The New World of the Nevada Test Site

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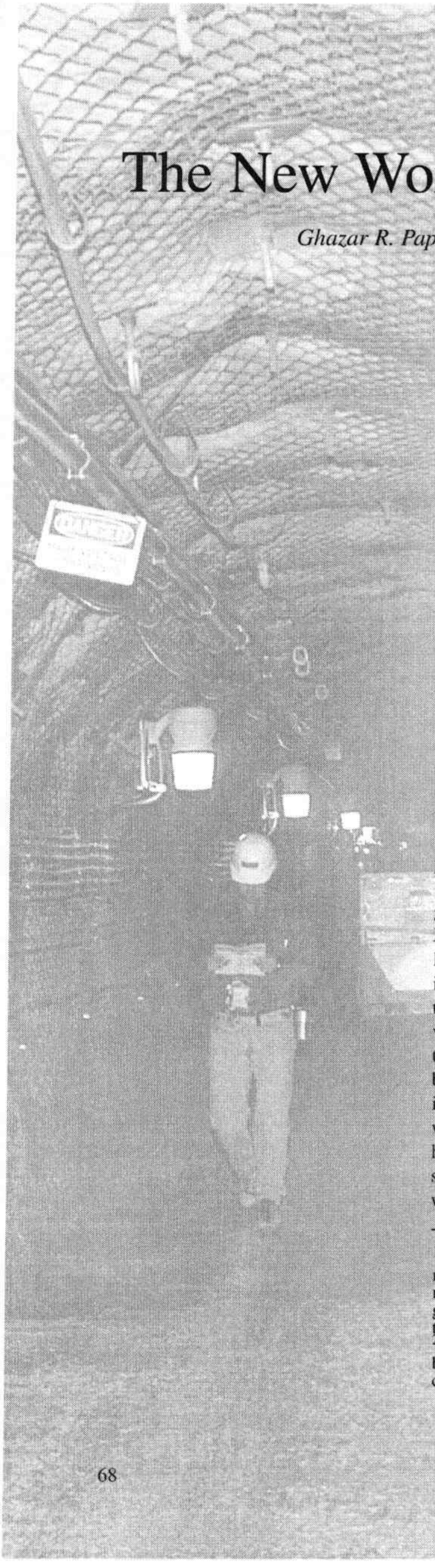

The Nevada Test Site (NTS) has been an integral part of many Los Alamos National Laboratory programs for more than 50 years. In 1951, Los Alamos conducted the first nuclear event at the NTS. It was the atmospheric shot Able, an airdrop of 1 kiloton in Area 5 (referred to as "Frenchman Flat"). Many weapon tests, both atmospheric and underground, were conducted until the 1992 moratorium on nuclear testing. The Divider event carried out by Los Alamos in September 1992 was the last underground nuclear test. The moratorium challenged us, the Laboratory staff, with the task of maintaining the capability to return to nuclear testing, should that be necessary, and of identifying and nurturing a niche where we could be relevant to the emerging stewardship mission while maintaining close ties with our proud past.

The story of the present underground complex in Area 1 (refer to Figure 1) of the NTS started in the late 1960s, when U1a, the first shaft[1] in that area, was mined. The idea of the shaft was part of Bill Ogle's larger vision for Area 1 (Ogle was leader of the Test Division at Los Alamos between 1965 and 1972). Very much in tune with "thinking big," which was characteristic of the time, Ogle had envisioned having not one but two shafts mined at Area 1. The two would be connected with a drift,[2] a line-of-sight pipe, and a series of fast closures in which to conduct nuclear testing. According to Ogle's idea, a nuclear explosive would have been contained in one shaft. Upon detonation, the explosive would have delivered an electromagnetic pulse to both a missile and its warhead located in the other shaft. Called the Flashlight Program, this idea, however, was never implemented. Only later, in 1986, was a 458-foot drift mined south from the shaft of the 1960s vintage in preparation of the Ledoux nuclear test of 1990.

When Jay Norman became leader of the Test Division at Los Alamos (1988), he started a long-term investment strategy for the development of a low-yield nuclear experiment research (LYNER) facility. The vintage shaft U1a became its site. In 1992, the LYNER facility was ready for its new role in support of the stewardship mission. Shortly thereafter, a new shaft, U1g (1100 feet north and 50 feet east of U1a), was mined and connected to U1a by a series of drifts and alcoves housing experiments and equipment for the stewardship mission. The purpose of the new shaft was to allow adding infrastructure into the LYNER facility. It became possible to install diagnostic cables to surface-located recording trailers, provide power to the underground complex, and most important, provide a second emergency egress to the surface through a pipe with a diameter of 48 inches (much like the shaft sunk during the Pennsylvania coal mine accident of 2002).

