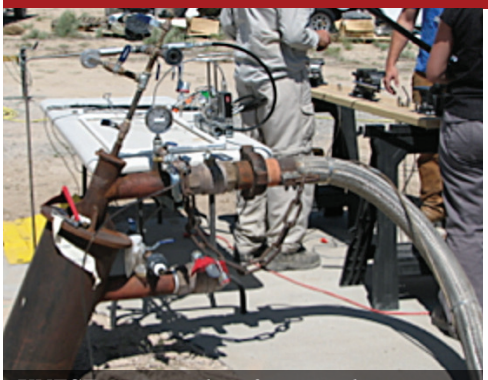

UNESE automated surface samplers

Introduction

The Underground Nuclear Explosion Signatures Experiment (UNESE) was created to address scientific knowledge gaps associated with nuclear explosion verification and nuclear nonproliferation. It is a multi-year research and development (R&D) project sponsored by the U.S. Department of Energy's National Nuclear Security Administration. Scientific knowledge and capabilities developed via UNESE will allow the U.S. to better detect, locate, and identify underground nuclear explosions (UNEs). UNESE R&D results will be applicable in current and future verification and nonproliferation contexts, and as a deterrent factor for potential proliferant nations.

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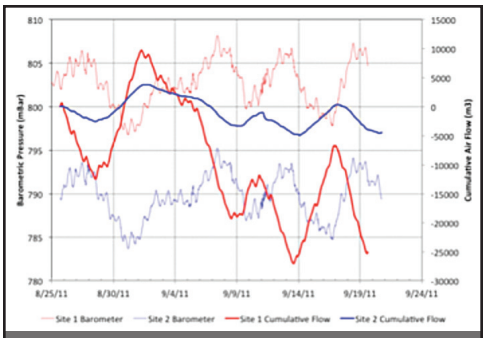
Underground Nuclear Explosion Signatures Experiment

UNESE is focused on post-detonation signatures that include:

- Subsurface gas emissions
- Persistence of surface-deposited radionuclides in fractures, surface and near-surface soil, flora and fauna, and air
- Dispersion of subsurface radon concentrations near ground-zero by explosive gases
- Fracturing of rock and damage to man-made structures
- Topographic changes including craters, depressions, rock heave, rock fall, and landslides
- Floral and faunal stress including dead and/or dying vegetation
- Testing artifacts including shafts, portals, pads, casings, and cables
- Geophysical subsurface changes including thermal, density, and electromagnetic anomalies, and water table changes.

The primary objective of UNESE is to better understand the production of these signatures, and monitor their changes over the course of days, months, and years.

UNESE R&D consists of the development and study of a series of test beds based primarily on previous UNEs detonated at the NNSS. These test beds allow the study of UNE signature production in differing geologies and



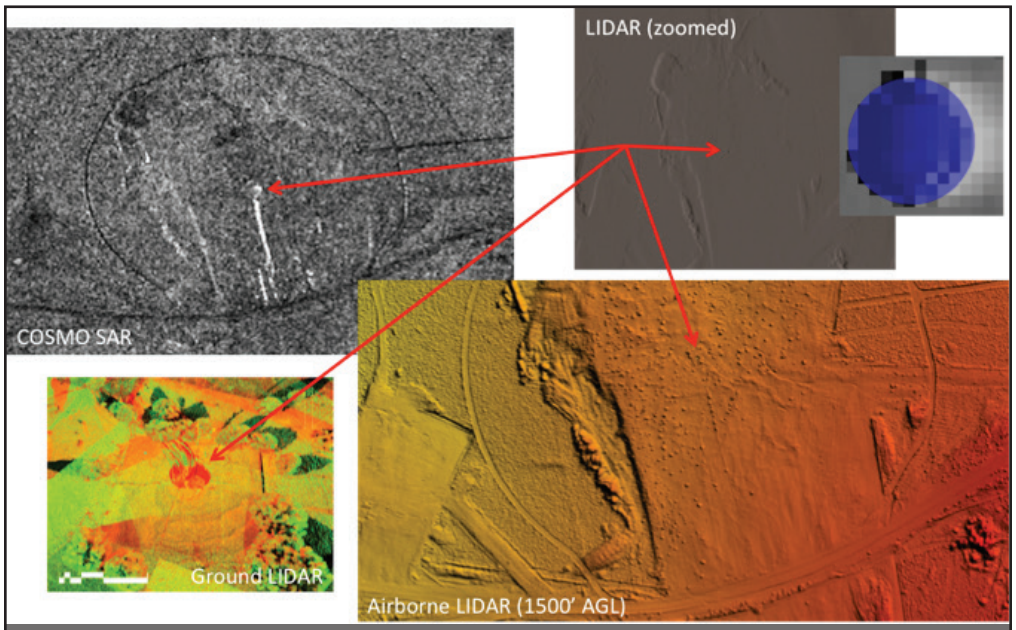
UNESE monitoring helps researchers understand the relationship between atmospheric pressure and gas migration through rock fractures.

emplacements scenarios, and provide comparisons for global locations of monitoring concern. Using these test beds, UNESE conducts measurements and experiments with a long-term goal of developing models for post-detonation signatures. These experiments and modeling efforts include:

- A study of noble gas migration via subsurface injection of chemical and radiological tracers into the chimney of a legacy UNE. Sampling of subsurface gas is achieved using automated and manual samplers strategically placed on the test bed and in deep angled boreholes.
- A controlled release of short-lived radiotracers into the atmosphere to simulate venting of a UNE to investigate various collection and detection methodologies.
- Gravity, magnetic, resistivity, and passive seismic geophysics to assess the location and extent of subsurface chimneys produced by legacy UNEs.

- Vertical integration of Hyperspectral Imaging (HSI), Multispectral Infrared Imaging (MSIR), Light Detection and Ranging (LIDAR), and Synthetic Aperture Radar (SAR) data sets for detection of craters and depressions, surface expressions of fracturing, testing artifacts, and floral and fauna stress.
- Atmospheric and subsurface modeling of noble gas production, decay, and transport using data obtained through UNESE experimentation.

The UNESE R&D are conducted by the NNSS in partnership with Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Pacific Northwest National Laboratory, and Sandia National Laboratories.



UNESE Vertical Integration of Optical Data Sets for Detection of Legacy UNE Signatures

National Nuclear Security Administration

For more information, contact:
U.S. Department of Energy
National Nuclear Security Administration
Nevada Field Office
Office of Public Affairs

P.O. Box 98518
Las Vegas, NV 89193-8518

Phone: 702.295.3521
Fax: 702.295.0154
Email: nevada@nnsa.doe.gov

www.nnss.gov

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