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NEVADA TEST SITE SENSOR TEST FACILITY

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Sandia National Laboratories recently established the SENSOR TEST FACILITY, a unique test environment at the Nevada Test Site for studying seismic, acoustic, and electro-magnetic signals that emanate from underground facilities. This required the renovation of a hardened underground structure to accommodate a suite of seismic, acoustic, and electro-magnetic sources and associated instrumentation. A geophysical site characterization was performed to understand the local geology and its effects on signals emanating from the facility. The area surrounding the facility has been surveyed and a grid installed in order to efficiently locate and place sensors.

INTRODUCTION

A Sensor Test Facility (STF) was recently established at the Department of Energy's Nevada Test Site (NTS). It has been used for a series of sensor tests that have demonstrated the usefulness of the testbed. The facility consists of a cut-and-cover bunker complex and the two square mile surrounding area. The STF was developed as a scientific testbed optimized for the development and evaluation of advanced sensor systems, including ground sensor systems designed to identify and detect hardened underground facilities. This was accomplished by identifying a facility in a remote location where seismic, acoustic, and electromagnetic interference would be minimal, establishing a testbed that would be accommodating to field testing, and conducting a thorough geophysical characterization of the area surrounding the facility in order to understand the local geology and its effects on geophysical signals emanating from the facility. The STF is representative of a number of cut-and-cover bunkers around the world that are used for the manufacture and/or storage of weapons of mass destruction.

This paper provides a general description of the Nevada Test Site, the Sensor Test Facility, and the Geophysical Site Characterization.

NEVADA TEST SITE

The STF is located within the Nevada Test Site about 65 miles northwest of the city of Las Vegas, Nevada (Fig. 1). The Test Site encompasses 1,350 square miles of desert and mountainous terrain. The site is surrounded by the Nellis Air Force Range, which provides a

