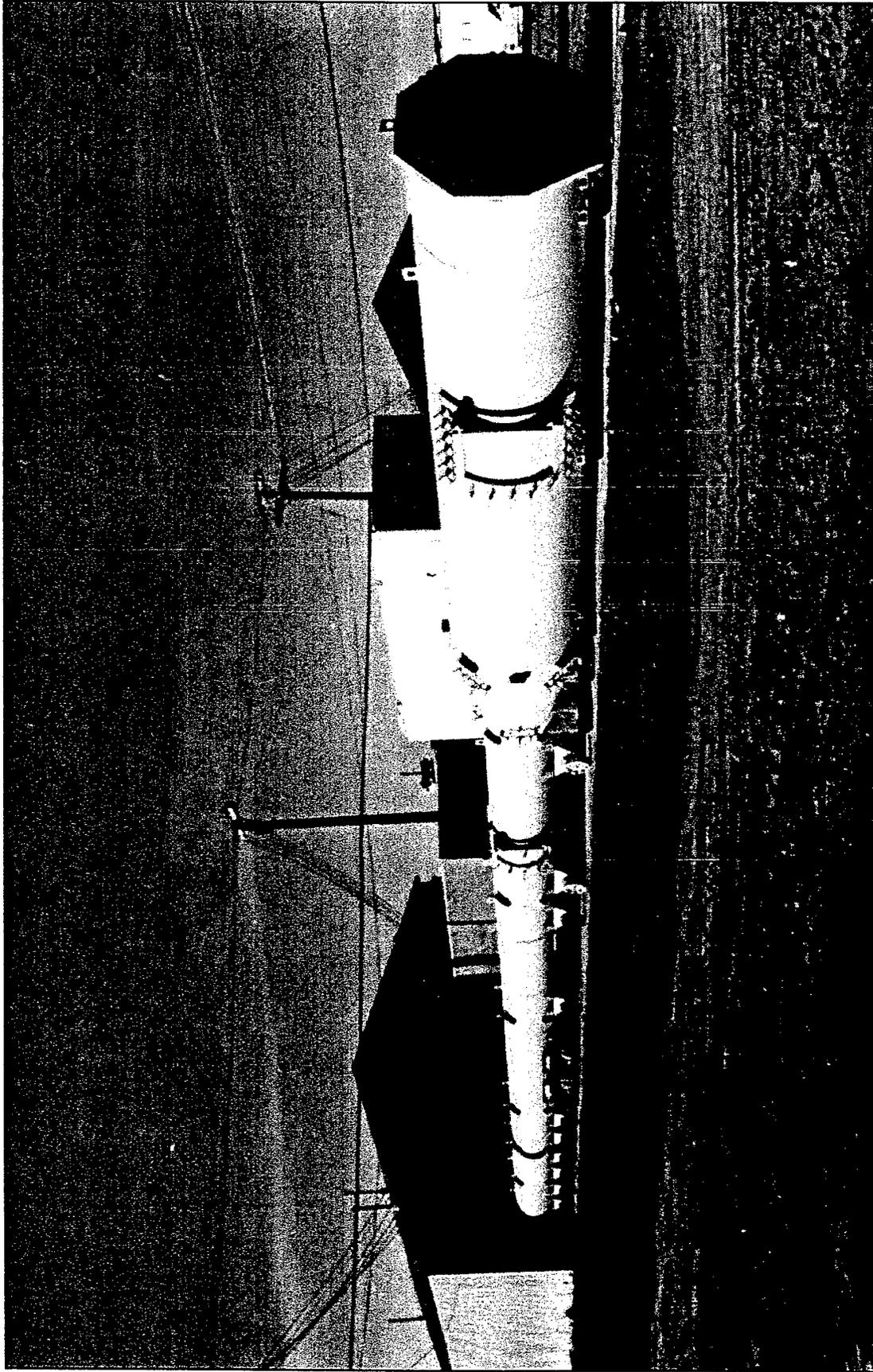


Figure 12. View of 24-40 Inch Diameter Shock Tube that Generated "Sharp"-Rising Overpressures and a Sample of the Waveform Recorded.



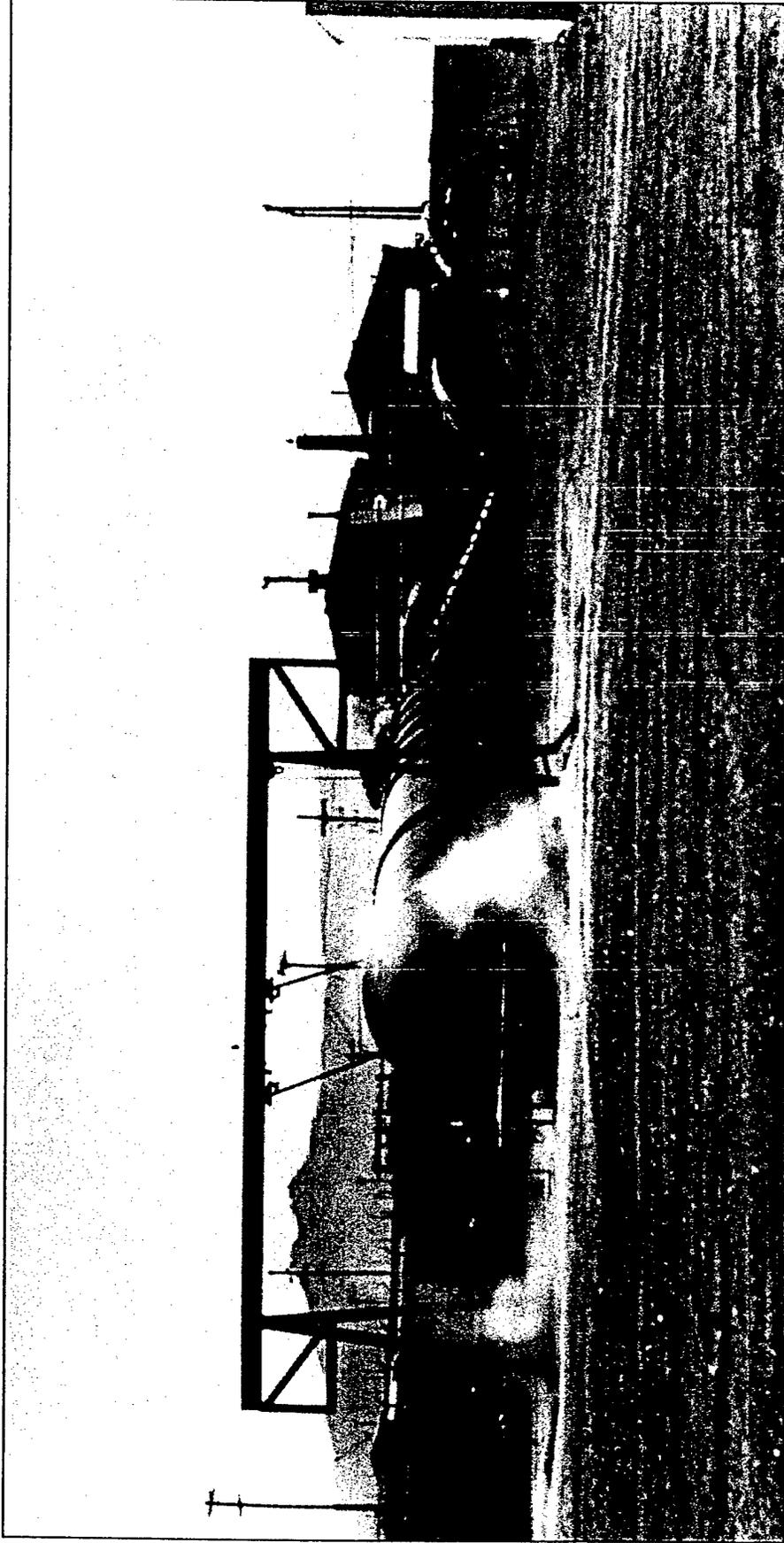
P01807

Figure 13. View of 24-40 Inch Diameter Shock Tube (Variable Ambient Pressure Configuration).



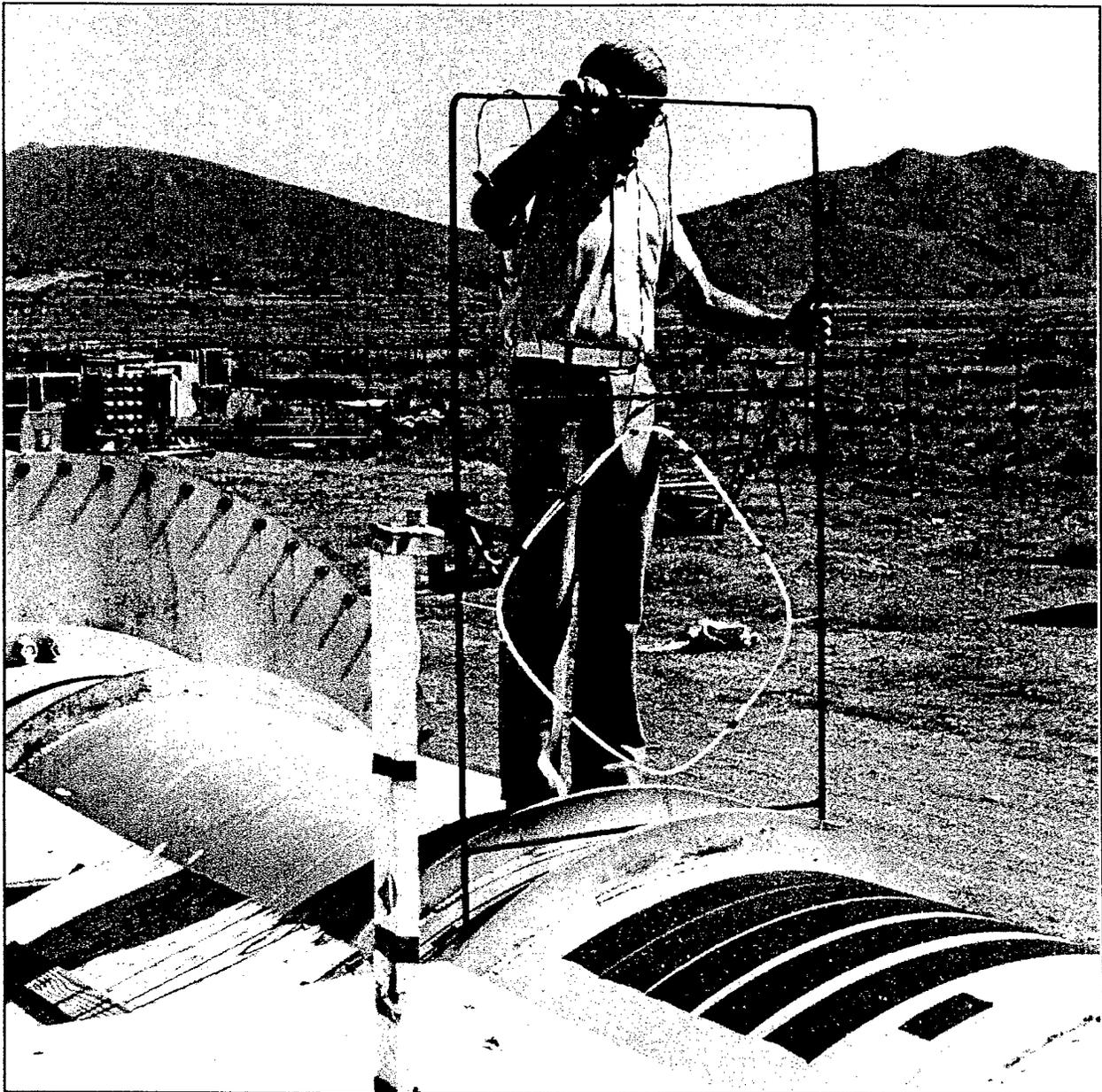
P01817

Figure 14. View of 42-72-Inch Diameter Shock Tube.



P01818

Figure 15. View of 10-Ft Diameter Shock Tube Used to Study the Effects of Cannon Muzzle Blast.



P01819

Figure 16. Primacord Charge Holder Being Inserted into 10-Ft Diameter Shock Tube.



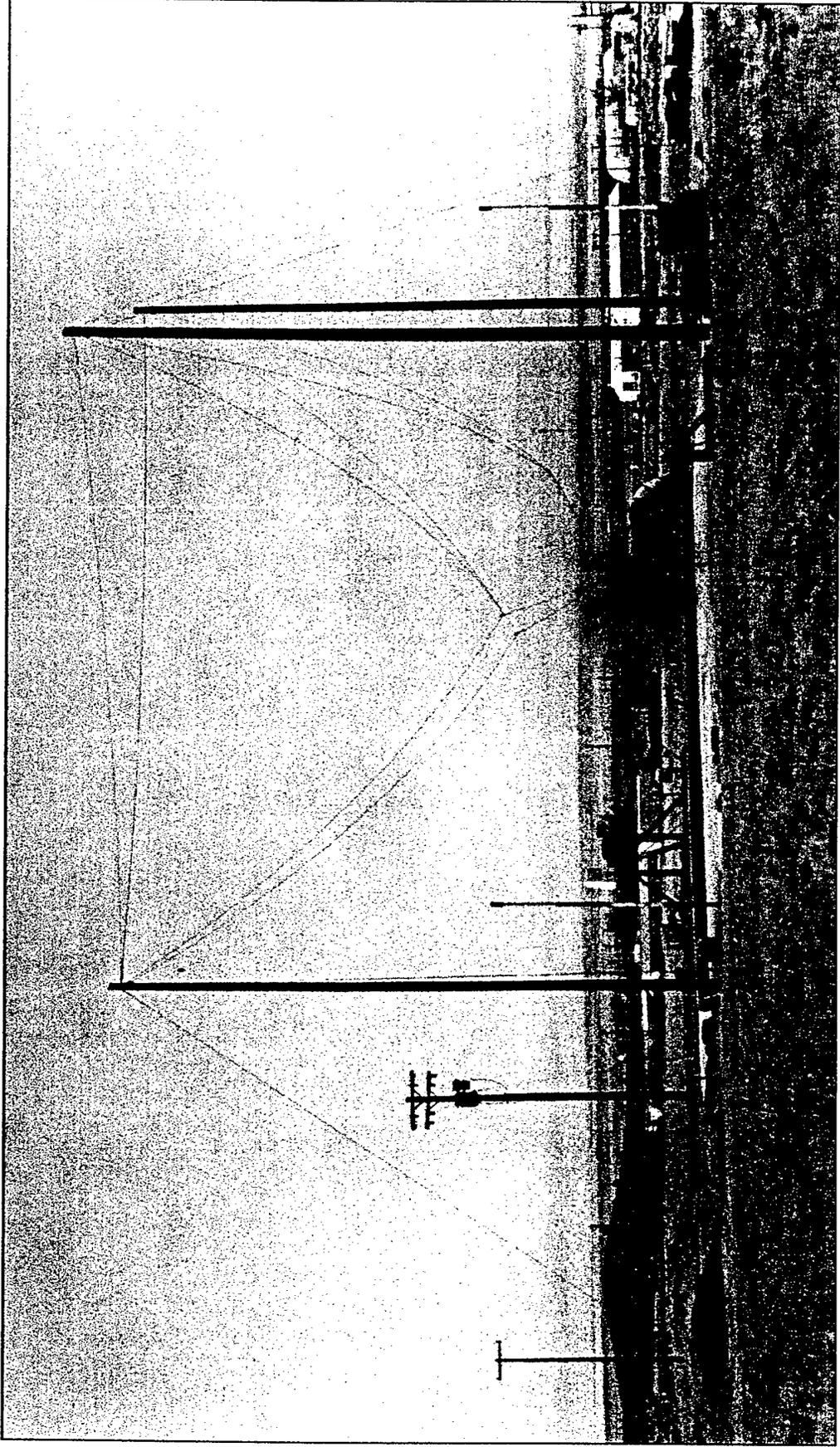
P01820

Figure 17. View of Newly Constructed Shot Pad 2. (Almost entire 96 acres of the Blast Overpressure Test Site can be seen from this vantage point. The office buildings can be seen to the left, animal support facilities in the center, and the shock tube facility to the right.) Circa 1963-1964.



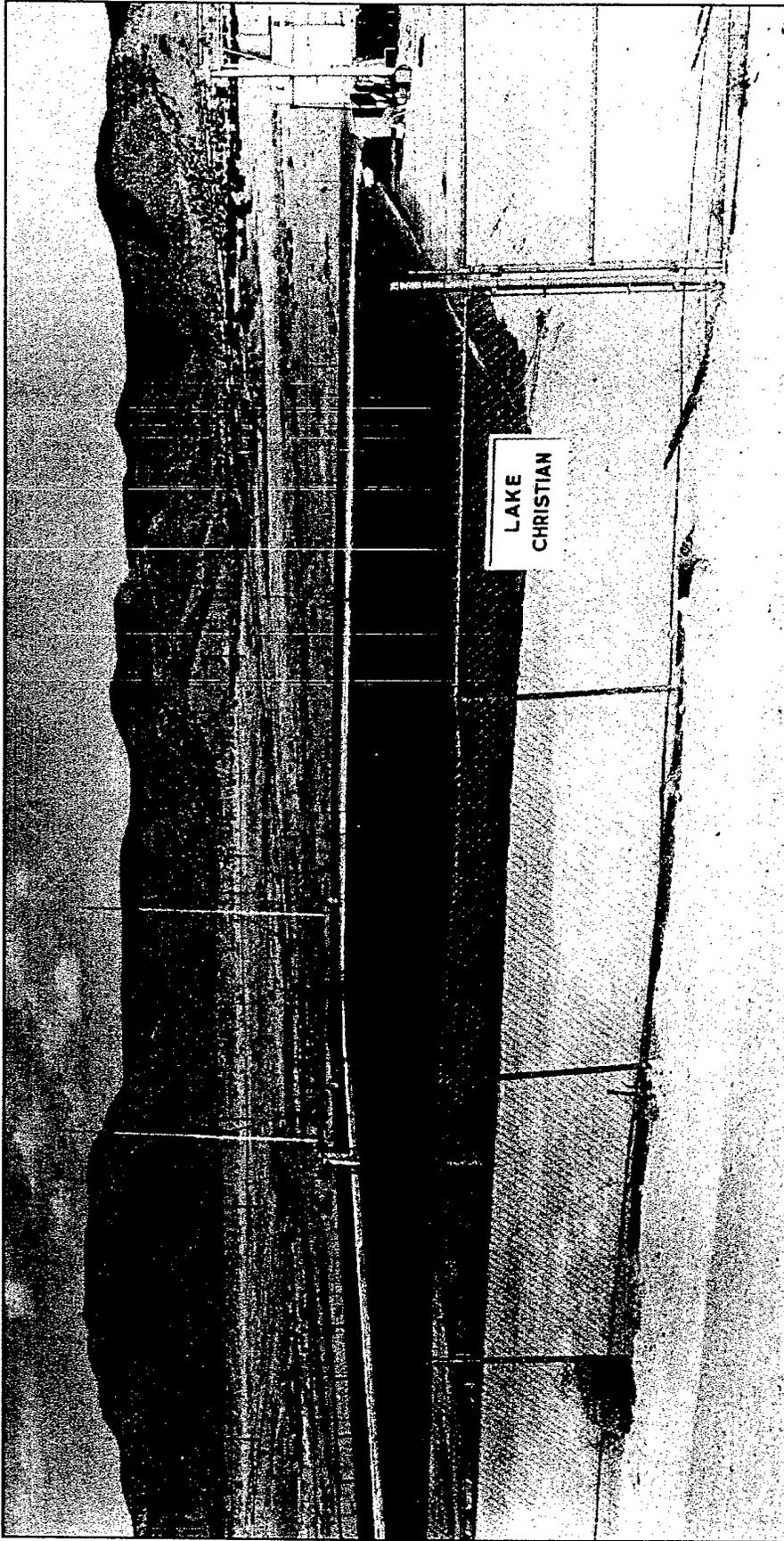
P01821

Figure 18. View of Construction Phase of Underground Instrumentation Bunker for Shot Pad 2. Circa 1963-1964.