Because of increased experimental activity in the underground complex at Area 1, yet another shaft, referred to as U1h, was mined and connected

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[1] A shaft is a deep excavation used for mining, conducting experiments, lowering men and materials, or ventilating underground workings. Shafts are typically vertical or nearly vertical.

[2] A drift is a long alcove that has a plug behind which multiple experiments can be conducted in drilled holes.

to the complex network of drifts. The U1h shaft was commissioned in 2001 and is located 1490 feet from U1a. Its primary purpose is to ensure worker safety because it provides additional egress from the complex during an emergency. A special lift basket is available to expedite rapid removal of underground workers during an emergency. Both U1g and U1h are within a few hundred feet of the experimental alcoves.

In over a decade since the moratorium on underground nuclear testing, the nature of testing at the NTS has changed considerably. To maintain the existing infrastructure in case of a return to nuclear testing and obtain data for the stewardship mission, we conducted high-consequence subcritical experiments. We then used results from those experiments to test models for computer simulations. In a subcritical experiment, high explosives (HEs) and special nuclear materials are used, but the experiment never achieves criticality, or a self-sustaining chain reaction.

This article highlights past and future subcritical experiments conducted at the NTS by Los Alamos with the operating partner Bechtel Nevada, the Atomic Weapons Establishment (AWE) in the United Kingdom, and the Lawrence Livermore National Laboratory. It also discusses the new Atlas pulsed-power facility residing at the test site and a possible future site for criticality experiments.

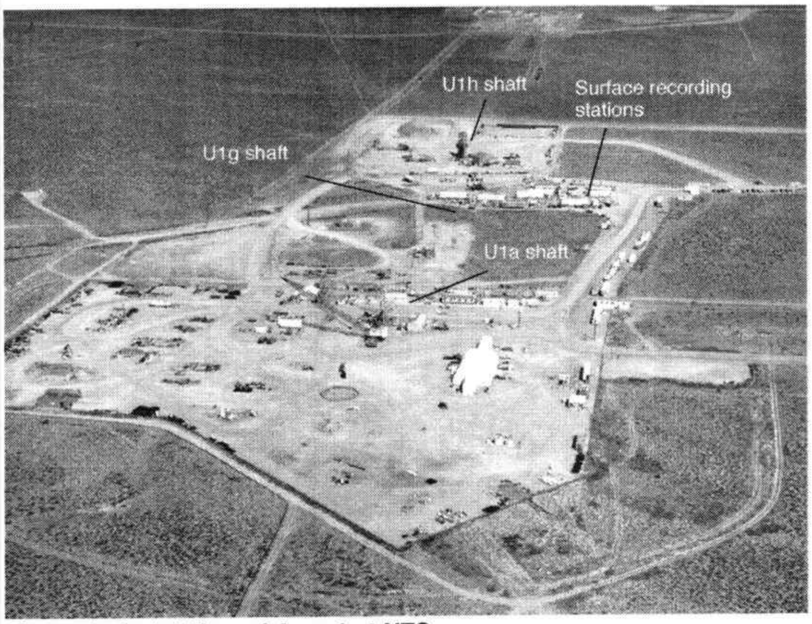

Figure 1. Aerial View of Area 1 at NTS

Subcritical Experiments

Kismet was the first experiment at U1a after the 1992 moratorium on nuclear testing. It was really a proof-of-principle test for determining the most functional layout plan for underground cavities, known as alcoves, that would house subcritical experiments supporting the readiness program and stewardship mission. In Kismet, we used only a small amount of HE to revive studies of downhole methods—for example, recovering data over very long lines. From the test, we obtained relevant information that helped us plan and prepare the test alcoves in the U1a complex.

A whole series of subcritical experiments followed Kismet. The first few were carried out in dedicated alcoves mined at the U1a complex for containment purposes, the traditional way of conducting experiments in an underground environment. Rebound and Stagecoach were the first and second subcritical experiments fielded by the Laboratory. For these and other past subcritical experiments described below, please refer to the pictorial summary on the next two pages. Rebound and Stagecoach were aimed at providing information about the behavior of plutonium alloys when compressed by high-pressure shock waves. Two different alloys were used in the experiments: new alloy in Rebound and aged alloy in Stagecoach (up to 40 years old). Diagnostic techniques derived from Rebound were refined in Stagecoach. The valuable data obtained on the equation of state of plutonium provided input to our modeling codes for certification of existing weapon pits. At the same time, those data gave useful information about aging effects and manufacturing site variability on plutonium alloys. During these experiments, we also developed diagnostics to be used in future experiments.

The next two subcritical experiments, Cimarron and Thoroughbred, continued our effort in support of the stewardship mission and readiness program and contributed to the development of diagnostics to study the dynamics of pit performance. These two experiments were conducted on mockup pit geometry inside mined alcoves. Relevant data were obtained on the performance of plutonium produced by different manufacturing methods and sources. In addition, an extensive list of lessons learned from the Cimarron experiment was implemented in the Thoroughbred experiment.