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DISCLAIMER

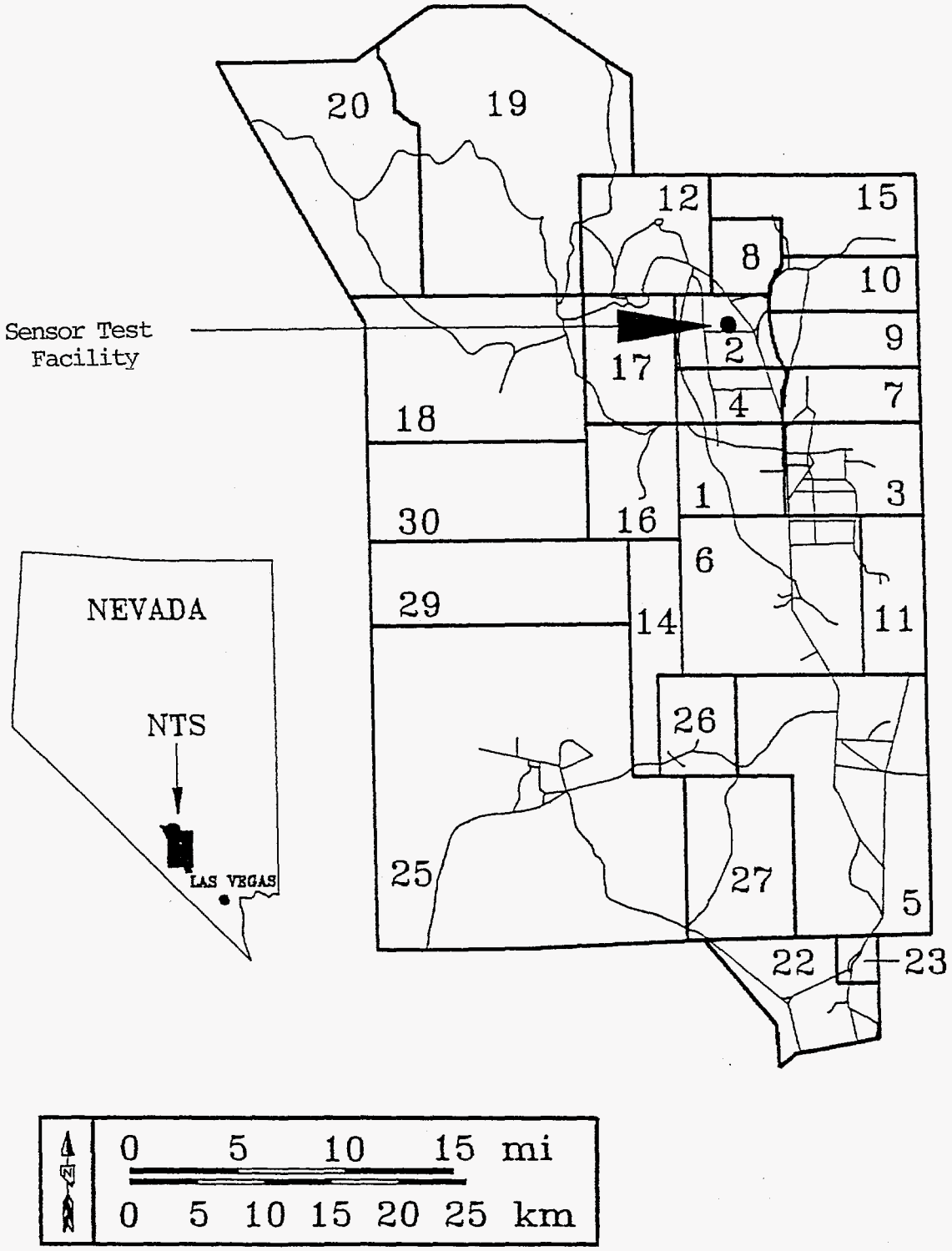


Figure 1: Nevada Test Site

buffer between the site and surrounding communities. The NTS offers a large expanse of space, including more than 1,000 miles of completely undisturbed land available for new projects.

Established as the Atomic Energy Commission's conus proving ground, the NTS has seen more than four decades of nuclear weapons testing. In recent years, under the direction of the Department of Energy, test site use has diversified into many other programs such as hazardous chemical spill tests, emergency response training, conventional weapons testing, waste management, and environmental technology projects that can best be conducted in this remote area.

The base camp of Mercury, which is located within the boundaries of the NTS, has many of the amenities found in a typical small town. Housing, medical services, fire protection, food, and recreational facilities capable of supporting thousands of workers are all located on site. There are more than 1,100 buildings including the Mercury restaurant and cafeteria. There are offices, laboratories, warehouses, and training facilities; an emergency care center, post office, fire station, and sheriff's substation; a motor pool complete with repair facilities; recreational facilities. There are 400 miles of road, two airstrips, and five heliports, as well as several active water wells. An electric power transmission system delivers 45 megawatts of power with backup power generation capability. Operations support includes construction and maintenance of facilities, roads, water and power systems, as well as equipment procurement and maintenance.

The size, facilities, and isolation of the test site combine to create a unique test environment that is capable of accommodating a wide range of projects. Additional information about the NTS is available through the Department of Energy, Nevada Operations Office, P. O. Box 98518, Las Vegas, NV 89193-8518.

SENSOR TEST FACILITY

The STF is representative of a number of hardened cut-and-cover facilities around the world, including a number of foreign facilities that are dedicated to the manufacture of weapons of mass destruction. This relationship is based on depth of burial, local geology, and construction details.

The STF is situated in the northwestern part of Yucca Valley. The average elevation is approximately 4410 ft. The Yucca Valley area in general was the site of numerous atmospheric and underground nuclear tests. As a result, the geology has been studied extensively. Sediments in this area are mostly alluvial while vegetation in the area is dominated by rabbitbrush (Chrysothamnus nauseoses), cheatgrass (Bromus spp.) and other grasses (Gramineae) [1]. Reference [2] provides more in-depth geologic and geotechnical information relevant to the Yucca Valley area. This includes a compilation of geologic related test data collected over the past 40 years.

The STF is geographically located within Area 2 of the NTS. The facility is on the north side of 2-04 Road approximately 1.5 miles west of its intersection with Rainer Mesa Road (Fig. 2). The facility consists of two underground buildings originally constructed to support the atmospheric nuclear testing program (Figs 3 and 4). The buildings were constructed in 1952. The generator building, the instrument building and the two-square mile surrounding area are commonly referred to as the 2-300 bunker complex.