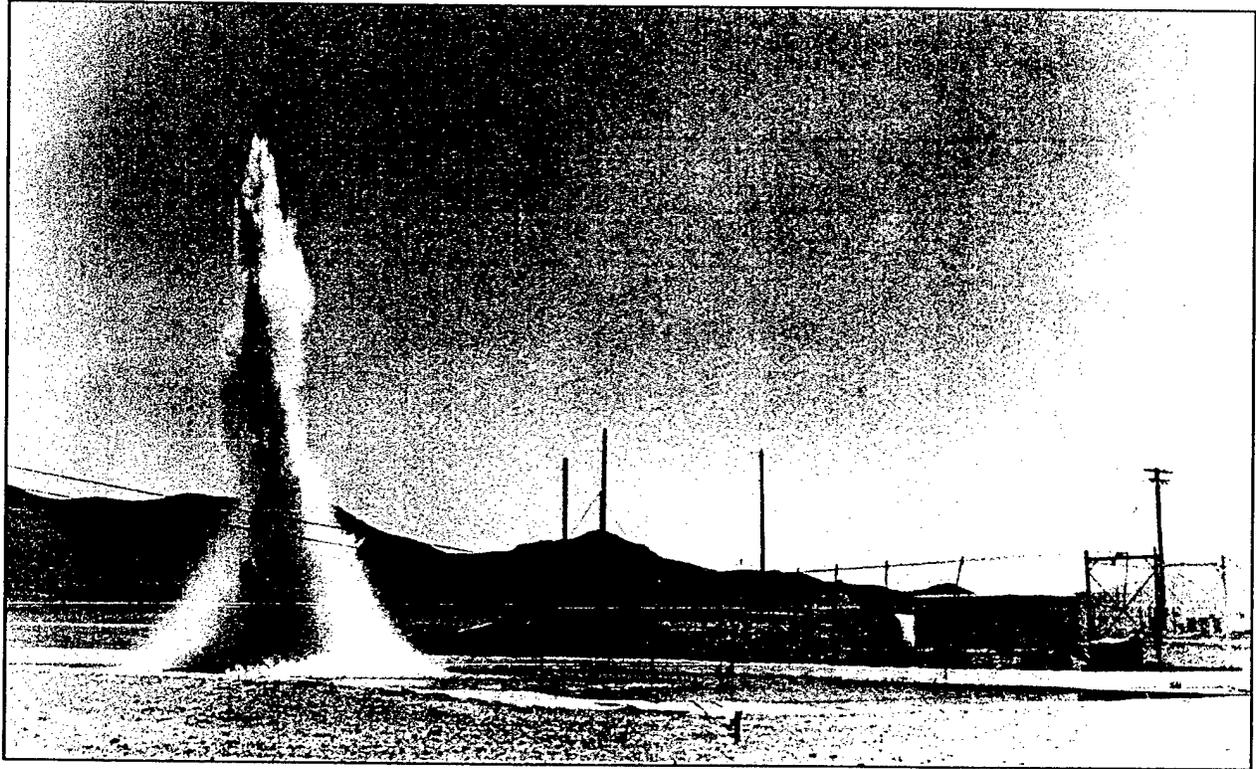
P01822

Figure 19. View of Firing Event at Shock Pad 2.



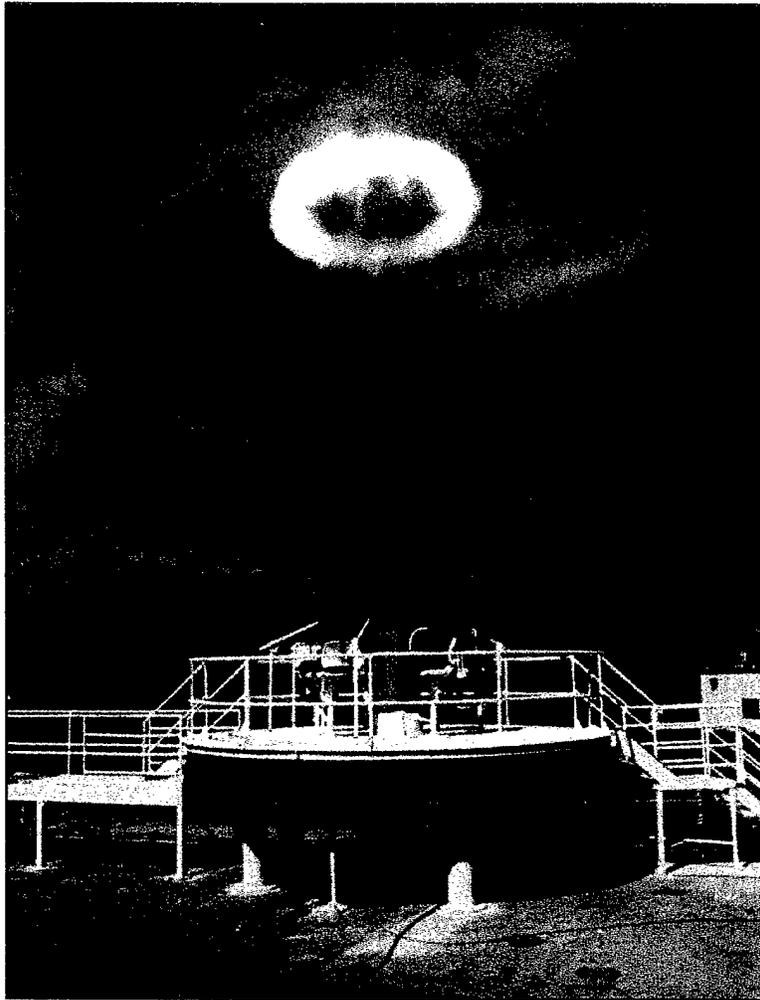
P01823

Figure 20. View of Test Pond Facility.



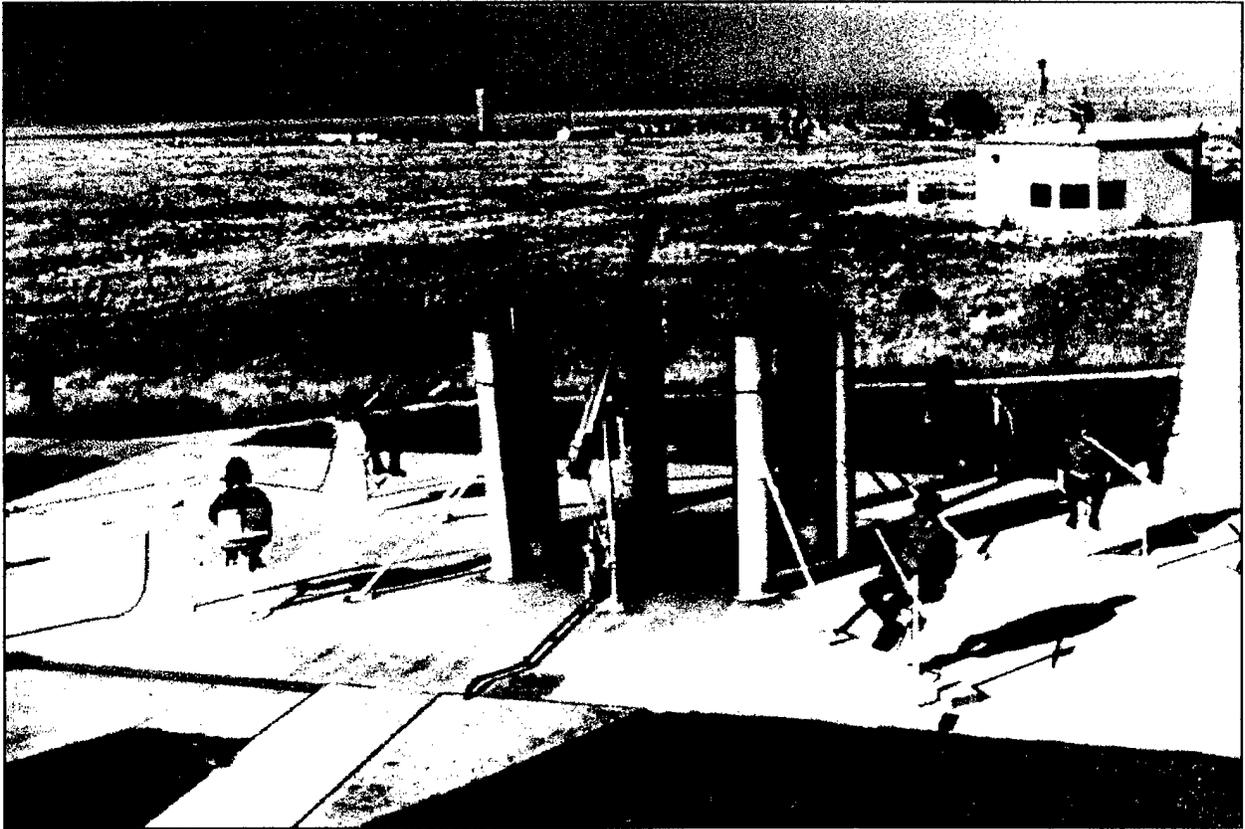
P01824

Figure 21. View of Test Pond Facility, 8-Lb Charge at 10-Ft Depth.



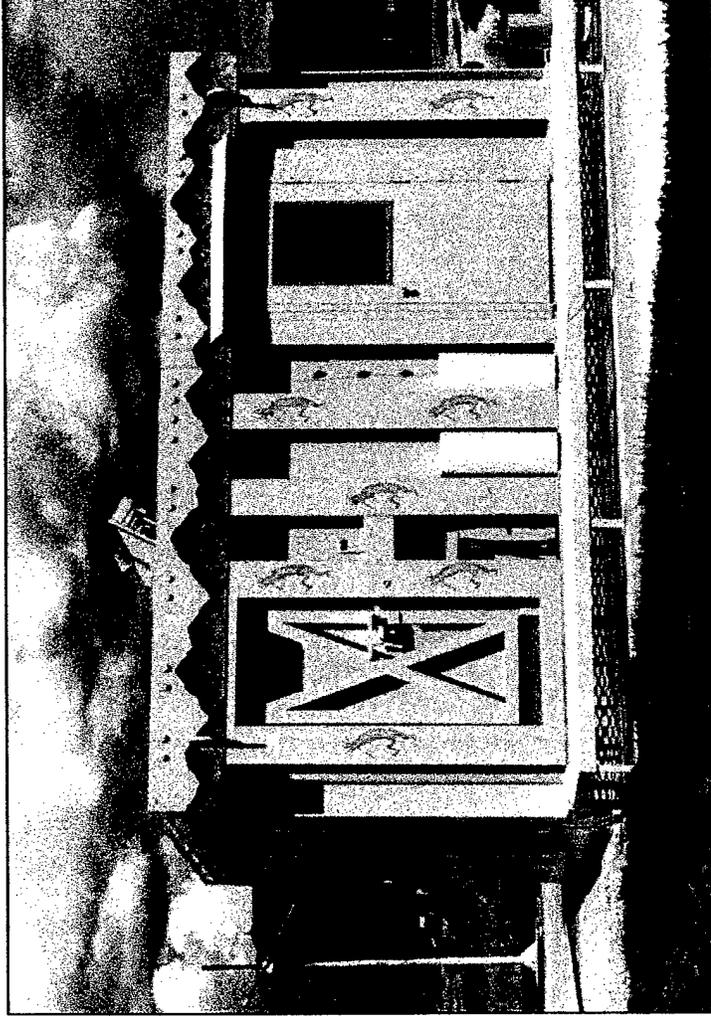
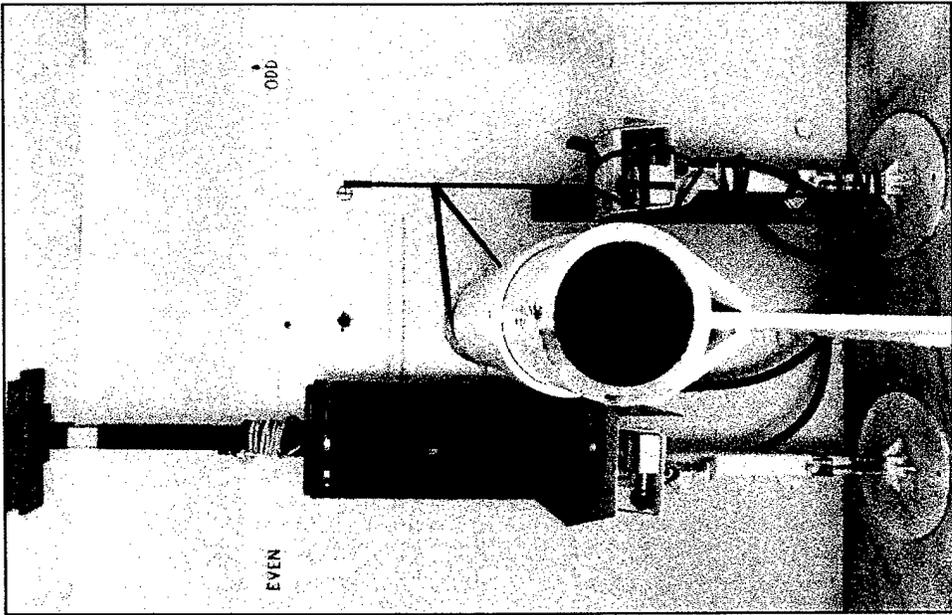
P01825

Figure 22. View of Mortar Simulator, 1-Meter Setup.



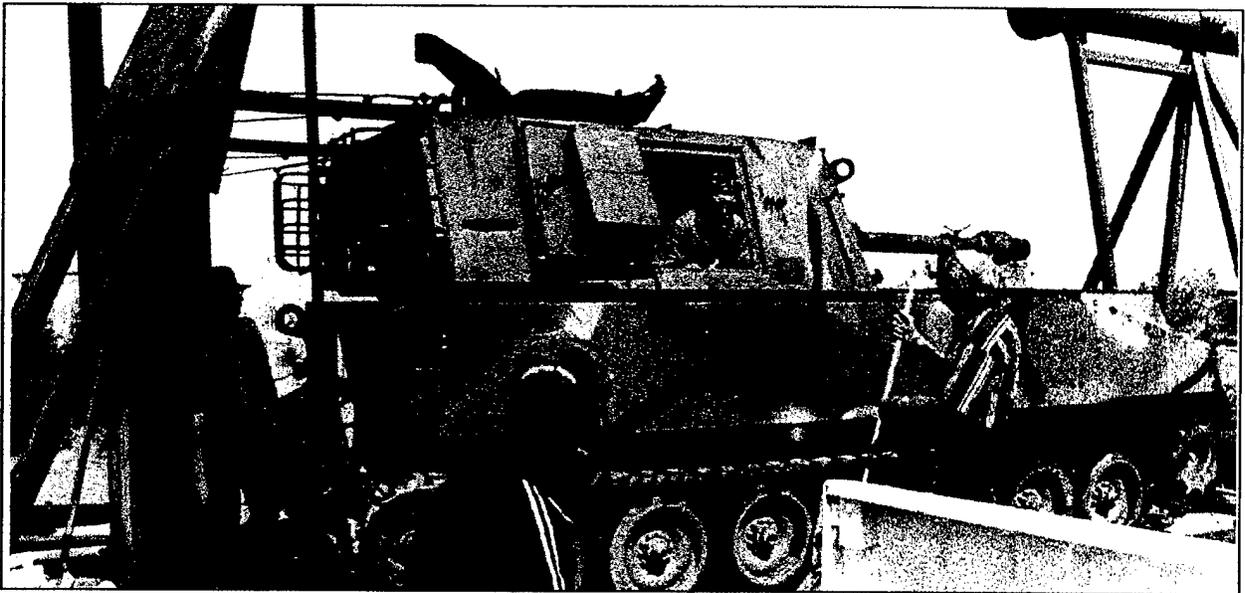
P01826

Figure 23. View of Mortar Simulator, 5-Meter Setup.



P01827

Figure 24. Front and Inside Views of Enclosure Simulator.



P01828

Figure 25. View of Self-Propelled Howitzer Muzzle Blast Simulator.

Muzzle Blast Simulator

Enclosure Simulator

Mortar Simulator



P01829

Figure 26. Muzzle Blast Simulator, Enclosure Simulator, and Mortar Simulator as Viewed from the Control Building during a Test.

SECTION III.

BIOGRAPHIES

Every effort was made to obtain the biographical sketches of the key investigators who were well known throughout the blast research community both nationally and internationally as some of the leading experts on the biological effects of blast. Unfortunately, we were unable to obtain information on a few key researchers, namely, Dr. Thomas Chiffelle, who played an important role in furthering the understanding of the pathology of blast injury, and Dr. Frederick Hirsch, who made an important contribution with his study and review of the effects of air blast on the ear.

