nuclear sciences

EXPLOSIVE DESIGN

Tailored excavating tool

It would be economically unsound to devise a nuclear explosive for each specific engineering job that comes along. What nuclear scientists try to do instead is to design one that is generally best for each of the three types of explosions: underground, excavation cratering and scientific research. One type is almost ready.

By this summer, reports Dr. B. Clark Groseclose, the Lawrence Radiation Laboratory at Livermore, Calif., expects to have a design that will provide any desired yield for excavation purposes, and with a minimum of radioactivity. For example, it could provide a one-megaton crater whose lip would be nearly radiation-free a month or so after detonation. The explosive would weigh about 15 tons and measure 50 inches in diameter.

An explosive designed to tap underground oil or natural gas reserves could be available within a year, contingent upon money and approval, he says.

GEONUCLEAR EFFECTS

Water is the key

Water has been singled out as the most important geological factor in determining the size of a crater formed by an underground nuclear blast. Calculations by Robert W. Terhune of Lawrence Radiation Laboratory indicate that a saturated bedrock will produce a crater 30 percent larger than one in corresponding dry bedrock.

Water reduces the strength and porosity of the rock so the material is a better stress transmitter, and provides a source of noncondensable water vapor. The expansion of the water, vaporized by the explosion, acts as a driving force to eject the surrounding material.

NUCLEAR EXCAVATION

Reducing seismic shock

In constructing a canal or mountain highway cut with nuclear explosives, a salvo of explosive devices must be used to produce a crater. The craters are eventually connected. The resulting shock, however, can damage nearby cities or injure local residents.

Tests that use conventional explosives, says John Toman of Lawrence Radiation Laboratory, show that by placing smaller explosives closer together and deeper, cratering ability can be enhanced. Thus, five 200-kiloton devices 600 feet apart could produce a crater deeper than one made by five 500-kiloton devices 1,000 feet apart. Although deeper, the 200 kiloton crater would be smaller.

VENTING

Water could be the culprit

It is possible that a wet environment can cause more radioactive fallout from underground nuclear explosions than a dry one. Data still being studied from the project Schooner blast of Dec. 8, 1968, show that the radioactive fallout was twice the expected amount.

Possible causes, says Dr. Howard A. Tewes of Lawrence Radiation Laboratory, are expanding water vapor released from the bedrock or the charges' proximity to the surface or both factors together.

HARBOR CONSTRUCTION

Blasting in Hawaii

A spinoff from project Plowshare, the Atomic Energy Commission's Atoms for Peace Program, is under way in northwest Hawaii. The Army is using techniques and data developed by nuclear excavation tests to build part of a small-boat harbor with conventional explosives.

So far, reports Lieut. Col. William E. Vandenberg of the Corps of Engineers' Nuclear Cratering Group, a test series of four one-ton charges and one 10-ton charge buried in Kawaihae Bay have provided data to allow designs of the final detonation. Crater contours from the test were broader and flatter than expected. Twelve additional 10-ton charges will be detonated in three shots at the end of April to complete the experiment, code-named Tugboat.

RESIDUAL RADIOACTIVITY

Tritium dissipation cyclic

Tritium is one of the most significant radioisotopes produced by an underground thermonuclear explosion. But there are few data on what happens to it in the environment near the crater. Recent studies of the 1962 Sedan crater in Nevada show that tritium in the earth moved by the detonation undergoes a seasonal up-and-down cycle with an over-all downward trend.

In the summer, evaporation and upward water movement through the soil concentrates the tritium at the surface of the ejecta. In the winter, rainfall dilutes the surface concentration. The following summer's increase never attains the level of the previous summer, resulting in a sort of descending staircase effect, says Dr. John J. Koranda of Lawrence Radiation Laboratory.

He found that half of the tritium disappears every 15 to 20 months.

Such knowledge can influence water resource development of the area and provide information about water movement in the environment.

HYDROLOGY

Nuclear-formed reservoir

One possible use for nuclear explosives is to excavate water reservoirs. A Soviet test conducted to determine levels of lingering radioactivity found that while it exists in the reservoir, it apparently does not seep into the surrounding groundwater.

One year after the test, 100 cubic meters of groundwater had flowed into the crater, which was 31 meters deep and 110 meters wide. The water dissolved small amounts of the soluble radioisotopes of the elements strontium, rubidium, antimony and cesium present in the crater fallback.

The studies were performed by Dr. U. A. Izrael and co-workers of the Institute of Terrestrial Physics, USSR Academy of Sciences in Moscow.