The generator building consists of a poured concrete, steel reinforced rectangular shaped structure with interior dimensions of 18 ft x 20 ft x 9 ft. The south elevation, the roof, and part of the east elevation are exposed. The rest of the building is buried. The concrete walls are 2 ft 8 in thick and the roof and floor are 3 ft thick. The entrance to the structure is through a 4 ft 2.5 in x 8 ft 2.5 in opening. Two generator exhaust pipes extend into the room from the ceiling and a 1000

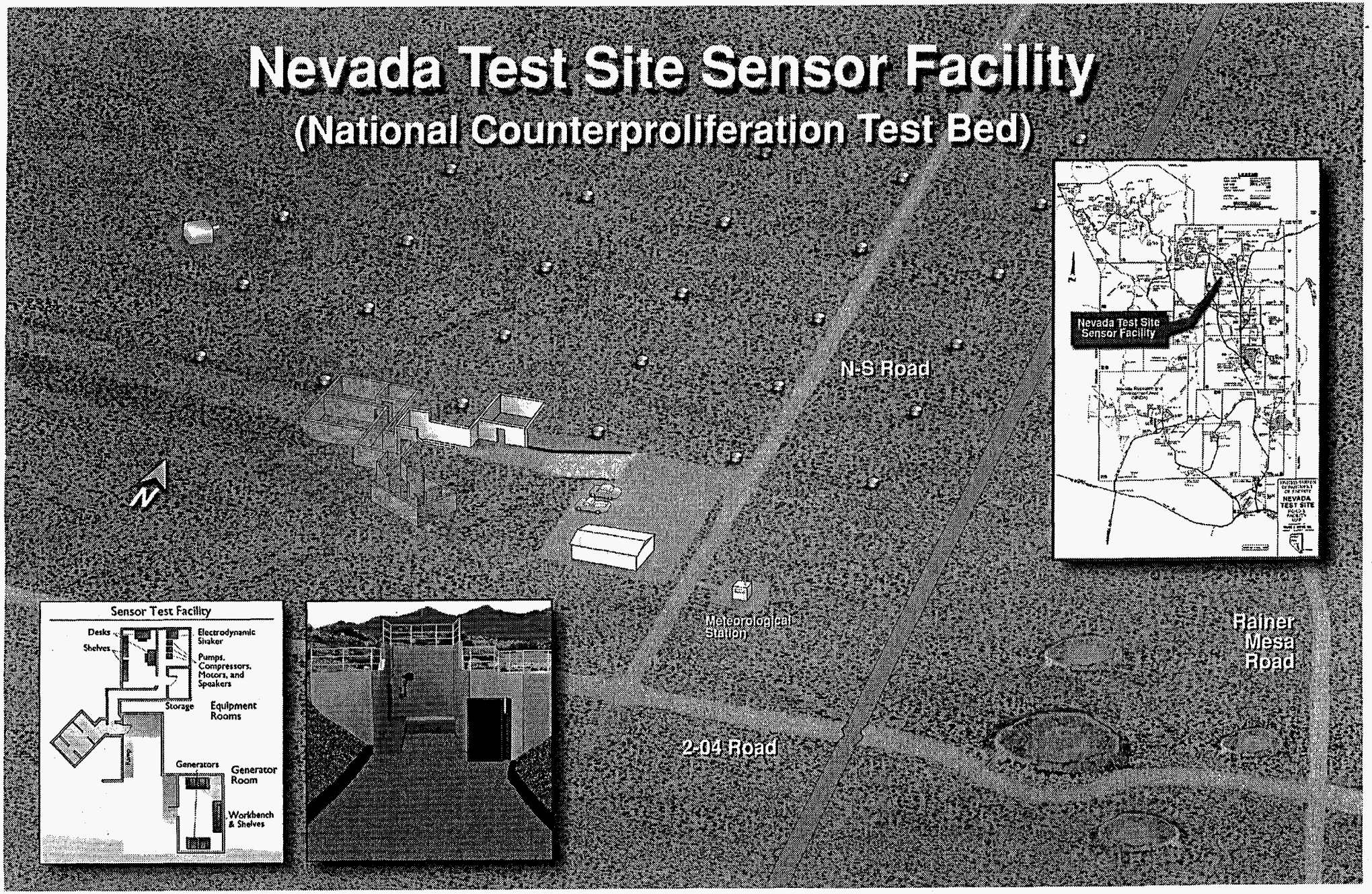
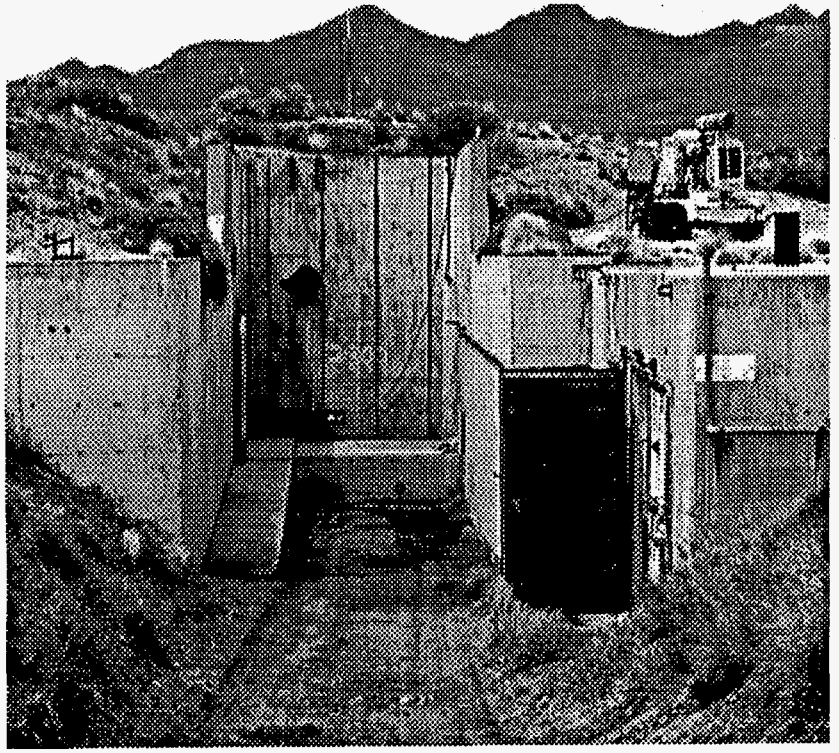
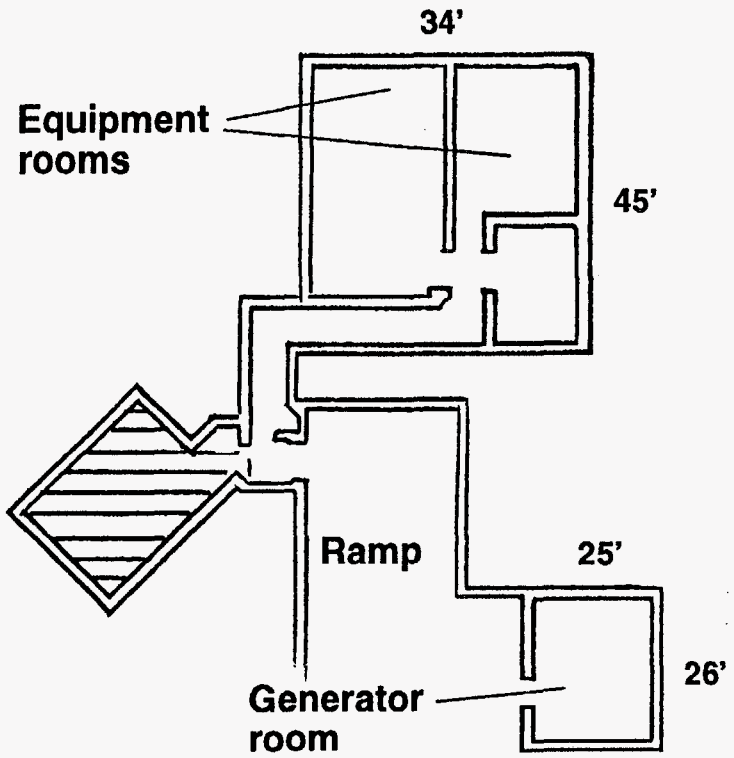