Gerald Bowen, M.S. Mr. Bowen, physicist, received his M.S. from the University of New Mexico in physics. From 1954 until his death, he was Head of the Department of Physics, Lovelace Foundation for Medical Education and Research. It was under Gerry Bowen's leadership that the Bowen Curves, the mathematical models, and the nuclear effects computer were developed. He also played a major role in the early studies of nuclear blast effects.

Edward G. Damon, Ph.D. Dr. Damon, physiologist, received his Ph.D. from the University of New Mexico in the biological sciences. From 1962 until 1984, while with the Comparative Environmental Biology Department of the Lovelace Foundation for Medical Education and Research, he was extensively involved in studies of the physiological effects of air blast injury and the treatment of pulmonary contusions by hyperbaric oxygen techniques. Dr. Damon was a member of the American Institute Biological Scientists, New Mexico Academy of Science, National Education Association, American Association for the Advancement of Science, and the New Mexico Association for the Advancement of Science.

E. Royce Fletcher, Ph.D. Dr. Fletcher, physicist, a 1964 graduate of the University of New Mexico with a Ph.D. degree in physics. He began his career in 1959 and continued until 1964 at the Lovelace Foundation for Medical Education and Research as a research associate while graduate student. From 1964 to 1985, he was Head, of the Department of Physics. He first worked on a theoretical model to predict the motion of objects translated by classical blast waves. He headed an experiment to determine the aerodynamic-drag parameters of small irregular objects by means of drop tests. Dr. Fletcher developed a Nuclear Bomb Effects Computer (circular slide rule) based on Lovelace empirical data and data from "The Effects of Nuclear Weapons." He later revised the Nuclear Bomb Effects Computer that is included in the current edition of "The Effects of Nuclear Weapons." His considerable contributions also included models extended to such problems as the displacement of man as a result of a nuclear-

produced blast wave; a model designed to study the lung during exposure to a pressure wave, a model designed to study the thoraco-abdominal response of underwater blast; and experiments to establish scaling laws so that the models may be extended to predict the effects in man produced by shock waves. Dr. Fletcher was a member of the Institute of Electrical and Electronics Engineers, American Institute of Electrical Engineers, Sigma Tau, Phi Kappa Phi, Kappa Mu Epsilon, and Sigma Xi.

Daniel L. Johnson, Ph.D. Dr. Johnson, biophysicist, directed the studies on nonauditory and auditory blast overpressure effects at the test site from October 1989 to October 1997. A graduate of the U.S. Military Academy, M.S.E. in Aeronautical Engineering and the University of Colorado, Ph.D., retiring as a Colonel from the U.S. Air Force, Dr. Johnson's research interests centered around the extensive research he had conducted on infrasound, noise dosimetry, and noise-induced hearing loss. He also helped to develop several innovative instruments for noise measurement. He served as Chairman of the Acoustical Society of American Standards Committee on Acoustics and an individual expert of the Standards Committee on Mechanical Shock and Vibration, and a member of the Standards Committee. He also was a Fellow of the Acoustical Society of America, a member of the National Hearing Conservation Association and SAE.



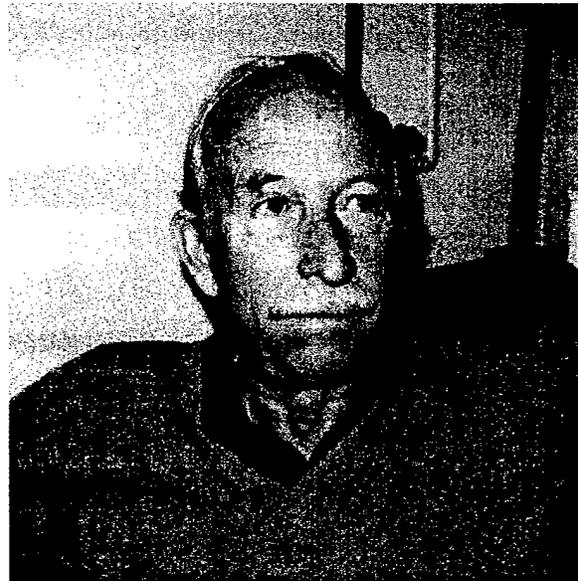
Daniel L. Johnson

P01830

Robert K. Jones, M.D. Dr. Jones, hematologist and pathologist, was Assistant Director of Research and Director of the blast biology program of the Lovelace Foundation for Medical Education and Research from 1967 until 1984. He received his M.D. degree from University of Cincinnati College of Medicine in 1957. Dr. Jones' professional memberships included the Ohio Society of Pathologists, American College of Pathology, New Mexico Society of Pathologists, and American Medical Association. While with the blast biology program, Dr. Jones' research interests centered on the pathogenesis and improved treatment of blast injuries. Dr. Jones directed the experiments carried out at the Lovelace Foundation to study the effects of primary blast and combined injury (blast, radiation, and thermal). He also led an extensive effort to the

combined injury literature survey. He participated in the early nuclear effects field tests and later in the high-explosive nuclear simulation tests.

Donald R. Richmond, Ph.D. Dr. Richmond, biophysicist, was Head of the Comparative Environmental Biology Department (later known as the Biodynamics Laboratory) of the Lovelace Foundation for Medical Education and Research from 1954 through 1984; Associate Group Leader, Life Sciences Division, of the Los Alamos National Laboratories, from 1984 through 1988; and Director, EG&G Mason Research Institute, from 1988 to 1989. Dr. Richmond received his Ph.D. degree in 1955 from the University of New Mexico. Dr. Richmond was a member of the American Ordnance Association; New York Academy, New York Academy of Sciences; American National Standards Institute; S2 Com-



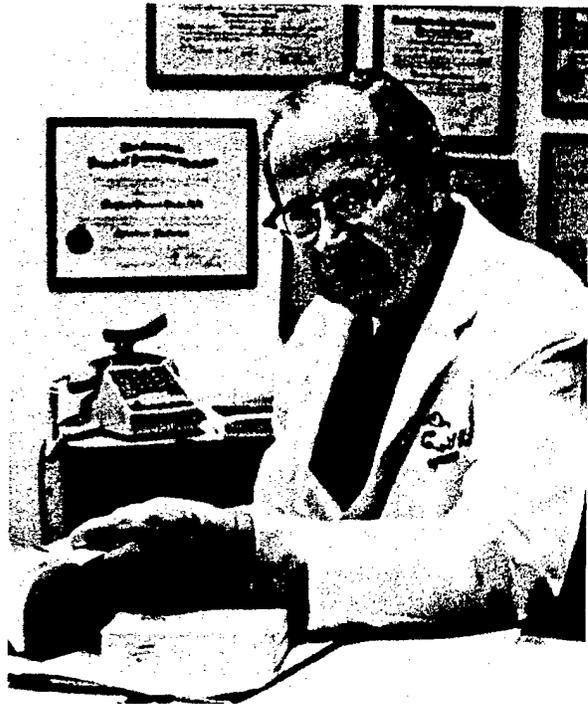
P01831

Donald R. Richmond

mittee on Mechanical Shock and Vibration, ST-54 Atmospheric Blast Effects Working Group; NATO RSG6/Panel 8 (Research Study Group 6), Effects of Impulse Noise; Joint United Kingdom/United States Workshops on Research and Development for Improved Combat Casualty Care; Working Group on Study of Potential Effects of Space Shuttle Sonic Booms on Channel Island Biota San Diego State University and U. S. Air Force. Dr. Richmond's research interests related to understanding the physical parameters associated with rapid increases in environmental pressure and their biological consequences in man. A specific interest was to define all facets of man's response to air and underwater blasts.

He conducted many investigations with a variety of animal species that provided information on the nature of blast injuries, the blast levels that are considered safe, and those levels that are dangerous. The investigations also provided information necessary to formulate sound principles of protection. Later he turned his attention to developing damage-risk criteria for repeated blasts and in the treatment of air blast and underwater blast injuries. Dr. Richmond's enormous contribution to the current understanding of blast effects is evidenced by his over 200 publications that he either authored or co-authored. He participated in the early nuclear effects field tests and later served as project manager of the biomedical trials

Clayton S. White, M.D. Dr. Sam White, physician, served as Director of Research and concurrently Head of a Section on Aviation and Internal Medicine (appointed in 1950, 1947, respectively); Member Board of Trustees (appointed in 1963); and President-Director, (appointed in 1965) of the Lovelace Foundation for Medical Education and Research. Dr. White, a Rhodes Scholar, received his M.D. degree in 1942 from the University of Colorado School of Medicine. Dr. White's research interests centered around medical research, aeromedical research, respiratory physiology, environmental medicine, emission spectroscopy, biological effects of nuclear weapons, blast biology, and inhalation of radioactive aerosols, etc. He belonged to many organizations both in the medical and scientific fields, e.g., American Medical Association, New York Academy of Sciences, and American Board of Preventive Medicine-Aviation Medicine (Founder Member). His professional activities were numerous. He served as the biomedical program director in the early nuclear effects field tests and later in the nuclear effects simulation H.E. field tests.



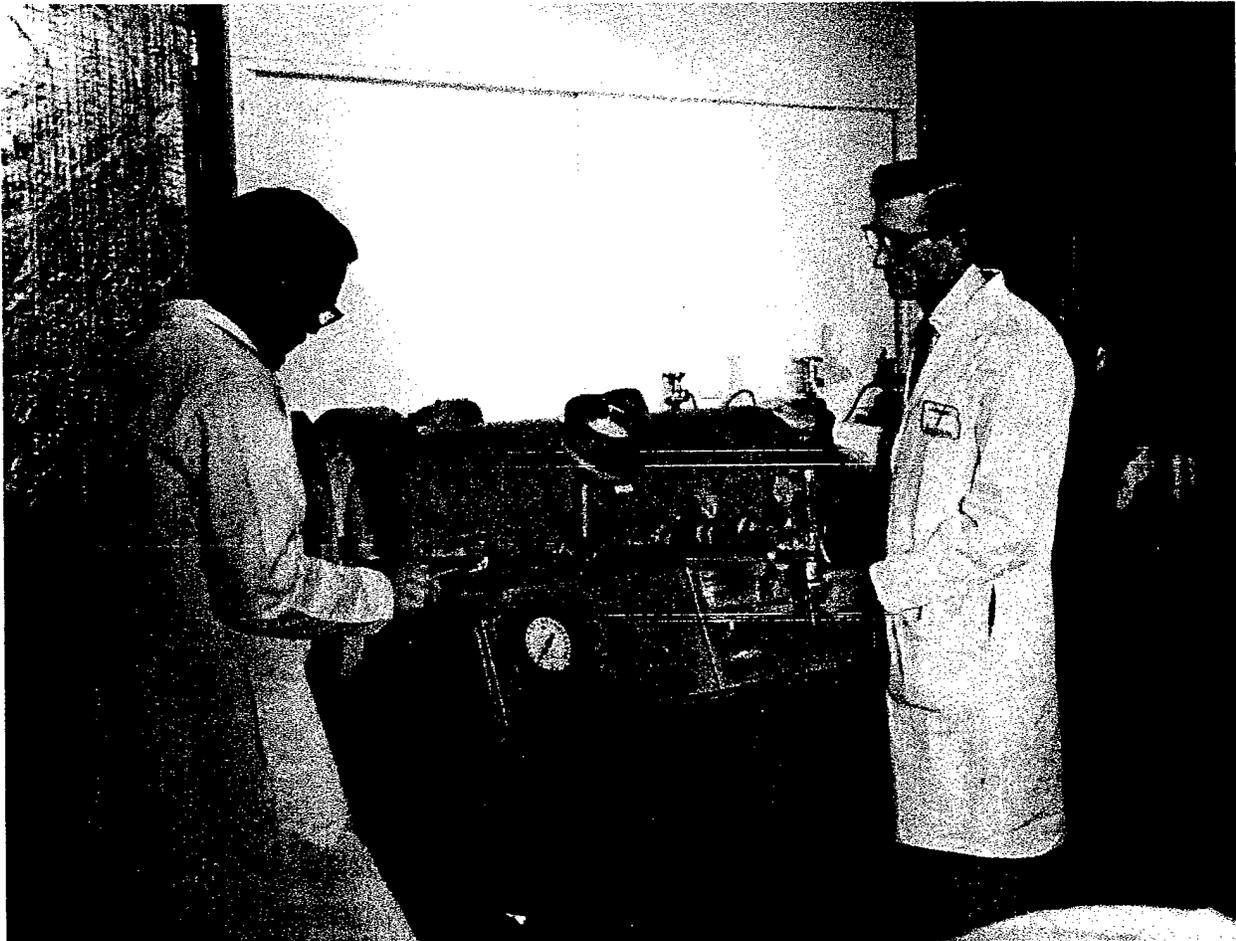
Clayton S. White

P01832

John T. Yelverton, M.S. Mr. Yelverton, physiologist, was involved in blast biology research for 33 years at the Blast Overpressure Test Site at Kirtland. Mr. Yelverton received his MS degree in Biology from the University of New Mexico. His research experience included the investigation of the effects of air and underwater blast, as well as thermal and ionizing radiation in both single and combined modalities on numerous species of animals to establish dose-response relationships. In addition, he conducted and participated in studies of the effects of airblast and/or ionizing radiation on pulmonary function in dogs and sheep, studies aimed at evaluating the effects of exhaustive exercise on blast trauma mortality, studies assessing the wound power of glass-energized fragments, studies estimating the effects of whole-body impact and decelerative tumbling on a large animal species, studies on the effects of pharmacological agents on overpressure induced trauma, and the influence of protective garments on lung injury. Over the years, Mr. Yelverton developed an expert knowledge of both shocktube and high-explosive technology and designed numerous test devices and enclosures, including an underwater life-support system for sheep, calibration jigs, and gauge mounts. He participated

in the high-explosive nuclear effects simulation field tests. He evaluated blast displacement effects on anthropomorphic dummies placed in various vehicles and enclosures for these tests.

P01833

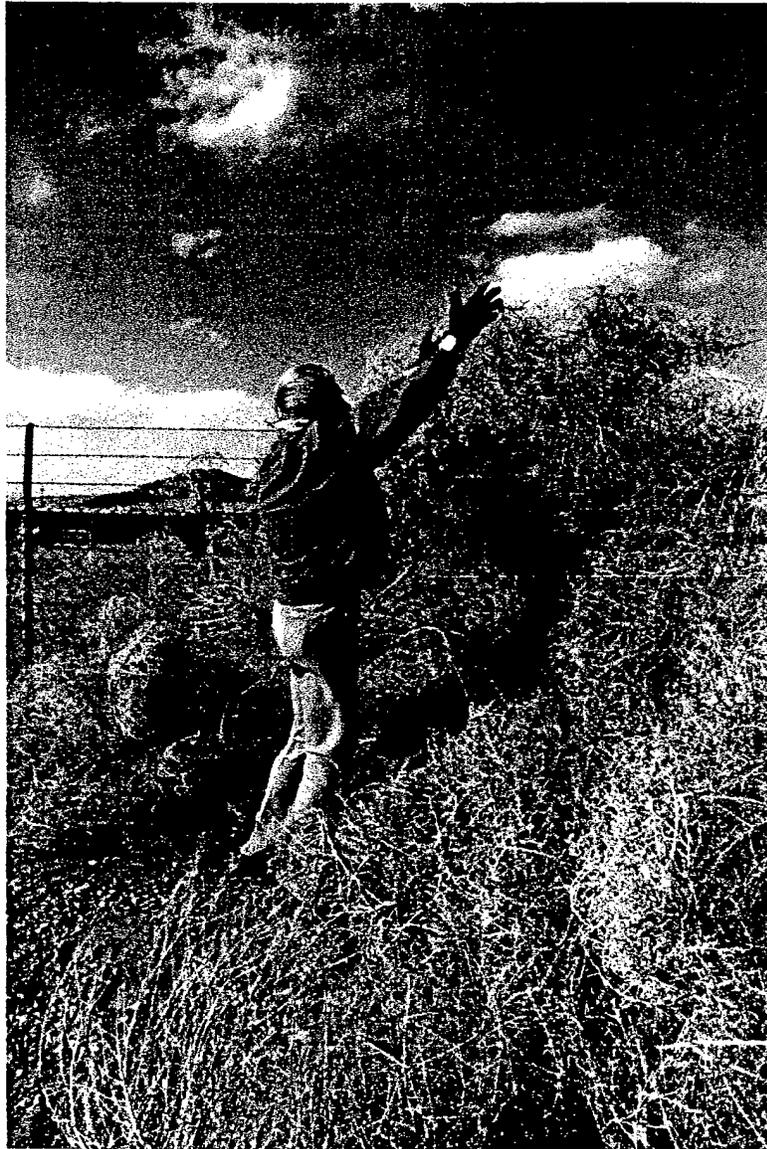


John Yelverton (left) and Edward G. Damon (right) During Hyperbaric Treatment of Blast Study (circa 1968).



P01834

Pictured in front of the 10-Ft Diameter Shock Tube (Left to Right): Staff of the Blast Overpressure Program John Yelverton, Keith Saunders, E. Royce Fletcher, William Hicks, Jess Hunley, Berlinda Martinez, Allie Shaw, Donald R. Richmond, and Takeshi Minagawa (circa 1980).



P01835

Daniel L. Johnson Clearing Path to BOP Test Site (the tumbleweeds won).
Circa 1996.

SECTION IV
BIBLIOGRAPHY

BOP Kirtland Data Sorted Alphabetically by Title

K0096

A Chronically Implanted Arterial Catheter for Unanesthetized Animals

Yelverton, J. T., Henderson, E. A., and Dougherty, R. W.

The Cornell Veterinarian, Vol. LIX(3): 466-472, July 1969

K0045

A Comparative Analysis of Some of the Immediate Environmental Effects at Hiroshima and Nagasaki

White, C. S., Bowen, I. G., and Richmond, D. R.

Civil Effects Test Operations Report, Lovelace Foundation for Medical Education and Research, U. S. Atomic Energy Commission, Civil Effects Study, Office of Technical Services, Department of Commerce, Washington, D.C., August 1964.

K0107

A Comparative Analysis of Some of the Immediate Environmental Effects at Hiroshima and Nagasaki

White, C. S., Bowen, I. G., and Richmond, D. R.

Health Physics, Pergamon Press, 10: 89-150, 1964

K0010

A Fluid-Mechanical Model of the Thoraco-Abdominal System With Applications to Blast Biology

Bowen, I.G., Holladay, A., Fletcher, E. R., Richmond, D. R., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., June 14, 1965

K0091

A Mathematical Model of the Lung for Studies of Mechanical Stress

Holladay, A. and Bowen, I. G.

Proceedings of the San Diego Symposium for Biomedical Engineering, La Jolla, CA, 1963

K0048

A Model Designed to Predict the Motion of Objects Translated by Classical Blast Waves

Bowen, I. G., Albright, R. W., Fletcher, E. R., and White, C. S.

Technical Report, Civil Effects Study, Lovelace Foundation for Medical Education and Research, Civil Effects Test Operations, U. S. Atomic Energy Commission, Office of Technical Services, Department of Commerce, Washington, D.C., January 1961

K0087

A Model to Simulate Thoracic Responses to Air Blast and to Impact

Fletcher, E. R.

In Symposium on Biodynamic Models and Their Applications, pp 27-70, Report No. AMRL-TR-71-9, Aerospace Medical Research Laboratory, Aerospace Medical Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, October 26-28, 1970

K0330

A Reappraisal of Man's Tolerance to Indirect (Tertiary) Blast Injuries

Jones, R. K., Richmond, D. R., and Fletcher, E. R.

Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, in Proc. Panel N5, Technical Cooperation Program Working Group on Therapy Regimes Meeting, London, April 1969

K0050

A Review of the Treatment of Underwater Blast Injuries

Yelverton, J. T., Richmond, D.R., Jones, R. K., and Fletcher, E. R.

Final Technical Report, Lovelace Foundation for Medical Education and Research, prepared for Department for the Navy, Office of Naval Research, Arlington, VA, National Technical Information Service, Depart. of Commerce, Springfield, VA, Sep.1976

K0136

A Safe Method for Safely Exposing Individuals at Distances of 0.5 to 2 M from the Source of an Explosion

Richmond, D. R.

Draft Report, Los Alamos National Laboratory, Blast Overpressure Project, Albuquerque, NM to Walter Reed Army Institute of Research, Washington, DC, September 4, 1987

K0005

A Shock Tube Utilized to Produce Sharp-Rising Overpressures of 400 Milliseconds Duration and Its Employment in Biomedical Experimentation

Richmond, D. R., Clare, V. R., Goldizen, V. C., Pratt, D. E., Sanchez, R. T., and White, C.S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, April 7, 1961

K0095

A Study of Effects of Combined Blast and Radiation Injury in Sheep

Jones, R. K., Chiffelle, T.L., and Richmond, D.R.

In Intermedes Proceedings, Combined Injuries and Shock, pp 57-66, 1968.

K0183

A Study of Shock-Driven Jets

Clark, R. O.

Draft Report, Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM, (undated, unpublished)

K0036

A Study of the Tissue Response to Sterile Deposits of Particulate Material

Chiffelle, T. L., Shering, F., Goldizen, V. C., and C. S. White

Final Report, Lovelace Foundation for Medical Education and Research, U. S. Atomic Energy Commission Technical Information Service Extension, Oak Ridge Tennessee, Office of Technical Services, Department of Commerce, Washington, D. C., October 1957

K0360

A Study of the Tissue Response to Sterile Subcutaneous Deposits of Particulate Material

Chiffelle, T. L., Shering, F., and White, C. S.

Technical Report, Lovelace Foundation for Medical Education and Research, prepared for the Atomic Energy Commission, Washington, DC, February 1954

K0015

A Tentative Estimation of Man's Tolerance to Overpressures from Air Blast

Richmond, D.R., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, Defense Atomic Support Agency, Washington, D.C., November 7, 1962

K0088

Absence of Electromagnetic Pulse Effects on Monkeys and Dogs

Hirsch, F. G. and Bruner, A.

Presented at the 56th Annual Meeting of Industrial Medical Association, Atlanta, GA, April 19-22, 1971

K0348

Actual Effectiveness of Hearing Protection: U. S. Army Study

Patterson, J.H., Jr., and Johnson, D. L.

Presented at Nice, France, 1993

K0089

Acute Effects of Air Blast on Pulmonary Function in Dogs and Sheep

Damon, E. G., Yelverton, J. T., Luft, U. C., Mitchell, K. Jr., and Jones, R. K.

Aerospace Med. 42(1): 1-9, 1971.

K0239

Addendum to the Final Report for a Feasibility Study of an Underwater Severance System for Personnel Egress, Appendix A. Lovelace Research Institute Report of Live Animal Tests....----

Moore, D. B., Anderson, M. C., and Huber, G. B.

Final Report, Appendix A. Lovelace Research Institute Report of Live Animal Tests with Type III Underwater Panel Severance Test Assemblies, Explosive Technology, Fairfield, CA, prepared for Naval Ordnance Station, Indian Head, MD, December 1976

K0339

Air Blast Criteria for Personnel In the Open

Richmond, D. R.

Letter of transmittal w/enclosure, Lovelace Foundation for Medical Education and Research, submitted to Geophysical Fluid Dynamics Division, Sandia Laboratories, January 1973

K0090

Air Blast Effects on the Eye

Levy, W. J. and Richmond, D. R.

Resume of exhibit displayed at the American Medical Association Convention, San Francisco, CA, June 1968

K0059

Air-Blast Studies with Eight Species of Mammals

Richmond, D. R., Damon, E. G., Bowen, I. G., Fletcher, E. R., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, August 1966

K0297

Airblast and Underwater Blast Studies with Animals

Richmond, D. R. and Axelsson, H.

Technical Paper, EG&G Mason Research Institute, presented at the 6th International Symposium on Wound Ballistics, Chongqing, China, 1-4 November 1988

K0058

Airblast Effects in Foxholes, Middle North Series, Mixed Company Event

Richmond, D. R., and Jackson, W. S.

Final Project Officers Report, Project LN 403, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 18 June 1974

K0315

Airblast Effects In Foxholes, Program 4-Biomedical, Project LN 403, Mixed Company/Middle Gust Event

Richmond, D. R. and Jackson, W. S.

Project Officers Results Report, Lovelace Foundation for Medical Education and Research, in Proceedings of Mixed/Company Middle Gust Results Meeting, March 1973, DASIAC, Santa Barbara, CA, May 1973

K0057

Airblast Effects Inside Field Fortifications, Middle North Series, Mixed Company III Event

Richmond, D. R., Fletcher, E. R., Jones, R. K., and Jackson, W. S.

Final Project Officers Report, Project LN401, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D.C., 18 June 1974

K0314

Airblast Effects Inside Field Fortifications, Program 4-Biomedical, Project LN 401, Mixed Company/Middle Gust Event

Richmond, D. R., Fletcher, E.R., Jones, R. K. and Jackson, W. S.

Preliminary Project Officers Results Report, Lovelace Foundation for Medical Education and Research, in Proceedings of Mixed/Company Middle Gust Results Meeting, March 1973, DASIAC, Santa Barbara, CA, May 1973

K0293

Airblast Effects on Personnel

Fletcher, E. R., Bowen, I. G., Jones, R. K., and Richmond, D.

Letter of transmittal w/enclosures, Lovelace Foundation for Medical Education and Research, prepared for U.S. Army Combat Development Command, Institute of Nuclear Studies, Fort Bliss, TX, January 1969.

K0185

Airblast Effects on Windows in Buildings and Automobiles - Eskimo II Test

Fletcher, E. R.

Technical Paper, Lovelace Foundation for Medical Education and Research, presented at the 15th Armed Services Explosives Safety Board Meeting, San Francisco, CA, September 1973

K0184

Airblast Effects on Windows in Buildings and Automobiles on the Eskimo III Event

Fletcher, E. R., Richmond, D. R., and Richmond, D. W.

Project Report, Lovelace Foundation for Medical Education and Research, Eskimo III Magazine Separation Test, Test and Evaluation Department, Naval Weapons Center, China Lake, CA, February 1976

K0195

Airblast Effects on Windows in Buildings and Automobiles on the Eskimo III Event

Fletcher, E. R., Richmond, D. R., and Richmond, D. W.

Technical Paper, Lovelace Foundation for Medical Education and Research, in Minutes of the Sixteenth Explosives Safety Seminar, Volume I/II, pp 185-213, Department of Defense Exp Safety Board, Washington, DC, September 1974

K0203

An Estimate of the Blast Effects to Personnel Inside Swedish Field Fortifications on Event Mill Race, Swedish Steel Field Fortifications, Experiment 7001

Richmond, D. R.

Final Report, Lovelace Biomedical and Environmental Research Institute, for Royal Fortifications Administration, Sweden, December 1981

K0054

An Estimation of the Personnel Hazards from a Multi-Ton Blast In a Coniferous Forest

Fletcher, E. R., Richmond, D. R., Bowen, I. G., and White, C. S.

Final Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, November 1967

K0187

Analysis of the Motion-Picture Record of the Dummy in the Goodyear C3 Shelter

Fletcher, E.R.

Project Report, Los Alamos National Laboratory, Los Alamos, NM, to Goodyear Aerospace Corporation, Litchfield Park, AZ

K0303

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1966-1967

K0308

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1971-1972

K0307

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1970-1971

K0306

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1969-1970

K0304

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1967-1968

K0302

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1965-1966

K0301

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1964-1965

K0300

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1963-1964

K0305

Annual Report, Lovelace Foundation for Medical Education and Research

White, C. S.

Lovelace Foundation for Medical Education and Research, 1968-1969

K0132

Auditory and Nonauditory Damage-Risk Assessment for Simulated Weapons Fired from an Enclosure

Johnson, D. R., Yelverton, J. T., Hicks, W. and Doyal, R.

Presentation, EG&G MSI, in Proceedings, 14th International Symposium, Military Aspects of Blast and Shock (MABS), Las Cruces, NM 10-15 Sep 1995, Section 6- Biological Effects of Airblast

K0030

Baroreceptor Reflex Response to Phenylephrine and Carotid Occlusion in Monkeys Receiving 1000 Rads Cobalt-60

Bruner, A., Neely, A. W., Henderson, E. A., and Weiss, G. K.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D.C., 10 August 1973

K0350

Behind Armor Effects Data Bases

Rough draft report, KAFB.BAE 1987, Statistics Group, Los Alamos National Laboratory, March 1988

K0202

Bioeffects from Airblasts Entering Enclosures

Richmond, D. R.

Draft of Personal Paper, unpublished (undated)

K0325

Bioeffects from Bare Charges Detonated Inside Armored Vehicles

Richmond, D. R.

Presentation vu-graphs, Los Alamos National Laboratory, Los Alamos, NM, 1985

K0110

Bioeffects of Simulated Muzzle Blasts

Yelverton, J. T., Richmond, D. R., and Fletcher, E. R.

Progress Report, Lovelace Biomedical and Environmental Research Institute, prepared for Department of the Army, Walter Reed Army Institute of Research, Washington, D.C. (no date)

K0128

Biologic Response to Complex Blast Waves

Richmond, D. R., Yelverton, J. T., Fletcher, E. R., and Phillips, Y. Y.

Technical Report, LA-UR, Los Alamos National Laboratory, in Proceedings Ninth International Symposium MABS 9, Oxford, England, September 23-27, 1985

K0032

Biological Blast Effects

White, C. S.

Progress Report, Lovelace Foundation for Medical Education and Research, prepared for U.S. Atomic Energy Commission, Technical Information Service, Washington, D. C.

K0214

Biological Blast Effects, Statement of Dr. Clayton S. White, Director of Research, Lovelace Foundation for Medical Education and Research, Albuquerque, NM

White, C. S.

In Hearings before the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy, Congress of the US, Eighty-Sixth Congress, First Session on Biological and Environmental Effects of Nuclear War, Part pp 311-372, US Gov Print Off, 1959

K0004

Biological Effects of Blast

White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D. C., December 1961

K0009

Biological Effects of Blast and Shock

Richmond, D. R. and C. S. White

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, April 1966

K0217

Biological Effects of Blast from Bombs. Glass Fragments as Penetrating Missiles and Some of the Biological Implications of Glass Fragmented by Atomic Explosions

Bowen, I. G., Richmond, D. R., Wetherbe, M. B., and White, C. S.

Progress Report, Contract AT(29-1)-1242, Lovelace Foundation, Albuquerque, NM, prepared for U.S. Atomic Energy Commission, Division of Technical Information, Oak Ridge, Tenn, June 18, 1956

K0321

Biological Effects of Complex Blast Waves from Explosions Inside an Enclosure

Richmond, D. R., Yelverton, J.T., Hicks, W., and Phillips, Y.Y.

Draft Results Report, Los Alamos National Laboratory, prepared for Walter Reed Army Institute of Research, Washington, DC, February 1987

K0190

Biological Effects of Exposure to Multiple Blasts

Richmond, D. R.

Draft Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC., 1971

K0216

Biological Effects of Overpressure II. A Shock Tube Utilized to Produce Sharp-rising Overpressures of 400 Milliseconds Duration and Its Employment in Biomedical Experiments

Richmond, D. R., Clare, V. R., Goldizen, V. C., Pratt, D. E., Sanchez, R. T. and White, C. S.

Reprint, Lovelace Foundation for Medical Education and Research, Albuquerque, NM, Aerospace Medicine 32: 997-1008, November 1961

K0044

Biological Effects of Pressure Phenomena Occurring Inside Protective Shelters Following a Nuclear Detonation, Operation Teapot, Project 33.1

White, C.S, Chiffelle, T.L., Richmond, D.R., Lockyear, W.H., Bowen, I.G., Goldizen, V.C., Merideth, H.W., Kilgore, D.E., et al

Report to the Test Director, Lovelace Foundation for Medical Education and Research, U.S. Atomic Energy Commission, Civil Effects Test Group, Office of Technical Services, Department of Commerce, Washington, D.C., October 1956

K0133

Biological Effects of Strong Shock Waves: Influence of the Pulse Duration in Repeated Exposures

Vassout, P., Dancer, A., Richmond, D., and Phillips, Y.

Institute Saint-Louis (ISL), Note S-N 911/84, Saint Louis, France, June 26, 1984

K0186

Biological Hazards from Blast-Induced Flying Glass

Fletcher, E. R. and White, C. S.

Preliminary Report, Lovelace Foundation for Medical Education and Research and Oklahoma Medical Research Foundation, Trident Missiles Flight Test Program, Sandia Laboratories, Albuquerque, NM, October 1976

K0179

Biological Response of Sheep Exposed in an Armored Fighting Vehicle to Overpressures Generated from High Explosives or Shaped-Charge Warheads

Damon, E. G., Costello, M. L., Sedgwick, R. T., Phillips, T. T., and Richmond, D. R.

Technical Report, Los Alamos National Laboratory, prepared for S-Cubed, San Diego, CA, March 1990

K0113

Biological Response to Complex Waves

Yelverton, J. T., Hicks, W., and Dodd, K. T.

Results Report, Los Alamos National Laboratory, prepared for Department of Respiratory Research, Division of Medicine, Walter Reed Army Institute of Research, Washington, D.C., March 1988

K0359

Biological Response to Integrated Effects of Radiation and Blast

Damon, E. G., Jones, R. K., Yelverton, J. T., Richmond, D. R., Hirsch, F. G., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, April 1967

K0349

Biological Scaling in Primary Blast

Bowen, I. G.

Submitted as Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, July 1965. Also presented at TTCP Meeting, Sub Group N, May 1965.

K0219

Biological Tolerance to Accelerative Forces, Addendum I

White, C. S.

Convair Aeromedical Consultant's Report, Lovelace Foundation for Medical Education and Research, Albuquerque, NM, 17 June 1954

K0226

Biological Tolerance to Air Blast and Related Biomedical Criteria

White, C. S., Bowen, I. G., and Richmond, D. R.

Final Report, Lovelace Foundation for Medical Education and Research, prepared for Civil Effects Branch, Division of Medicine, U. S. Atomic Energy Commission, Washington, D. C.

K0363

Biomedical Background Material and Objectives, Program 4, Operation Snowball

Richmond, D. R. et al.

Project Descriptions, Lovelace Foundation, Volume 1, DASA Data Center Special Report, pp 344-385, 1964

K0199

Biomedical Effects of Impulse Noise

Richmond, D. R. and Damon, E. G.

Technical Report, Fortifikatorisk Notat Nr 209/93, support provided by Office of Test Development, Norwegian Defense Construction Service, Oslo, Norway, September 1993

K0002

Biomedical Program 500 Ton Explosion

Betz, P.A., Bowen, I. G., Chiffelle, T. L., Damon, E.G., Fletcher, E.R., Gaylord, C.S., Hicks, W., Perret, R.F. et al.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, Albuquerque, NM, prepared for Defense Atomic Support Agency, Washington, D.C., 1 June 1965

K0223

Biophysical Mechanisms and Scaling Procedures Applicable in Assessing Responses of the Thorax Energized by Air-Blast Overpressures or by Non-Penetrating Missiles

Bowen, I. G., Fletcher, E.R., Richmond, D. R., Hirsch, F. G., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, November 1966

K0106

Biophysical Mechanisms and Scaling Procedures Applicable in Assessing Responses of the Thorax Energized by Air-Blast Overpressures or by Nonpenetrating Missiles

Bowen, I. G., Fletcher, E. R., Richmond, D. R., Hirsch, F. G., and White, C. S.

Annals of the NY Acad. Of Sci. 152, Article 1, pp 122-146, October 28, 1968

K0092

Blast Biology

White, C. S., and Richmond, D. R.

Clinical Cardiopulmonary Physiology, Chapter 63, pp 974-992, Grune & Stratton, Inc., 1960

K0031

Blast Biology

White, C. S., and Richmond, D. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Division of Biology and Medicine, U.S. Atomic Energy Commission, Washington, D.C., September 18, 1959

K0043

Blast Biology--A Study of the Primary and Tertiary Effects of Blast in Open Underground Protective Shelters, Operation Plumbbob, Project 33.1

Richmond, D.R., Taborelli, R.V., Bowen, I. ., Chiffelle, T.L., Hirsch, F.G., Longwell, B.B., Riley, J. G., White, C.S., et al

Report to the Test Director, Lovelace Foundation for Medical Education and Research, U.S. Atomic Energy Commission, Civil Effects Test Group, Office of Technical Services, Department of Commerce, Washington, DC, February 1959

K0191

Blast Biophysics: Past, Present, and Future

Richmond, D. R., Fletcher, E. R., Martinez, B. S., and Yelverton, J. T.