Figure 2: Sensor Test Facility





Construction Date: 1952
Original Function: Instrumentation Bunker
(atmospheric testing)
Construction Type: Reinforced Concrete

Figure 3: Sensor Test Facility (Floor Plan)

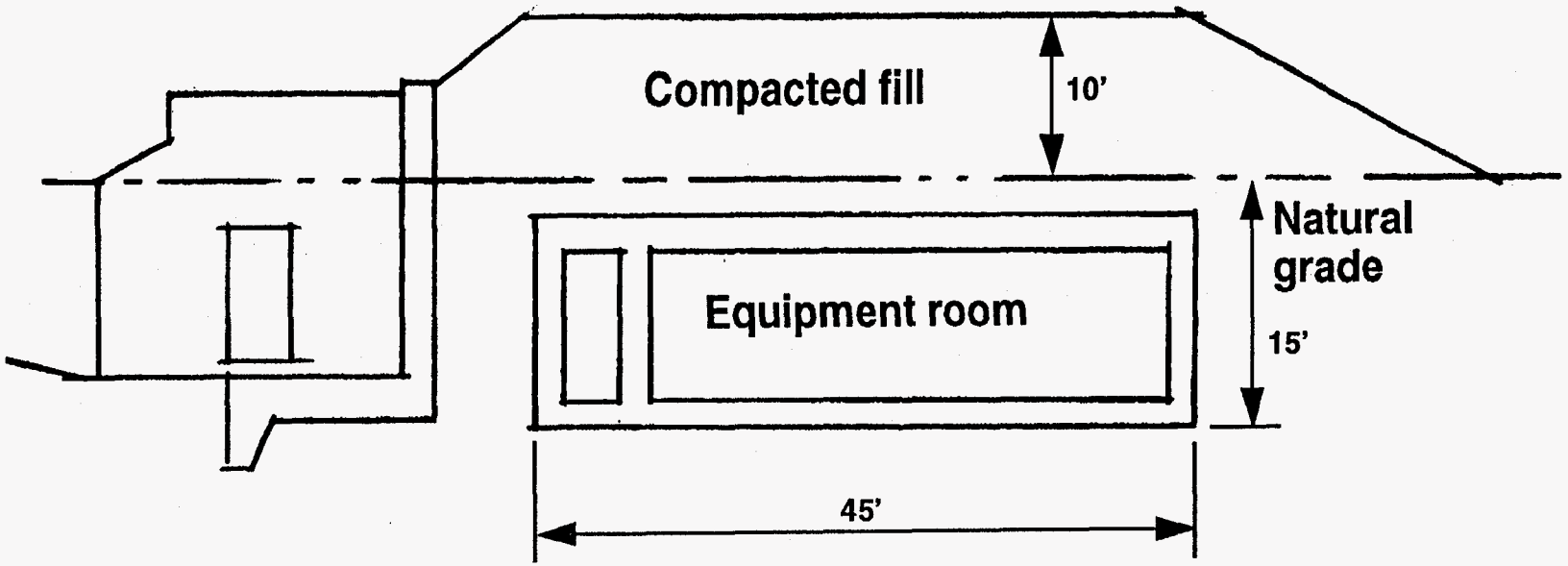


Figure 4: Sensor Test Facility (Cross Section)

gallon fuel oil tank is located outside the northeast corner of the structure.

The instrumentation building consists of a poured concrete, steel reinforced underground bunker with four separate equipment rooms. An open ramp 130 ft long x 16 ft wide and sloping at approximately 15 degrees, provides access to the facility. A concrete loading platform is located at the bottom end of the ramp. On the south side of the platform, a 4 ft x 8 ft opening provides access to a corridor that leads to the individual rooms. The interior walls, floors, and ceilings are concrete with steel strut inserts spaced on 2 ft centers. The concrete walls are 2 ft thick and the roof and floor are 1 ft 6 in thick and 1 ft 8 in thick respectively. Up to 15 ft of earth fill rests above the structure.