Technical Paper, in Proceedings of the Misers Bluff Phase II Results Symposium, March 27-29, 1979, Section 7-1, Vol. III, pp 7-1 to 7-54, Defense Nuclear Agency, Washington, DC, September 1979

K0361

Blast Criteria for Open Spaces and Enclosures

Richmond, D. R.

Presented at the XXI Nordic Congress of Military Medicine, Oslo, May-2-June 1990. In Scandinavian Supplementum 34, Effects of Noise and Blasts, (Ed. Hans M. Borchgrevink), June 1990.

K0122

Blast Criteria for Personnel in Relation to Quantity-Distance

Richmond, D. R. and Fletcher, E. R.

In Proceedings of the Thirteenth Annual Explosives Safety Seminar, September 14-16, 1971, San Diego, Calif, pp 401-419, Armed Services Explosives Safety Board, Washington, DC, 1971

K0313

Blast Displacement in Field Fortifications, Event Dice Throw

Fletcher, E. R., Richmond, D. R., Clark, R. O. and Yelverton, J.T.

Project Officers Report, Lovelace Biomedical and Environmental Research Institute, in Proceedings of the Dice Throw Symposium, Vol. 3, Section 11, 36 pp, Defense Nuclear Agency, Washington, DC, June 1977

K0319

Blast Displacement of Dummies in Open Terrain and in Field Fortifications, Event Dial Pack, Project LN402

Fletcher, E. R., Richmond, D.R., and Jones, R. K.

Project Officers Report, Lovelace Foundation for Medical Education and Research, in Proceedings, Event Dial Pack Symposium, published by the Defence Research Board of Canada, Vol.II, pp 607-625, March 1971

K0311

Blast Displacement of Dummies on the Surface, Project LN401, Event Dial Pack

Richmond, D. R. and Fletcher, E. R.

Final Report, Project Officers, Lovelace Foundation for Medical Education and Research, Event Dial Pack Preliminary Report, Vol. I-Part II, Defense Atomic Support Agency Information and Analysis Center, Santa Barbara, CA May 1971

K0062

Blast Displacement of Prone Dummies

Fletcher, E. R., Richmond, D. R., and Jones, R. K.

Final Technical Progress Report, Operation Prairie Flat, Project LN-402, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 1 June 1971

K0379

Blast Displacement of Prone Dummies, Operation Prairie Flat, Project LN402

Fletcher, E.R. and Richmond, D.R.

In Symposium Report, Operation Prairie Flat, pp 442-452, prepared for Defense Atomic Support Agency, Washington, D.C., January 1970

K0335

Blast Effects Behind Armor

Richmond, D. R., Yelverton, J.T., Berkbigler, L. W., Moore, L. M., and Phillips, T. T.

Technical Paper, LA-CP-88-12, Los Alamos National Laboratory, Los Alamos, NM, 1988

K0125

Blast Effects Inside Structures

Richmond, D. R. and Kilgore, D. E. Jr.

Report, Lovelace Foundation for Medical Education & Research, Proc. of the 2nd Conf. on Mil. Appli. of Blast Simulators, Nov 2-5, 1970, Naval Weapons Laboratory, Dahlgren, VA, pp 781-804, DNA-2775P, Defense Nuclear Agency, Wash., DC, May 19, 1972

K0056

Blast Effects of Helicopter Plexiglas Windows, Middle North Series, Mixed Company Event,

Fletcher, E. R., Richmond, D. R., Jones, R. K., and Jackson, W. S.

Final Project Officer's Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D.C., 18 June 1974

K0333

Blast Effects on Anthropomorphic Dummies Inside a Norwegian Field Fortifications, Event Direct Course

Richmond, D. R., Fletcher, E. R., and Yelverton, J. T.

Final Report, Lovelace Biomedical and Environmental Research Institute, prepared for Norwegian Defense Construction Service, Oslo mil/Akershus, N-Oslo, Norway, March 1984

K0334

Blast Effects on Anthropomorphic Dummies Inside the French AMF-80 Shelter, Event Direct Course, Experiment 6200 France/BRL

Richmond, D.R., Fletcher, E. R., and Yelverton, J. T.

Final Report, Lovelace Biomedical and Environmental Research Institute, prepared for Defense Nuclear Agency, Kirtland Air Force Base, NM, March 1984

K0204

Blast Effects on Crew Personnel, Event Mill Race Experiment 2311

Richmond, D. R., Yelverton, J. T., and Fletcher, E. R.

Final Report, Lovelace Biomedical and Environmental Research Institute, prepared for Defense Nuclear Agency, Kirtland Air Force Base, NM, 17 February 1982

K0322

Blast Effects on Dummies in BRL FET-Event Minor Scale

Richmond, D. R. and Yelverton, J. T.

Project Officer's Results Report, Los Alamos National Laboratory, to be included as an appendix in the final U.S. Army Ballistic Research Laboratories Project Officers Report, Aberdeen, MD, July 1986 (draft copy)

K0323

Blast Effects on Dummies in Fighting Bunkers, Dice Throw Event

Clark, R. O.

Preliminary Results Report, Lovelace Biomedical and Environmental Research Institute, prepared for Field Command, Defense Nuclear Agency, Kirtland Air Force Base, NM, November 1976

K0120

Blast Effects on Helicopter Plexiglas Windows

Fletcher, E. R.

Contract Report No. 142, Lovelace Foundation for Medical Education and Research, prepared for U. S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, MD, March 1974

K0309

Blast Effects on Helicopter Plexiglas Windows, Program 1 - Airblast, Project LN 115/402

Fletcher, E. R., Richmond, D. R., Jones, R. K., Jackson, W. S.

Preliminary Report, Lovelace Foundation for Medical Education and Research, in Proceedings of the Mixed Company/Middle Gust Results Meeting, 13-15 Mar 1973, Defense Nuclear Agency, Washington, DC, May 1973

K0326

Blast Effects on Helicopter Plexiglas Windows, Project LN115/402, Event Mixed Company Middle North Series

Fletcher, E. R., Richmond, D. R., Jones, R. K., and Jackson, W. S.

Final Project Officer's Report, Lovelace Foundation for Medical Education and Research, Contract DAAD-05-72-C-0362, to Ballistic Research Laboratories, Aberdeen, MD, 1 December 1973

K0328

Blast Effects on the Canadian XC4 Mask

Grant, G., Yelverton, J. T., Matthes, A., Hicks, W., and Richmond, D.

Final Project Officer's Report, Los Alamos National Laboratory, prepared for Defence Research Establishment, Ottawa, Canada, November 1986 (cy of rough draft)

K0205

Blast Effects on the Crews of U. S. Army Tactical Equipment, Dice Throw Event

Richmond, D. R., Yelverton, J. T., Fletcher, E. R., Hicks, W., Saunders, K., Trujillo, A.

Project Report, Lovelace Foundation, prepared for U. S. Army Ballistic Research Laboratories, Aberdeen, MD, 1976

K0312

Blast Effects on the Crews of U.S. Army Tactical Equipment, Dice Throw Event

Richmond, D. R., Yelverton, J. T., Fletcher, E. R., Hicks, W., Saunders, K., and Trujillo, A.

Project Officers Report, Lovelace Biomedical and Environmental Research Institute, in Proceedings of the Dice Throw Symposium, Vol. 2, Section 11, 132 pp, Defense Nuclear Agency, Washington, DC, June 1977

K0001

Blast Induced Translational Effects

Fletcher, E. R. and Bowen, I. G.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, Albuquerque, NM prepared for Defense Atomic Support Agency, Washington, D.C., November 1966

K0201

Blast Injuries from the Detonation of Small Charges Inside an Armored Vehicle

Richmond, D. R.

Draft Preliminary Report, Los Alamos National Laboratory, Kirtland Air Force Base Site, unpublished (undated)

K0196

Blast Injuries Produced by the Detonation of Small Charges Within an Enclosure

Richmond, D. R., Yelverton, J. T., and Fletcher, E. R.

Draft Report, Lovelace Biomedical and Environmental Research Institute, prepared for Division of Medicine, Walter Reed Army Institute of Research, Washington, DC (undated]

K0138

Blast Overpressure Report, Life Fire Test/Crew Casualty Assessment Workshop,

Richmond, D. and Josephson, L.

Minutes Final copy, co-chairman's, Working Group IV, EG&G Mason Research Institute and Naval Weapons Center, China Lake, CA, submitted to The Analytical Sciences Corporation, Fort Walton Beach, FL, 1988

K0271

Blast Overpressure Studies with Animal and Man: Task Order 2 - Biological Response to Complex Blast Waves

Yelverton, J. T., Johnson, D. L., Hicks, W., and Doyal, R.

Final Report, EG&G Special Projects, Contract DAMD-17-88-C-8141, U.S. Army Medical Research Acquisition Activity, SGRD-RMA-RC, Ft Detrick, MD, October 1993

K0268

Blast Overpressure Studies with Animals and Man, Task Order 3: Comparison of Blast Overpressure Effects on Two Versions of ACAPS

Johnson, D. L.

Interim Report, EG&G Special Projects, Contract DAMD-17-88-C-8141, prepared for U.S. Army Medical Research and Development Command, Fort Detrick, MD, August 1991

K0269

Blast Overpressure Studies with Animals and Man: Task Order 2 - Biological Response to Complex Blast Waves in a 17.3-m Enclosure

Yelverton, J. T.

Interim Task Order Report, FY90 Protocol, EG&G Special Projects, Contract DAMD-17-88-C-8141, U.S. Army Medical Research and Development Command, Fort Detrick, MD, March 1991

K0272

Blast Overpressure Studies with Animals and Man: Task Order 2 - Biological Response to Complex Blast Waves in Various Enclosure Volumes

Yelverton, J. T. and Johnson, D. L.

Interim Report, Task Order 2 FY 91 Protocol, EG&G Special Projects, Contract DAMD17-88-C-84-8141. U. S. Army Medical Research Acquisition Activity, SGRD-RMA-RCG, Fort Detrick, MD, December 1991

K0270

Blast Overpressure Studies with Animals and Man: Task Order 4 - Nonauditory Damage Risk Assessment for Simulated Weapons Fired from an Enclosure

Johnson, D. R., Yelverton, J.T., Hicks, W. and Doyal, R.

Final Report, EG&G Special Projects, Contract DAMD17-88-C-8141, U.S. Army Medical Research and Development Command, Fort Detrick, MD, November 1993

K0080

Blast Overpressure Studies With Animals and Man: A Walk-Up Study

Johnson, D. L.

Final Report, EG&G Special Projects, Contract DAMD-17-8-C-8141, prepared for U. S. Army Aeromedical Research Laboratory, Fort Rucker, AL, September 1994

K0256

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Group BBB, 5 Meter Distance, Unmodified Muff, Sep-Oct 1989)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, October 1989

K0257

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Group BCC, 5 Meter Distance, Unmodified Muff, Oct-Nov 1989)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, November 1989

K0248

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Group CBC, 3 Meter Distance, Modified Muff, Aug-Sep 1992)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, September 1992

K0258

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups BDD and BDE, 5 Meter Distance, Unmodified Muff, Jan-Feb 1990)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, March 1990

K0259

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups BEF and BEG, 5 Meter Distance, Unmodified Muff, Mar-Apr 1990)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, April 1990

K0260

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups BFH and BFI, 5-Meter Distance, Unmodified Muff, Apr-May 1990)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, May 1990

K0261

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups BGJ-BGK, 5-Meter Distance, Unmodified Muff, Jun-Jul 1990)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, July 1990

K0247

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups CAA and CAB, 3 Meter Distance, Modified Muff, July-Aug 1992)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, August 1992

K0253

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups CCD and CCE, 3 Meter Distance, Modified Muff, Sep-Oct 1992)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, Nov 1992

K0249

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups CDF and CDG, 3 Meter Distance, Modified Muff, Nov-Dec 1992)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, December 1992

K0250

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups CEH and CEI, 3 Meter Distance, Modified Muff, Jan-Feb 1993)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, February 1993

K0251

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups CFJ and CFK, 3 Meter Distance, Modified Muff, Feb-Mar 1993)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, April 1993

K0252

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups CGL and CGM, 3 Meter Distance, Modified Muff, Mar-Apr 1993)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, June 1993

K0243

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups DAA and DAB, 1 Meter Distance, Modified Muff, August 1991)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, September 1991

K0241

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups DBC and DBD, 1 Meter Distance, Modified Muff, Sep-Oct 91)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, Nov 91

K0242

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups DCE and DCF, 1 Meter Distance, Modified Muff, Nov-Dec 1991)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, January 1992

K0244

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups DDG and DDH, 1 Meter Distance, Modified Muff, Jan-Feb 1992)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, March 1992

K0245

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups DEI and DEJ, 1 Meter Distance, Modified Muff, Mar-Apr 1992)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, May 1992

K0246

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups DFK and DFL, 1 Meter Distance, Modified Muff, June-July 1992)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, July 1992

K0262

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups MAA-MAB, 5-Meter Distance, Modified Muff, Sep 1990)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, Oct 1990

K0263

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups MBC-MBD, 5-Meter Distance, Modified Muff, Oct-Nov 1990)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, Nov 1990

K0264

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups MCE-MCF, 5-Meter Distance, Modified Muff, January 1991)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, Jan 1991

K0265

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups MDG, 5-Meter Distance, Modified Muff, February 1991)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, March 1991

K0267

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups MEH-MEI, 5-Meter Distance, Modified Muff, April-May 1991)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, May 1991

K0266

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups MFJ and MFK, 5-Meter Distance, Modified Muff, May-June 1991)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, July 1991

K0254

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups PAA and PAB, 3 Meter Distance, Perforated Ear Plug, May 1993)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, July 1993

K0255

Blast Overpressure Studies with Animals and Man: Direct Determination of Occupational Exposure Limits for Freefield Impulse Noise (Groups PBC and PBD, 3 Meter Distance, Perforated Plug, Jul-Aug 1993)

Johnson, D. L.

Interim Report, EG&G Special Projects, prepared for U.S. Medical Research and Materiel Command, Fort Detrick, MD, August 1993

K0240

Blast Overpressure Studies With Animals and Men: A Walk-Up Study

Johnson, D. L.

Final Report, Contract DAMD-17-88-C-8141, EG&G Special Projects, prepared for U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, September 1994

K0277

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 - Firing from an Enclosure Simulator, Groups 101 and 102

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, July 1994

K0278

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 - Firing from an Enclosure Simulator, Groups 103 and 104

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, August 1994

K0279

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 - Firing from an Enclosure Simulator, Groups 105 and 106

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, September 1994

K0280

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 - Firing from an Enclosure Simulator, Groups 107 and 108

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, December 1994

K0281

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 - Firing from an Enclosure Simulator, Groups 109, 110, and 111

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, February 1995

K0282

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 - Firing from an Enclosure Simulator, Groups 112, 113, and 114

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, March 1995

K0283

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 - Firing from an Enclosure Simulator, Groups 115, 116, and 117

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, May 1995

K0284

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 - Firing from an Enclosure Simulator, Groups 118, 119, and 120

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, June 1995

K0276

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 1 and 4 - Firing from an Enclosure Simulator

Johnson, D. L.

Final Task Report, Task Orders 1 and 4, EG&G Management Systems, Inc., Contract DAMD17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD February 1997

K0285

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 4 - Nonlinear Earplug Study, Groups 201, 202, 203, and 204

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, October 1995

K0286

Blast Overpressure Studies: Direct Determination Exposure Limits for Intensive Reverberant Impulse Noise, Task Order 4 - Nonlinear Earplug Study, Groups 205, 206, 207, and 208

Johnson, D. L.

Interim Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, November 1995

K0273

Blast Overpressure Studies: Task Order 5 - Part II: Nonauditory Damage-Risk Assessment for Simulated Weapons Fired 100 Times from an Enclosure

Merickel, B.

Final Report, EG&G Management Systems, Inc., Contract DAMD17-93-C-3101, U.S. Army Medical Research and Materiel Command, Ft Detrick, MD, October 1997

K0275

Blast Overpressure Studies: Task Order 2 - Nonauditory Damage Risk Assessment for Simulated 155mm Self-Propelled Howitzer Muzzle Blast

Yelverton, J. T.

Final Task Report, EG&G Management Systems, Inc., Contract DAMD-17-93-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, February 1997

K0274

Blast Overpressure Studies: Task Order 2 - Nonauditory Damage Risk Assessment for Simulated Muzzle Blast from a 120mm M121 Mortar System

Yelverton, J. T., Johnson, D. L., Hicks, W., and Merickel, B.

Final Report, EG&G Management Systems, Inc., Contract DAMD1793-C-3101, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD, October 1997

K0207

Blast Protection Afforded by Foxholes and Bunkers - Event Dial Pack

Richmond, D. R.

Technical Paper, Lovelace Foundation for Medical Education and Research, in Proceedings Kolloquium des Fechausschusses I, Probleme des Baulichen Schutes, Weill/Rhein, Germany, pp 11-36, June 1971

K0318

Blast Protection Afforded by Foxholes and Bunkers, Event Dial Pack, Project LN401

Richmond, D. R., Fletcher, E. R., and Jones, R. K.

Project Officers Report, Lovelace Foundation for Medical Education and Research, in Proceedings, Event Dial Pack Symposium, published by the Defence Research Board of Canada, Vol.II, pp 581-606, March 1971

K0369

Blast Simulations

Richmond, D. R.

Comments on attendance at Fifth International Symposium on Military Applications of Blast Simulation w/attech - Notes on Swedish Lung Model,

K0081

Blast-Induced Translational Effects

Fletcher, E. R. and Bowen, I. G.

Annals of the New York Academy of Sciences 152(1): 378-403, October 28, 1968

K0213

Canadian Biomedical Experiments Proposed for 100 Ton TNT Explosion

White, C. S., Bowen, I. G., and Richmond, D. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support, Washington, DC, 27 July 1961

K0331

Characteristics and Biological Effects of Fragments from Glass and Acrylic Windows Broken by Airblast

Fletcher, E. R. and Richmond, D. R.

Technical Report, Lovelace Foundation for Medical Education and Research, in Research Report 22, DCPA All-Effects Research Contractors Meeting, Pacific Grove, CA, April 21-25, 1974, October 1974

K0336

Characteristics of Plexiglas Fragments from Windows Broken by Airblast

Fletcher, E. R., Richmond, D. R., Babb, R. G., and Viney, J. F.

Technical Report, Lovelace Foundation for Medical Education and Research, prepared for Ballistic Research Laboratories, Aberdeen Proving Ground, MD, February 1974

K0094

Chest Wall Velocity as a Predictor of Nonauditory Blast Injury in a Complex Wave Environment

Axelsson, H., and Yelverton, J. T.

J. of Trauma: Injury, Infection, and Clinical Care, 40 (3): S31 to S37, 1996

K0114

Cloth Ballistic Vest Alters Response to Blast

Phillips, Y. Y., Mundie, T. G., Yelverton, J. T., and Richmond, D. R.

Department of Respiratory Research, Walter Reed Army Institute of Research, Washington, D.C. In Proceedings Fifth International Symposium, 11-14 June 1985, Gotenburg, Sweden. Also J. of Trauma 28(1): S149-

K0352

Combined Injury Bibliography - 1945 to 1965

Levy, W. J., Jones, R. K. and Rupprecht, F. C.

Lovelace Foundation for Medical Education and Research, prepared for Combined Nuclear Weapons Effects Study Working Group, 1965 (unpublished)

K0162

Comments on Blast Effects on Personnel.

Richmond, D. R. and Fletcher, E. R.

Draft Comments, 6 pp, Lovelace Foundation for Medical Education and Research, to Institute of Nuclear Studies, US Army Combat Development Command, Fort Bliss, TX, December 1, 1970

K0212

Comments on CDOG Study No., USACDCNG 62-8, Criteria for Nuclear Weapon Personnel Casualties

White, C. S., Bowen, I. G., and Richmond, D. R.

Technical Paper, Lovelace Foundation for Medical Education and Research, submitted to Defense Atomic Support Agency, Washington, DC, August 3, 1963

K0139

Comments on Draft USANCA Nuclear Notes No. 9, Nuclear Weapons Effects Mitigation Techniques

Richmond, D. R.

Draft comments, Lovelace Biomedical and Environmental Research Institute, to US Army Nuclear Chemical Agency, Springfield, VA

K0164

Comments on the Report Entitled "Preliminary Civilian Casualty Criteria for Low-Yield Nuclear Weapons (U)" DNA-3547T

Richmond, D. R. and Fletcher, E. R.

Comments by Lovelace Foundation for Medical Education and Research for Director, Defense Nuclear Agency, Washington, DC (formerly Confidential, downgraded 31 Dec 81)

K0362

Comparative Effects Data of Biological Interest

White, C. S. and Bowen, I. G.

Lovelace Foundation for Medical Education and Research, Booklet compiled for Office of the Surgeon, Hqs Field Command, Armed Forces Special Weapons Project (circa 1959).

K0218

Comparative Effects Data of Biological Interest

White, C.S. and Bowen, I. G.

Progress Report, First Draft, Contract AT(2901)-1242 Lovelace Foundation for Medical Education and Research, Albuquerque, NM, Div of Biology and Medicine, U.S. Atomic Energy Commission, Wash., DC, 10 Apr 1959

K0063

Comparative Effects of Hyperoxia and Hyperbaric Pressure in Treatment of Primary Blast Injury

Damon, E. G. and Jones, R. K.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D.C., 1 March 1971

K0040

Comparative Nuclear Effects of Biomedical Interest

White, C. S., Bowen, I. G., Richmond, D. R., and Corsbie, R. L.

Civil Effects Test Operations Report, Lovelace Foundation for Medical Education & Research, Albuquerque, NM prepared for Civil Effects Test Operations, US Atomic Energy Commission, Division of Biology and Medicine, Washington, D. C., September 1960

K0368

Current Research - Blast

Richmond, D. R.

In Minutes, Joint United Kingdom-United States, Maritime and Marine Combat Casualty Care Workshops, 1. Ballistic Injuries, pp 18-19, Institute of Naval Medicine, Alverstoke, England, July 27-31, 1981

K0142

Current Research and Development on the Bioeffects of Blast

Richmond, D. R.

Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM. Presented at Joint UK/US Navy Workshops on R&D for Improved Combat Casualty Care, Institute of Naval Medicine, Alverstoke, Hampshire, England 27-31 July 1981

K0144

Current Status on Impulse Noise Induced Nonauditory Injury In Sheep

Richmond, D.R.

Pathology Report, Lovelace Biomedical and Environmental Research Institute, to Walter Reed Army Institute of Research, Washington, DC, July 25, 1978

K0121

D.A.S.A. - A.E.C. Blast Tube Facility, Operated by Lovelace Foundation for Medical Education and Research for the Defense Atomic Support Agency, Albuquerque, NM

Descriptive Brochure, Lovelace Foundation for Medical Education and Research, Albuquerque, NM, circa 1965-1970.

K0127

Damage-Risk Criteria for Personnel Exposed to Repeated Blasts

Richmond, D. R., Yelverton, J. T., Fletcher, E. R., Phillips, Y. Y., Jaeger, J. J. and Young, A. J.

Minutes of the Twentieth Explosives Safety Seminar, Norfolk, VA 24-26 Aug 1982, Vol. II, pp 1489-1512

K0192

DASA-AEC-Lovelace Foundation Blast Simulation Facilities

DASA Data Center Special Report 27, Blast and Shock Simulation Facilities in the UK, Canada, and the US, DASA-1627, Defense Atomic Support Agency, Washington, DC, April 1965

K0007

DASA-AEC-Lovelace Foundation Blast-Simulation Facility

Richmond, D.R., Gaylord, C. S., Damon, E. G., and Taborelli, R. V.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., August 1966

K0099

Delayed Match-to-Sample Early Performance Decrement in Monkeys after ⁶⁰Co Irradiation

Bruner, A., Bogo, V., and Jones, R. K.

Rad. Res. 63: 83-96, 1975

K0067

Delayed Match-to-Sample Performance Decrement in Monkeys Following Cobalt-60 Irradiation

Bruner, A., Bogo, V., and Jones, R. K.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 10 August 1973

K0046

Determinations of Aerodynamic-Drag Parameters of Small Irregular Objects by Means of Drop Tests

Fletcher, E. R., Albright, R. W., Goldizen, V. C., and Bowen, I. G.

Technical Report, Lovelace Foundation for Medical Education and Research, prepared for Civil Effects Test Operations, U.S. Atomic Energy Commission, Office of Technical Services, Department of Commerce, Washington, DC, June 1960

K0197

Direct Airblast Effects in the Open Including Multiple Blasts

Richmond, D. R.

Personal Papers, unpublished (undated)

K0364

Distribution and Density of Missiles from Nuclear Explosions - Operation Teapot, Nevada Test Site, February-May 1955

Bowen, I. G., Strehler, A. F., and Wetherbe, M. B.

Technical Report, Lovelace Foundation for Medical Education and Research, for Test Director, Civil Effects Group, Atomic Energy Commission, December 1956.

K0377

Dose-Rate Effects of 60 Co Irradiation on Performance and Physiology in Monkeys

Bruner, A.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, July 1975

K0129

Double Peak Study

Richmond, D. R.

Results Report, Lovelace Biomedical and Environmental Research Laboratory, prepared for Department of the Army, Walter Reed Army Institute of Research, Department of Clinical Physiology, Washington, DC, June 18, 1982

K0317

Dummy Response, Minor Scale Event, Valhall II, Experiment 7410

Yelverton, J. T. and Fletcher, E. R.

Project Officers Report, Los Alamos National Laboratory, in Proceedings of the Minor Scale Symposium, February 1986, Vol. IV, pp 85-102, Field Command, Defense Nuclear Agency, Washington, DC, June 1986

K0126

Effectiveness of a Leaking Earmuff Versus a Leaking Earplug

Johnson, D. L. and Patterson, J. H.

Technical Report, EG&G Special Projects and US Army Aeromedical Research Laboratory, Fort Rucker, AL., USAARL 97-23, July 1997

K0098

Effects of 1000 Rad of 60Co on Baroreceptor Reflex Responses in Phenylephrine and Carotid Occlusion in Monkeys

Bruner, A., Neely, A.W., Henderson, E. A., and Weiss, G.K.

Radiat. Res. 61:393-404, 1975

K0078

Effects of 60Co on Electrical Self-Stimulation of the Brain and Blood Pressure

Bruner, A.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 13 December 1974

K0310

Effects of Airblast on Sheep in Two-Man Foxholes, Operation Prairie Flat, Project LN 401

Richmond, D. R., and Jones, R. K.

Final Project Officers Report, Lovelace Foundation for Medical Education and Research, in Operation Prairie Flat Preliminary Report, Vol. I, pp 634-644, January 1969

K0228

Effects of Ambient Pressure on Tolerance of Mammals to Air Blast

Damon, E. G., Gaylord, C. S., Yelverton, J.T., Richmond, D. R., Bowen, I. G., Jones, R. K., and White, C. S.

Technical Paper, Lovelace Foundation for Medical Education and Research, in Aerospace Medicine, 19(10): 1039-1047, October 1968

K0027

Effects of Irradiation and Blast on Pulmonary Function in Sheep

Yelverton, J.T., Damon, E. G., Jones, R. K., Chiffelle, T. L., and Luft, U. C.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D. C., January 1971 (unpublished)

K0053

Effects of Overpressure on the Ear - A Review

Hirsch, F. G.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, November 1966

K0101

Effects of Overpressure on the Ear--A Review

Hirsch, F. G.

Annals of the NY Acad. of Sci. 152, Article 1: 147-162, October 28, 1968

K0198

Effects of Overpressures in Group Shelters on Animals and Dummies, Project 23.15, Operation Upshot-Knothole

Richmond, D. R.

Final Report, Lovelace Foundation for Medical Education and Research, Civil Effects Test Group, Nevada Proving Grounds, Atomic Energy Commission, Washington, DC, March-June 1953

K0066

Effects on Blood Pressure and Heart Rate of Selective Shielding of Midline Trunk Structures in Monkeys Exposed to 1000 Rads 60Co

Bruner, A.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 18 June 1976

K0055

Estimate of Man's Tolerance to the Direct Effects of Air Blast

Bowen, I. G., Fletcher, E. R., and Richmond, D. R.

Technical Report, Lovelace Foundation for Medical Education and Research, prepared for the Defense Atomic Support Agency, Washington, D. C., October 1968

K0168

Evaluation of Jeep and Anthropomorphic Dummy Displacements in the French Large Blast Simulator

Fletcher, E. R.

Final Technical Report, Lovelace Biomedical and Environmental Research Institute, prepared for Defense Nuclear Agency, Washington, D.C., January 1985

K0130

Exercise Tolerance of Rats Following Exposure to Gamma Radiation

Yelverton, J. T., Viney, J. F., Jojola, B. III, and Jones, R. K.

Technical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, 1971 (unpublished)

K0340

Exposure Inside an Enclosure

Richmond, D. R.

Technical Paper, Life Sciences Division, Los Alamos National Laboratory, presented at Meetings at Etablissement Technique de Bourges, NATO Panel VIII, RGS6 Group, Effects of Impulse Noise, Bourges, France, June 1987

K0111

Exposure of an Anthropomorphic Dummy to Blast Overpressure

Young, A. J., Jaeger, J. J., Phillips, Y. Y., and Richmond, D. R.

Walter Reed Army Institute of Research, Division of Medicine, Department of Clinical Physiology, Washington, DC (no date)

K0292

FAE Effects

Richmond, D. R.

Technical Paper, Los Alamos National Laboratory, presented at Meetings at Etablissement Technique de Bourges, NATO Panel VIII, RSG-6 Group, Effects of Impulse Noise, Bourges, France, June 1987

K0288

FAE Effects on Personnel in General

Richmond, D. R.

Foreign Travel Trip Report, Los Alamos National Laboratory, presented at the meeting of the NATO AD HOC Working Group of Protective Construction Measures, Oslo, Norway, May-June 1988

K0006

Far-Field Underwater-Blast Injuries Produced by Small Charges

Richmond, D. R., Yelverton, J. T., and Fletcher, E. R.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D.C., 1 July 1973

K0182

Flying Glass Hazard from Windows Broken by Airblast

Fletcher, E. R.

Draft, Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Director, Defense Nuclear Agency, Washington, DC, 1978

K0075

Glass Fragment Hazard from Windows Broken by Airblast

Fletcher, E. R., Richmond, D. R., and Yelverton, J. T.

Topical Report, Lovelace Biomedical and Environmental Research Institute, prepared for Defense Nuclear Agency, Washington, DC, 30 May 1980

K0150

Gross Scoring System of Lesions Produced by Blast Overpressure

Clifford, C. B.

Notes of Meeting, Department of Comparative Pathology, Division of Pathology, Walter Reed Army Institute of Research, Washington, DC, w/ltr of transmittal, 27 May 1982

K0022

Immediate Changes in Estimated Cardiac Output and Vascular Resistance After 60Co Exposure in Monkeys

Bruner, A.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D.C., 8 August 1976

K0173

Immediate Changes in Estimated Cardiac Output and Vascular Resistance after 60Co Exposure in Monkeys: Implications for Performance Decrement

Bruner, A.

Technical Paper, Lovelace Foundation for Medical Education and Research, in Radiat. Res. 70: 391-405, 1977.

K0083

Immediate Dose-Rate Effects of 60Co on Performance and Blood Pressure in Monkeys

Bruner, A.

Rad. Res. 70: 378-390, 1977

K0376

Immediate Effects of 33 to 180 Rad/Min 60Co Exposure on Performance and Blood Pressure in Monkeys

Bruner, A.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, September 1976

K0375

Impact-Velocities of Steel Spheres Translated by Air Blast, Program 4, Project 4.6, Operation Snowball

Fletcher, E. R.

Files, Lovelace Foundation for Medical Education and Research (undated).

K0019

Injuries Produced by the Propagation of Airblast Waves Through Orifices

Richmond, D.R., Fletcher, E. R., Saunders, K., and Yelverton, J. T.

Topical Report for Period 1 March 1979-1 March 1980, Lovelace Foundation for Medical Education and Research, Defense Atomic Support Agency, Washington, DC, 1 March 1980

K0177

Intrathoracic Pressure in Humans Exposed to Short Duration Airblast

Young, A. J., Jaeger, J. J., Phillips, Y. Y., Fletcher, E. R., and Richmond, D. R.

Reprint, Walter Reed Army Institute of Research, Washington, D.C., Military Medicine, 150(9): 483, September 1985

K0189

Large Animal Response to Complex Waves Generated in the EG&G Variable Volume Test Enclosure

Yelverton, J. T. and Johnson, D. L.

Presentation, EG&G Special Projects, Albuquerque, NM, at the RSG-6 Meeting, NATO Defense Applications of Biomedical Sciences Research Study Group 6, Panel 8, Effects of Impulse Noise, Albuquerque, NM, October 1991

K0112

Low Level Blast Exposure in Humans

Jaeger, J., Phillips, Y., Young, A., Hoyt, R., and Richmond, D. R.

Walter Reed Army Institute of Research, Department of Clinical Physiology, Division of Medicine, Washington, DC

K0148

Lung Model Program Computer Runs , Burroughs R-5500 Algol Compiler Level 12

Fletcher, E. R.

Personal Files, Lovelace Foundation for Medical Education and Research, Albuquerque, NM, November 23, 1970

K0158

M-17 and M-43 Chemical Defense Masks

Johnson, D. L.

Photographs, Personal communication D. L. Johnson to J. Patterson.

K0176

Method Used Developing Direct-Blast Criteria for 50-Percent Combat Ineffectiveness of Troops in Foxholes, Sections I and II. Incident Shock Parallel and Perpendicular to Ground Surface

Richmond, D. R.

Correspondence, Lovelace Foundation for Medical Education and Research, to USA Nuclear Agency/WED, Fort Bliss, TX, January 6, 1975

K0035

Missile Studies With a Biological Target, Project 33.4, Operation Plumbbob, Nevada Test Site, May-October 1957,

Goldizen, V. C., Richmond, D. R., Chiffelle, T. L., Bowen, I. G., and White, C. S.

Report to the Test Director, Civil Effects Test Group, Lovelace Foundation for Medical Education and Research, U. S. Atomic Energy Commission, Office of Technical Services, Department of Commerce, Washington, DC, January 23, 1961

K0011

Mortality in Small Animals Exposed in a Shock Tube To "Sharp"-Rising Overpressures of 3-4 msec Duration

Richmond, D.R., Goldizen, V. C., Clare, V. R., Pratt, D. R., Sherping, F., Sanchez, R.T., Fischer, C.C., and White, C.S.

Technical Progress Report, Defense Atomic Support Agency, Washington, D.C., June 15, 1961

K0346

Nature of Blast Injuries: Blast/Overpressure Criteria

Richmond, D. R.

Technical Paper, EG&G Mason Research Institute, presented at Crew Casualty Assessment Workshop, Working Group IV: Blast Overpressure Report (no date)

K0294

Necropsy Results, Underwater Blast Study

Richmond, D. R.

Letter of transmittal, Lovelace Foundation for Medical Education and Research, prepared for Explosives Technology, Farfield, CA, October 1976

K0338

New Airblast Criteria for Man

Richmond, D. R., Yelverton, J. T. and Fletcher, E. R.

Technical Paper, Life Sciences, Los Alamos National Laboratory, presented at the Twenty-Second DOD Explosives Safety Seminar, Anaheim, CA, 26-28 August 1986

K0154

Nonauditory Biological Effects of Exposure to Repeated Blasts

Richmond, D. R.

Foreign Travel Reports, NATO RSG6 , Notes, Lovelace Biomedical and Environmental Research Institute, to Department of Energy, Albuquerque, NM, with letter of transmittal, 21 Aug 1981

K0365

Nonauditory Effects of Repeated Exposures to Intense Impulse Noise

Phillips, Y. Y., Dancer, A., and Richmond, D. R.

Walter Reed Army Institute, paper presented at a NATO Meeting, Italy, September 1985.

K0105

Nonauditory Injury Threshold for Repeated Intense Freefield Impulse Noise

Dodd, K. T., Yelverton, J.T., Richmond, D. R., Morris, J. R., and Ripple, G. R.