The northwest room measures 16 ft x 24 ft 6 in x 9 ft, the southwest room measures 12 ft x 34 ft 6 in x 9 ft, the northeast room measures 9 ft 6 in x 15 ft x 9 ft, and the southeast room measures 18 ft x 18 ft x 9 ft. The southeast room is currently not in use and access to the room has been blocked off with a plywood panel.

The 2-300 bunker complex had not been occupied or utilized in over twenty years. As a result, the facility required renovation. This included cleaning, painting, reestablishing electrical power, installing a ventilation system and telephone lines, establishing a parking area, and adding portable trailers to the area. The goals of the renovation efforts were to make the facility operational, bring the facility into compliance with current environmental, safety and health standards, and to make the facility accommodating to field test personnel.

The facility is equipped with standard 110 volts commercial power and 220 volt 3-phase power. There are provisions for generating and distributing 50Hz power. Ventilation is provided by a series of filtered intake and exhaust fans. Two trailers located approximately 15 meters from the facility are available for office space, storage, and light electrical work.

The area (1000 meters in diameter) surrounding the facility has been surveyed and a grid installed. The grid is based on a two-dimensional Cartesian coordinate system referenced to true north. Grid points are marked with fiberglass stakes at 50-meter increments and the coordinates are marked onto the stakes. The grid provides for the efficient placement of sensors in the surrounding area.

Approximately 30 meters from the bunker complex is a permanent weather station which is part of a large array of weather stations operated at the NTS by the Air Resources Laboratory. The weather station provides wind speed and direction, temperature, pressure, relative humidity and precipitation data.

The STF can accommodate a variety of equipment. Presently, a suite of controlled sources and facility equipment are operational. The operational equipment include a 350 lb electrodynamic shaker, an acoustic system (power amplifier, signal generator, and speakers), a set of compressors, generators and motors.

The STF was recently used for the phenomenology phase of the Tactical Unattended Ground Sensors (TUGS) project sponsored by Defense Special Weapons Agency (DSWA) under the Counterproliferation Program. The goal of this project was to develop a sensor system capable of locating and identifying hardened underground facilities dedicated to the manufacture of weapons of mass destruction. In support of this test, numerous items of equipment were operated inside the facility while sensors deployed in the surrounding area were used to collect data. The data included seismic, acoustic, and electro-magnetic signatures that have been stored in a database and are the basis of the phenomenolgy analysis.

Airdrop tests can also be performed at the STF because of its remote location. As part of a recent test series, ballistic airdrop units were evaluated. Six 50 lb aerodynamically shaped sensor packages were dropped from a helicopter at approximately 1,500 ft elevation. The facility was then operated while the sensor packages were evaluated.

GEOPHYSICAL SITE CHARACTERIZATION

The STF was developed to be a scientific testbed optimized for studying geophysical signals that emanate from underground facilities. As part of the development, a geophysical characterization of the surrounding area was conducted, providing a good understanding of the near-surface geologic structure and its effects on signals that emanate from the facility.

Seismic and electromagnetic surveys were conducted. The seismic survey was accomplished with seismic refraction data sets to determine seismic compressional velocities, velocity structure, surface wave velocities and frequencies. These data sets were generated through a series of deep and shallow refraction lines utilizing both explosive charge and hammer blow source terms. Electrical resistivity soundings and transient electromagnetic profiles were used determined the electrical conductivity structure of the surrounding area.

Reference [3] provides the details of the seismic refraction studies as well as the electrical/electromagnetic characterization. This includes descriptions of the experiments, data processing, and modeling results.

SUMMARY

Sandia National Laboratories has recently established the SENSOR TEST FACILITY. The facility was developed as a scientific testbed optimized for studying the phenomenology associated with geophysical signatures emanating from underground facilities. The STF is located within the boundaries of the Nevada Test Site. The facility is isolated from outside seismic, acoustic, and electro-magnetic interference and the local geology has been thoroughly characterized. The STF is an ideal facility for the development and evaluation of ground-based sensors/sensor systems designed to locate and characterize activities associated with underground facilities.

REFERENCES

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