J. of Occup. Med. 32(3): 260-266, March 1990

K0211

Notes on the Canadian Biomedical Experiments Carried out in Conjunction with the 100-Ton Explosion at Suffield Experimental Station Near Ralston, Alberta, Canada, Oct 10, 1961

Richmond, D. R.

Technical Paper, Lovelace Foundation for Medical Education and Research, in Minutes of Meeting, Tripartite Technical Cooperation Program, 14-15 March 1963

K0047

Nuclear Bomb Effects Computer (Including Slide-Rule Design and Curve Fits for Weapons Effects

Fletcher, E. R., Albright, R. W., Perret, R. F. D., Franklin, M. E., Bowen, I. G. and White, C. S.

Technical Report, Lovelace Foundation for Medical Education and Research, prepared for Civil Effects Test Operations, U. S. Atomic Energy Commission, Office of Technical Services, Department of Commerce, Washington, DC, April 1962

K0324

On Fuel-Air Explosions

Richmond, D. R.

Technical Presentation, Los Alamos National Laboratory, presented at the Meeting of Munitions Experts, Washington, DC, September 1985

K0071

Organic Acids as Metabolic Indicators - The Metabolism of 14C-Propionate in Rats Exposed to Irradiation and Thermal Injuries

Henderson, T. R. and Jones, R. K.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D.C., February 1973

K0209

Orbital Blow-Out Fractures in Dogs Produced by Air Blast

Richmond, D. R., Pratt, D. E., and C. S. White

Formal Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, April 10, 1962

K0084

Part II. Personnel Sensitivity. The Scope of Blast and Shock Biology and Problem Areas in Relating Physical and Biological Parameters

White, C. S.

Ann. NY Acad. of Science, 152(1): 89-102, October 28, 1968

K0049

Pathology of Direct Air-Blast Injury

Chiffelle, T. L.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for the Defense Atomic Support Agency, Washington, D.C., April 1966

K0093

Pathology Scoring System for Blast Injuries

Yelverton, J. T.

J of Trauma: Injury, Infection, and Clinical Care, 40 (3): S111-S115, 1996. Presented at the 7th International Symposium of Weapons Traumatology and Wound Ballistics, St Petersburg, Russia, September 1994.

K0181

Personnel Casualties, Chapter 10, Section 1, Airblast, Revised Edition of DNA EM-1

Richmond, D. R.

Draft, Lovelace Biomedical and Environmental Research Institute, to Defense Nuclear Agency, Washington, DC, October 1981

K0329

Personnel Protection from Blast Displacement, Miser's Bluff Event

Fletcher, E. R., Yelverton, J. T., and Richmond, D. R.

Preliminary Data Report, Lovelace Biomedical and Environmental Research Institute, prepared for Defense Nuclear Agency, Washington, DC, 9 August 1978

K0229

Personnel Protection, Event Misers Bluff

Fletcher, E. R., Yelverton, J.T., and Richmond, D. R.

Final Results Report, Lovelace Biomedical and Environmental Research Institute, in Proceedings, Misers Bluff Results Symposium, Phase II, 27-29 March 1979, Vol II/III, pp 4-295 through 4-322, 26 Sep 79

K0097

Physical Correlates of Eardrum Rupture

Richmond, D. R., Fletcher, E. R., Yelverton, J. T., and Phillips, Y. Y.

Annals of Otolaryngology, Rhinology & Laryngology, 98(5), Part 2, Suppl. 140: 35-41, May 1989

K0100

Picture Memory (Pseudomatching) in Rhesus Monkeys

Bruner, A., Bogo, V. and Gallegos, A.

Perceptual and Motor Skills 42: 627-633, 1976

K0029

Picture Memory (Pseudomatching) in the Rhesus Monkey

Bruner, A., Bogo, V., and Gallegos, A. N.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D. C., 15 October 1975

K0371

Primary Blast Experiments Suggested for the 500-Ton Explosion, Operation Snowball

Richmond, D. R. and White, C.S.

Technical progress report, Lovelace Foundation for Medical Education and Research, to Defense Atomic Support Agency, Washington, DC, March 11, 1963

K0316

Primary Blast Injuries in the Open and in Foxholes Resulting from Nuclear Type Detonations

Richmond, D.R. and Damon, E. G.

Technical Report, Technico Southwest, Inc., Contract DNA-001-88-C-0207, prepared for Defense Nuclear Agency, Washington, DC, September 1990

K0072

Probability of Injury from Airblast Displacement as a Function of Yield and Range

Fletcher, E. R., Yelverton, J. T., Hutton, R. A., and Richmond, D. R.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 29 October 1975

K0134

Probit Analysis Tables - Individual and Parallel

Fletcher, E. R.

Lovelace Foundation for Medical Education and Research, personal files, (no date)

K0118

Project Harbor Study: Notes on Immediate Survival 1. Biomedical Parameters

White, C. S.

Project Report, Project Harbor Study, National Academy of Sciences, Woods Hole, Massachusetts, Team C, Lovelace Foundation for Medical Education and Research, prepared for Division of Biology and Medicine, U. S. Atomic Energy Commission, August 1963

K0140

Proposed Nuclear Effects Mitigation Techniques

Richmond, D. R.

Draft report, w/ltr of transmittal, Lovelace Biomedical and Environmental Research Institute, to US Army Nuclear Chemical Agency, Springfield, VA, February 1981

K0156

Proposed Nuclear Effects Mitigation Techniques for Airblast Effects on Personnel

Richmond, D. R.

Correspondence, Lovelace Biomedical and Environmental Research Institute, 1988

K0171

Proposed Revision of NFPA Standard No. 45

Richmond, D. R. and Fletcher, E. R.

Correspondence, Lovelace Biomedical and Environmental Research Institute, to Sandia National Laboratories, Albuquerque, NM, 29 Sep 78

K0174

Proposed Revision to Draft on Standard for Single Point Explosives in Air

Richmond, D. R.

Correspondence, Lovelace Foundation for Medical Education and Research, Alb., NM, to Sandia Laboratories, Jack Reed, Chairman, ANSI (material prepared for DOD Explosive Safety Board in 1971), January 5, 1973

K0038

Radiation Effects on a Pneumococcal Infection Produced by Subcutaneous Injections Into White Mice

Clapper, W. E., and Meade, G. H.

Final Report, Lovelace Foundation for Medical Education and Research, U. S. Atomic Energy Commission, Division of Technical Information, Oak Ridge, Tennessee, Office of Technical Services, Department of Commerce, Washington, D. C., October 1953

K0020

Radiation Effects on Auditory and Visual Discrimination Tasks in Monkeys

Bogo, V., Hutton, R. A., and Bruner, A.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., March 1970

K0200

Rating of Hearing Protector Performance for Impulse Noise

Johnson, D. L. and Patterson, J. Jr.

Technical Paper, EG&G Special Projects, Proceedings 1992 Hearing Conservation Conf., Cincinnati, OH, April 1-4, 1992

K0222

Rationale of Treatment of Primary Blast Injury to the Lung

White, C. S.

Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, June 1968 (presented at the Panel N-5, Effects on Personnel, Technical Cooperation Program, Brooks AFB, TX, May 1968)

K0026

Recovery of the Respiratory System Following Blast Injury

Damon, E.G., Yelverton, J. T., Luft, U. C., and Jones, R. K.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., October 1970

K0145

Reduction and Analysis of Range/Response Data

Damon, E. G.

Personal Correspondence, E.G. Damon to D. R. Richmond, LS-1 KAFB Site, Los Alamos National Laboratory, Albuquerque, NM, May 24, 1989

K0206

Results from Propagation Tests with C-4 Charges, Blast Overpressure-Kirtland Test Site

Richmond, D. R.

Progress Report, EG&G Mason Research Institute, Western Operations, to U. S. Army Medical Research and Development Command, Ft Detrick, MD, 1989

K0332

Results of Exploratory Tests for Planning Complex Blast Wave Effects Studies

Richmond, D. R.

Report, EG&G Management Systems, Inc., to Walter Reed Army Institute of Research, Washington, DC, July 1983

K0167

Results Table, Group V, 2.5 psi Administered 50 Times, Laryngeal Lesions Study

Richmond, D. R.

Results Report, Lovelace Biomedical and Environmental Research Institute, to Walter Reed Army Institute of Research, Washington, DC, May 1980

K0152

Results Tables, Underwater Blast Internal Effects

Richmond, D. R.

Progress Report, Lovelace Biomedical and Environmental Research Institute, to Explosives Technology, Fairfield, CA, 26 October 1976

K0163

Review of Nonauditory Effects of Blast Overpressure

Yelverton, J. T., Johnson, D. L. and Axelsson, H.

Technical Report, EG&G Management Systems, Inc., to U.S. Army Medical Research and Materiel Command, Fort Detrick, MD (no date). Also, in Ototoxic Effects of Chemicals, Chapter 36, pp 447-461, (no date)

K0351

Review of Nonauditory Effects of Blast Overpressure

Yelverton, J. T., Johnson, D. L., and Axelsson, H.

Draft of Technical Paper, EG&G MSI, in Scientific Basis of Noise-Induced Hearing Loss, Chapter 36, (Axelsson, A., et al., Eds), Thieme Press, (no date)

K0194

Safe Distances from Underwater Explosions

Richmond, D. R.

Technical Paper, Lovelace Foundation for Medical Education and Research, in Minutes of the Fifteenth Explosives Safety Seminary, San Francisco, CA, 18-20 Sep 73, vol II, pp 1450-1475, Dept of Def Exp Safety Board, Washington, DC

K0193

Safe Distances from Underwater Explosions for Mammals and Birds

Richmond, D. R. and Jones, R. K.

Technical Paper, Lovelace Biomedical and Environmental Research Institute, in Proceedings of the 1st Conf. On the Environ. Effects of Explosive and Explosions, May 1973, NOLTR 73-223, pp 113-118, Naval Ord Lab, Silver Spring, MD, 12 Feb 74

K0070

Safe Distances from Underwater Explosions for Mammals and Birds

Yelverton, J. T., Richmond, D. R., Fletcher, E. R., and Jones, R. K.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 13 July 1973

K0298

Safe Distances from Underwater Explosions for Mammals and Birds

Yelverton, J. T., Richmond, D. R., Fletcher, E.R., and Jones, R. K.

Final Report, Lovelace Foundation for Medical Education and Research, prepared for Naval Ordnance Laboratory, Silver Spring, MD, April 1973

K0052

Secondary Missiles Generated by Nuclear-Produced Blast Waves, Project 33.2: Operation Plumbbob, Nevada Test Site, May-October 1957

Bowen, I. G., Franklin, M. E., Fletcher, E. R., and Albright, R. W.

Technical Report to the Test Director, Lovelace Foundation for Medical Education and Research, U. S. Atomic Energy Commission, Civil Effects Branch, Washington, DC, Oct. 28, 1963

K0034

Shock Tube Studies of the Effects of Sharp-Rising, Long-Duration Overpressures on Biological Systems

Richmond, D. R., Taborelli, R. V., Shering, F., Wetherbe, M.B., Sanchez, R. T., Goldizen, V. C., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for U. S. Atomic Energy Commission, Office of Technical Information, March 10, 1959

K0224

Shock Tube Studies of the Effects of Sharp-Rising, Long-Duration Overpressures on Biological Systems

Richmond, D. R., Taborelli, R. V., Shering, F., Wetherbe, M. R., Sanchez, R. T., Goldizen, V. C., and White, C. S.

Technical Report, Lovelace Foundation for Medical Education and Research, in Proceedings of Third Shock Tube Symposium, pp 171-189, Air Force Special Weapons Center, Kirtland AFB, NM, 10-12 March 1959

K0232

Shockwave Results from Underwater Explosion Tests Conducted by Lovelace Foundation for Medical Education and Research

Slifko, J. P.

Internal Memorandum, U.S. Naval Ordnance Laboratory, Silver Spring, MD, 21 Aug 1970

K0116

Short-Duration Airblast Exposure Does Not Increase Pulmonary Microvascular Permeability

Young, A. J., Hoyt, R.F., Jaeger, J. J., and Phillips, Y. Y.

Military Medicine, 151(3): 139, 1986

K0135

Table, "Injury in Sheep in Relation to Peak Overpressure and Impulse, Twenty Blasts Each"

Richmond, D. R.

Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM, prepared for Walter Reed Army Institute of Research, Washington, DC, March 30, 1982

K0370

Table, Pressure-Time Parameters as a Function of Charge Weight

Richmond, D. R.

Ltr of transmittal w/attach, Lovelace Biomedical and Environmental Research Institute, prepared for Walter Reed Army Institute of Research, December 22, 1980.

K0166

Tables and Pressure-Time Records, Blast Parameters and Parameters for Peak Overpressure Effects, and Gross Pathology - Isopressure-Isoimpulse Study

Richmond, D. R.

Results Tables, Lovelace Biomedical and Environmental Research, to Walter Reed Army Institute of Research, Washington, DC, 1981

K0149

Tables, Penetration of Glass Fragments Into Sheep Corneas

Yelverton, J. T.

Personal notes, Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM, November 1975

K0153

Tables, To Be Included in the Effects of Nuclear Weapons Slide Rule

Fletcher, E. R.

Correspondence, Lovelace Foundation for Medical Education and Research, to Stanford Research Institute, Menlo Park, CA, October 25, 1974

K0155

Tables, Hematocrit Values and Postmortem Findings, Blood Marker III Study

Richmond, D. R.

Results Report, Lovelace Biomedical and Environmental Research Institute, to Walter Reed Army Institute of Research, Washington, DC, 10 November 1980

K0147

Tables, Lung Inflation Study

Yelverton, J. T.

Status Report, Lovelace Biomedical and Environmental Research Institute, to Walter Reed Army Institute of Research, Washington, D.C., October 1982.

K0146

Tables, Quick Look at the Incidence of Sinus Hemorrhages from Blast In Several Species

Richmond, D. R.

Status Report, Lovelace Biomedical and Environmental Research Institute, to Walter Reed Army Institute of Research, June 23, 1978

K0151

Tables, Results of Experiments on Gastrointestinal Tract Injury

Richmond, D. R.

Status Report, Lovelace Biomedical and Environmental Research Institute, to Walter Reed Army Institute of Research, Washington, DC, February 19, 1981

K0160

Tables, Series I: Incident Shock Pressures Measured Adjacent to the Foxhole Containing Rats (Foxholes)

Richmond, D. R.

Personal Papers, Lovelace Foundation for Medical Education and Research, Albuquerque, NM (undated)

K0143

Tables, WRAIR Pulmonary Vascular Permeability Study, Pressure Time Parameters

Richmond, D. R.

Data Report, Lovelace Biomedical and Environmental Research Institute, to Walter Reed Army Institute of Research, Washington, DC, submitted May 21, 1983

K0320

Tables: Underwater Gut Rupture vs Bubble Size

Richmond, D.R.

Personal papers, Lovelace Foundation for Medical Education and Research, tabulated data, prepared for Naval Ordnance Laboratory, Silver Spring, MD, 1973

K0141

Tables: Blast Lesions in Animals, DRC Study

Richmond, D. R.

Progress report data tables, Lovelace Biomedical and Environmental Research Insitute, to Walter Reed Army Institute

K0013

Tentative Biological Criteria for Assessing Potential Hazards from Nuclear Explosions

White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., December 1963

K0225

Tentative Biological Criteria for Estimating Blast Hazards

White, C. S.

Technical Paper, Lovelace Foundation for Medical Education and Research, in Proc. Symp. on Protective Structures for Civilian Populations, pp 41-4, April 1965, Nat. Acad. Sci., National Research Council, Wash, DC (see also CEX 65.4)

K0102

Tertiary Blast Effects. Effects of Impact on Mice, Rats, Guinea Pigs and Rabbits

Richmond, D. R., Bowen, I. G., and White, C.S.

Aerospace Med. 32: 789-805, September 1961

K0060

Tertiary Blast Effects: The Effects of Impact on Mice, Rats, Guinea Pigs and Rabbits

Richmond, D. R., Bowen, I. G., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., February 28, 1961

K0042

Tertiary Effects of Blast--Displacement, Operation Plumbbob, Project 33.3

Taborelli, R. V., Bowen, I. G. and Fletcher, E. R.

Report to the Test Director, Lovelace Foundation for Medical Education and Research, U. S. Atomic Energy Commission, Civil Effects Test Group, Office of Technical Services, Department of Commerce, Washington, DC, February 1959

K0157

Tests Run to Evaluate the Effects of Time Between Repeated Blasts

Richmond, D. R.

Personal correspondence to D. L. Johnson, Blast Overpressure Project-Kirtland Air Force Base, EG&G MSI, Albuquerque, NM, January 1996

K0024

The Acute Effects of Air Blast on Pulmonary Function in Dogs and Sheep

Damon, E.G., Yelverton, J. T., Luft, U. C., Mitchell, K., Jr., and Jones, R. K.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, March 1970

K0366

The Analysis of Respiratory Gases

White, C. S.

Aviation Medicine--Selected Reviews, AGARDograph 25, pp 125-161, Pergamon Press, 1958

K0068

The Biodynamics of Air Blast

White, C. S., Jones, R. K., Damon, E. G., Fletcher, E. R., and Richmond, D. R.

Technical Paper, Lovelace Foundation for Medical Education and Research, in Proceedings AGARD Conference Proc. No 88 on Linear Acceleration of Impact Type, Oporto, Portugal, 23-26 Jan 1971

K0079

The Biodynamics of Airblast

White, C. S., Jones, R. K., Damon, E. G., Fletcher, E. R., and Richmond, D. R.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 1 July 1971

K0215

The Biologic Response to Overpressure I. Effects on Dogs of Five to Ten-Second Duration Overpressures Having Various Times of Pressure Rise

Richmond, D. R., Wetherbe, M.B., Taborelli, R. V., Chiffelle, T. L. and White, C. S.

Reprint Lovelace Foundation for Medical Education and Research, in J of Aviation Medicine 28: 447-460, October 1957

K0210

The Biologic Response to Overpressure III. Mortality in Small Animals Exposed in a Shock Tube to Sharp-Rising Overpressures of 3 to 4 msec Duration

Richmond, D. R., Goldizen, V. C., Clare, V. R., Pratt, D.E., Sherping, F., Sanchez, R. T., Fischer, C. C., and White, C. S.

Technical Paper, Lovelace Foundation, Aerospace Medicine 33: 1-27, January 1962

K0117

The Biological Effects of Plexiglas Fragments

Richmond, D. R., Yelverton, J. T., Fletcher, E. R., and Hicks, W.

Final Report, Lovelace Foundation for Medical Education and Research, prepared for Ballistic Research Laboratories, Aberdeen Proving Ground, MD, 1 Jan 1974

K0077

The Biological Effects of Repeated Blasts

Richmond, D. R., Yelverton, J. T., and Fletcher, E. R.

Final Report, Lovelace Biomedical and Environmental Research Institute, Inc., prepared for Defense Nuclear Agency, Washington, DC, 30 April 1981

K0172

The Displacement of Anthropomorphic Dummies Inside an AMF-80 Shelter Subjected to H.E. Bombs

Fletcher, E. R., Richmond, D. R. and Hicks, W.

Technical Report, Lovelace Biomedical and Environmental Research Institute, for Aeronautical Systems Division/AESD, Wright Patterson Air Force Base, OH, November 1983

K0037

The Effect of Foreign Body Particles on Infections in Mice

Clapper, W. E., and Meade, G. H.

Final Report, Lovelace Foundation for Medical Education and Res., U. S. Atomic Energy Commission, Technical Information Service Extension, Oak Ridge, Tennessee, Office of Technical Services, Department of Commerce, Washington, D. C., August 15, 1955

K0372

The Effects of a 500-Ton Explosion on Cattle Exposed in the Higher Pressure Regions, Program 4 - Project 4.2, Operation Snowball

Damon, E. G., Sherrod, J.H., Chiffelle, T. L. and Richmond, D. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, to Defense Atomic Support Agency, Washington, DC, February 1965

K0374

The Effects of a 500-Ton Explosion on Goats Exposed in the Higher Pressure Region, Program 4-Project 4.1, Operation Snowball

Betz, P. A., Chiffelle, T. L., Damon, E. G., and Richmond, D. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D. C., February 1965

K0343

The Effects of a 500-Ton Explosion on Goats in Foxholes, Program 4, Project 4.3, Suffield Experimental Station, Alberta, Canada - 1964

Richmond, D. R.

Preliminary Report, Lovelace Foundation, in Appendix J, Minutes of the 4th Meeting, Panel N1 (Biomedical), Sub-Group N, Tripartite Technical Cooperation Program, Toronto, Canada, 28-30 Sep 1964

K0341

The Effects of a 500-Ton Explosion on Goats, Program 4, Project 4.1, Suffield Experimental Station, Alberta, Canada - 1964

Richmond, D. R.

Preliminary Report, Lovelace Foundation, in Appendix J, Minutes of the 4th Meeting, Panel N1 (Biomedical), Sub-Group N, Tripartite Technical Cooperation Program, Toronto, Canada, 28-30 Sep 1964

K0337

The Effects of Air Blast on Sheep in Two-Man Foxholes, Project LN401 Operation Prairie Flat

Richmond, D. R. and Fletcher, E. R.

Preliminary Report, Lovelace Foundation for Medical Education and Research, in Operation Prairie Flat Symposium Report, pp 420-441, Volume I-Part II, Defense Atomic Support Agency, Washington, DC, January 1970

K0065

The Effects of Airblast on Discriminated Avoidance Behavior in Rhesus Monkeys

Bogo, V., Hutton, R. A., and Bruner, A.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 1 March 1971

K0061

The Effects of Airblast on Sheep in Two-Man Foxholes

Richmond, D. R., Fletcher, E. R., and Jones, R. K.

Final Report, Operation Prairie Flat, Project LN-401, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 1 June 1971.

K0008

The Effects of Ambient Pressure on the Tolerance of Mammals to Air Blast

Damon, E. G., Gaylord, C. S., Hicks, W., Yelverton, J. T., Richmond, D. R., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, August 1966

K0012

The Effects of Ambient Pressure on the Tolerance of Mice to Air Blast

Damon, E.G., Richmond, D. R., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., March 1964

K0227

The Effects of Blast and Ionizing Radiation in Rats

Richmond, D. R., Damon, E. G., Betz, P. A., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, for Defense Atomic Support Agency, Washington, DC, June 1965.

K0103

The Effects of Blast and Ionizing Radiation in Rats

Richmond, D.R., Jones, R.K., and White, C. S.

Intermedes Proceedings, Combined Injuries and Shock, pp 67-74, 1968

K0064

The Effects of Exhaustive Exercise on Rats at Various Times Following Blast Exposure

Yelverton, J. T., Viney, J. F., Jojola, B. III, and Jones, R. K.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 1 April 1971

K0291

The Effects of Fuel-Air Explosions on Dummies Inside the Valhall II and in the Open

Richmond, D. R.

Final Report, Life Sciences Division, Los Alamos National Laboratory, prepared for Norwegian Defence Construction Service, Oslo, Norway, April 1988

K0076

The Effects of Intermittent Positive Pressure Respiration on Occurrence of Air Embolism and Mortality Following Primary Blast Injury

Damon, E. G., Henderson, E. A., and Jones, R. K.

Final Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, January 1973

K0342

The Effects of Overpressure on Cattle, Program 4, Project 4.2, Suffield Experimental Station, Alberta, Canada - 1964

Richmond, D. R.

Preliminary Report, Lovelace Foundation, in Appendix J, Minutes of the 4th Meeting, Panel N1 (Biomedical), Sub-Group N, Tripartite Technical Cooperation Program, Toronto, Canada, 28-30 Sep 1964

K0003

The Effects of Shock Tube Generated, Step-Rising Overpressures on Guinea Pigs Located in Shallow Chambers Oriented Side-On and End-On to the Incident Shock

Clare, V.R., Richmond, D. R., Goldizen, V. C., Fischer, C. C., Pratt, D. E., Gaylord, C. E. and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, Albuquerque, NM, prepared for Defense Atomic Support Agency, Washington, D.C., May 31, 1962

K0221

The Effects of Shock-Tube-Generated Air Blast on Guinea Pigs Mounted in Model Foxholes of Various Design

Damon, E. G., Gaylord, C. S., Richmond, D. R., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, August 1967 (unpublished)

K0161

The Effects of Smooth-Rising Air Blasts on Animals

Richmond, D. R. and Fletcher, E. R.

Draft Technical Progress Report, Lovelace Foundation for Medical Education and Research, to Defense Atomic Support Agency, Washington, DC, 1970

K0231

The Effects of Underwater Explosions on Birds

Yelverton, J. T., Richmond, D. R., Fletcher, E. R., and Jones R. K.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, February 1973

K0131

The Environmental Medical Aspects of Nuclear Blast

White, C. S., Bowen, I. G., and Richmond, D. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, presented at the Twentieth Anniv. meeting and National Preparedness Symposium, sponsored by National Institute for Disaster Mobilization, Inc., Washington, DC, 1962

K0208

The Environmental Medical Aspects of Nuclear Blast

White, C.S., Bowen, I.G., and Richmond, D. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, November 1962

K0018

The Exposure of Guinea Pigs to Pressure-Pulses Generated During the End-to-End Test (No. 2) of Atlas Missile 8-D (March 31, 1962)

Richmond, D.R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, June 26, 1962

K0327

The Influence of Airway Pressure on Lung Injury Resulting from Airblast

Young, A. J., Phillips, Y. Y., Jaeger, J. J., Yelverton, J. T., and Richmond, D. R.

Military Medicine 150(1): 31-33, 1984

K0104

The Influence of Clothing on Human Intrathoracic Pressure During Airblast

Young, A. J., Jaeger, J. J., Phillips, Y. Y., Yelverton, J.T., and Richmond, D. R.

Aviat. Space Environ. Med., 56: 49-53, 1985

K0188

The Influence of Kevlar Vests on Airblast Induced Lung Injuries

Yelverton, J. T., Richmond, D. R., Phillips, Y. Y., and Dodds, K.

Abstract, Los Alamos National Laboratory, Los Alamos, NM, of paper presented at the MABS 10 Symposium, submitted to Harry Diamond Laboratories, Adelphi, MD, September 11, 1986

K0178

The Internal Environment of Underground Structures Subjected to Nuclear Blast. I. The Occurrence of Dust

White, C. S., Wetherbe, M. B., and Goldizen, V. C.

Preliminary Report, Lovelace Foundation for Medical Education and Research, Operation Plumbob, Project 33.5, Atomic Energy Commission, Civil Effects Test Group, Technical Services, Department of Commerce, Washington, DC, September 1957

K0041

The Internal Environment of Underground Structures Subjected to Nuclear Blast. II. Effects on Mice Located in Heavy Concrete Shelters

Richmond, D. R., White, C. S., Sanchez, R. T. and Shering, F.

Report to the Test Director, Lovelace Foundation for Medical Education and Research, Civil Effects Test Group, Atomic Energy Commission Technical Information Service, Oak Ridge, Tenn., Technical Services, Department of Commerce, Washington, D. C.

K0039

The Nature of the Problems Involved in Estimating the Immediate Casualties From Nuclear Explosions

White, C. S.

Technical Report, Lovelace Foundation for Medical Education & Res., U. S. Atomic Energy Commission, Div. of Technical Information, Oak Ridge, Tennessee, National Technical Information Service, U. S. Depart. of Commerce, Springfield, VA, July 1971

K0220

The Nature of the Problems Involved in Estimating the Immediate Casualties from Nuclear Explosions

White, C. S.

Lovelace Foundation for Med. Ed. & Res., summarized before The Conference on Disaster Medical Care, American Medical Association Committee on Disaster Medical Care/Council on National Security, Albuquerque, NM, November 15, 1968

K0115

The Non-Auditory Effects of Complex Blast Waves on Personnel Inside an APC Attacked by Shaped Charge Warheads

Axelsson, Hakan and Richmond, D. R.

Swedish Defence Research Establishment, FOA rapport, presented at the Sixth International Symposium on Wound Ballistics, 1-4 November 1988, Chongqing, People's Republic of China

K0017

The Overpressure-Duration Relationship and Lethality in Small Animals

Richmond, D.R., Goldizen, V. C., Clare, V. R. and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., September 10, 1962

K0299

The Physics of Decelerative Tumbling, Operation Plumbbob

Fletcher, E. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, July 1965

K0025

The Relation Between Eardrum Failure and Blast-Induced Pressure Variations

White, C. S., Bowen, I. G., and Richmond, D. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, August 1967

K0086

The Relationship Between Eardrum Failure and Blast-Induced Pressure Variations

White, C. S., Bowen, I. G., and Richmond, D.R.

Space Life Sciences 2: 158-205, 1970

K0069

The Relationship Between Fish Size and Their Response to Underwater Blast

Yelverton, J. T., Richmond, D. R., Hicks, W., Saunders, K., and Fletcher, E. R.

Topical Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D. C., 18 June 1975

K0296

The Relationship Between Fish Size and Their Response to Underwater Blast

Yelverton, J.T. and Richmond, D. R.

Technical Paper, Lovelace Foundation for Medical Education and Research, presented at 2nd Conference on the Environmental Effects of Explosions and Explosions, Naval Surface Weapons Center, Silver Spring, MD, October 1976

K0159

The Relationship Between Selected Blast Wave Parameters and the Response of Mammals Exposed to Air Blast

Richmond, D. R., Damon, E. G., Fletcher, E. R., Bowen, I. G. and White, C.S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, Nov 1966

K0085

The Relationship Between Selected Blast-Wave Parameters and the Response of Mammals Exposed to Air Blast

Richmond, D. R., Damon, E. G., Fletcher, E. R., Bowen, I. G., and White, C. S.

Ann.of the NY Acad. of Sciences, 152: 103-121, October 26, 1968

K0137

The Response of Dummies Inside a C3 Tactical Shelter on a CVCV Truck Exposed to Blast and Thermal on Event Misty Picture - U.S. Army Natick, Experiment 1015

Richmond, D.R.

Draft Report, Los Alamos National Laboratory, LS-1 KAFB Site, to American Development Corporation, North Charleston, SC, January 1988

K0074

The Scope of Blast and Shock Biology and Problem Areas in Relating Physical and Biological Parameters

White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, November 1966

K0051

The Thoraco-Abdominal System's Response to Underwater Blast

Fletcher, E. R., Yelverton, J. T., and Richmond, D. R.

Final Technical Report, 1 June 74 to 30 Sep 76, Lovelace Foundation for Medical Education and Research, prepared for Office of Naval Research, Arlington, VA, September 1976

K0073

The Tolerance of Birds to Airblast

Damon, E. G., Richmond, D. R., Fletcher, E. R., and Jones, R. K.

Final Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, DC, 23 July 1974

K0021

The Tolerance of Cattle to "Long"-Duration Reflected Pressures in a Shock Tube

Damon, E. G., Gaylord, C. S., Yelverton, J. T., and Richmond, D. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, August 1966

K0016

The Tolerance of Guinea Pigs to Air Blast When Mounted in Shallow, Deep, and Deep-With-Offset Chambers on a Shock Tube

Richmond, D.R., Clare, V. R., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., October 27, 1962

K0033

Thermal Radiation Measurements (Parts I and II), Project 39.3: Operation Plumbbob

Greig, A. L., and Pearse, H. E.

Preliminary Report. Operation Plumbbob, Nevada Test Site, May-October 1957, Lovelace Foundation for Medical Education and Research, prepared for Division of Biology and Medicine, U.S. Atomic Energy Commission, Washington, D. C., May 23, 1958

K0108

Threshold for Laryngeal Lesions from Repeated Blasts - A Progress Report

Richmond, D. R.

Progress Report, Lovelace Biomedical and Environmental Research Institute, prepared for Department of the Army, Walter Reed Army Institute of Research, Washington, D.C., June 23, 1980

K0344

Threshold Lung Injury in Goats from a 500-Ton Explosion, Program 4, Project 4.4, Suffield Experimental Station, Alberta, Canada - 1964

Richmond, D. R.

Preliminary Report, Lovelace Foundation, in Appendix J, Minutes of the 4th Meeting, Panel N1 (Biomedical), Sub-Group N, Tripartite Technical Cooperation Program, Toronto, Canada, 28-30 Sep 1964

K0235

Translation Effects Criteria

Bowen, I. G.

Illustrative material and notes, Lovelace Foundation for Medical Education and Research, presentation before Subcommittee on Blast and Thermal, Advisory Committee on Civil Defense, National Academy of Sciences, Washington, D. C., Aug 1967

K0345

Translation of Goats and Anthropomorphic Dummies by Blast Waves, Program 4, Project 4.5, Suffield Experimental Station, Alberta, Canada - 1964

Richmond, D. R.

Preliminary Report, Lovelace Foundation, in Appendix K, Minutes of the 4th Meeting, Panel N1 (Biomedical), Sub-Group N, Tripartite Technical Cooperation Program, Toronto, Canada, 28-30 Sep 1964

K0014

Translational Effects of Air Blast from High Explosives

Bowen, I.G., Woodworth, P. B., Franklin, M. E., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, DC, November 7, 1962

K0119

Translational Effects of Blast Waves: A review of past work and suggestions for future experiments with 500-ton high-explosive shot

Bowen, I. G., Richmond, D. R., and White, C. S.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Atomic Support Agency, Washington, D.C., March 11, 1963

K0123

Translational Problems in Shelters

Fletcher, E. R.

Report, Minutes of Fifth Meeting, Panel N-1 (Biomedical), Sub-Group N, Tripartite Technical Cooperation Program, US Naval Radiological Defense Laboratory, San Francisco, CA and Lovelace Foundation, Albuquerque, NM, pp H-1 to H-21, May 10-14 1965

K0175

Trip Report on Fifth International Symposium on Military Applications of Blast Simulation and visit to Swedish Defense Institute

Richmond, D. R.

Trip Report on Fifth International Symposium on Military Applications of Blast Simulation, Stockholm, Sweden, May 23-26, 1977 Lovelace Foundation for Medical Education and Research, Director, AFRRI, Bethesda, MD, 26 July 1977

K0028

Tyrosine Aminotransferase Induction in Rat Liver as a Response to Irradiation and/or Flash Burn Injuries

Henderson, T. R. and Jones, R. K.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Defense Nuclear Agency, Washington, D.C., 30 October 1972

K0124

Underwater Blast Criteria

Bowen, I. G.

Letter of transmittal w/enclosure, Lovelace Foundation for Medical Education and Research, submitted to U. S. Naval Ordnance Laboratory, MD., August 1968

K0233

Underwater Blast Studies

Richmond, D.R.

Draft copy of presentation, Lovelace Biomedical and Environmental Research Institute, undated.

K0234

Underwater Blast Studies With Animals

Richmond, D. R., Yelverton, J. T., Gaylord, C. S., and Fletcher, E. R.

Technical Progress Report, Lovelace Foundation for Medical Education and Research, prepared for Explosions Research Department, US Naval Ordnance Laboratory, Silver Spring, MD, February 1970 (unclassified formerly Confidential)

K0347

Underwater Blast Swimmer Vulnerability

Bowen, I. G.

Correspondence, Lovelace Foundation for Medical Education and Research, submitted to U.S. Naval Ordnance Laboratory, Silver Spring, MD, September 1968.

K0109

Underwater Explosion Damage Risk Criteria for Fish, Birds, and Mammals

Yelverton, J. T

Lovelace Biomedical and Environmental Research Institute, presented at The 102nd Meeting of the Acoustical Society of America, Carillon Hotel, 30-Nov-4 Dec 1981, Miami Beach, FL, 1981

K0295

Underwater Explosion Levels Evaluated by a Swimmer

Richmond, D. R.

Technical Paper, Lovelace Foundation for Medical Education and Research, presented at 2nd Conference on the Environmental Effects of Explosions and Explosions, Naval Surface Weapons Center, Silver Spring, MD, October 1976

K0165

Underwater Shock Facility and Explosion Levels Evaluated by a Swimmer

Richmond, D. R.

Technical Paper, Contribution 4:2, pp 4:2:1-4:2:20, Lovelace Biomedical and Environmental Research Institute, presented at the 5th International Symposium on Military Application of Blast Simulation, Stockholm, Sweden, 23-26 May 1977

K0170

Whole-Body Impact Studies With Sheep

Richmond, D. R.

Presentation, Lovelace Biomedical and Environmental Research, DCPA Meeting, Asilomar, CA, April 21-25, 1974