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THE NEVADA TEST SITE ENVIRONMENTAL-SURVEILLANCE PROGRAM

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INTRODUCTION

DEFINITION

The Environmental Surveillance Program at the Nevada Test Site is a comprehensive analysis and documentation of the radiological environs and the effects of radiation at NTS. The program consists of the following phases:

--Systematic collection of samples of air, water, soil, vegetation, surface dust, and animals from both random and specific locations throughout NTS.

--Analysis of these samples to determine types, amounts, movement (by natural or man-made forces), and changes in patterns of radiation in the environment, and to relate transient conditions to test activities or other causes.

--Evaluation of radiation data (as to types, amounts, and locations) by comparing them with established standards.

--Documentation of all data to provide a complete, continuous history of the radiological environment at NTS.

OBJECTIVES

The short-term goal of the program, with regard to on-site health and safety, is to minimize casual personnel exposure to radiation. The goal is achieved through total-environment monitoring, which makes it possible to locate and identify the many localized radiological environmental conditions as to types and quantities of contamination.

The long-range objective is to anticipate future radiological problems and their solution. This is done through a continuing review of up-to-date records on the radiological environment within NTS. These accumulated data also will provide the AEC-NVOO with a basis for evaluating NTS land for later tests or other activities, and for installation of facilities.

There are other benefits related to this long-term objective. Data gathered now constitute an excellent background of environmental information. Such information provides a base or reference to which subsequent Test Site activities and radiation measurements can be compared. Also, the data provide a basis of comparison and evaluation for other nuclear installations and for NTS-related off-site areas of contamination that may develop in the future.

To achieve the short-term goals and long-range objective of the program requires a combination of planning, continuity of operations, documentation, and evaluation of data. The entire effort, then, extends beyond day-to-day environmental surveillance.

Below is a general description of how the radiological surveillance program is carried out. Detailed procedures describing precise methods of sampling, analyzing, documenting, and reporting comprise a separate report, available on request.

METHODS

AIRBORNE-PARTICULATE SAMPLING AND ANALYSIS

Low-volume air samplers run continuously at twelve key locations within the Test Site to gather samples of airborne material. Radiological analysis of the samples provides aerosol information for the entire NTS. This facet of the program permits not only immediate surveillance of health conditions but also a continual study of aerosol conditions and how they change.

In particular, continual studies of air-contamination levels provide information on the following aspects of air-related radiation:

--Quantitative and qualitative changes and rates of change of airborne contamination.

--Changes in the alpha-to-beta ratio.

--The increase in air contamination after tests, and the criteria for "normal" air conditions.

--The extent to which nuclear-explosive tests and reactor tests affect background-radiation levels, and the elapsed time for a return to normal levels.

--Changes in airborne contamination which can be related to tests elsewhere in the world.

--The extent to which airborne contamination contributes to water, soil, and vegetation contamination. (This is determined as a result of comparing different samples--e.g., surface water with underground water; pretest water, soil, or vegetation samples with posttest samples--and relating the differences to levels of airborne radiation.)

Air samples are analyzed for gross alpha and beta activity. Isotopic analyses are made when significant concentrations of contamination are observed, or when it is desirable to know which radionuclides are entering water, soil, etc. All sampling and analysis data are recorded. They are reported periodically in terms of average air contamination for gross alpha and beta activity. Selected samples are analyzed by spectrometry.

CORRELATING SAMPLING DATA

It is possible to estimate the extent to which airborne contamination contributes to the contamination of surface water--both absolutely, and in relation to the degree of water contamination attributed to transport of contamination from its source by underground water.

Air samples collected near the surface water are analyzed for amounts of radioactivity; results are compared with the data obtained from water-sample analysis. If the water sample shows more activity than what should result from airborne contamination as indicated by air-sample analysis, then there must be an additional source of water contamination. So, air and water samples are collected near the water source and analyzed to determine the relative amount of contamination introduced to the water at this location. Air and water samples are taken from Area 5, Area 12 camp, White Rock Spring, Cane Springs, Tippipah Spring, and Topopah Spring, and other NTS locations where there is standing surface water. Samples are analyzed and data are compared for these reasons:

--To relate the amounts of contamination in different sources of water: standing surface water, such as spring-fed ponds; and surface storage or well water.

--To detect underground water transport of contaminants.

--To determine the locations and rate of movement of contamination from air to water, to soil, and to vegetation.

--To assess long-range ecological effects resulting from airborne contamination deposited and concentrated in standing surface water.

For a complete air-sampling program, one which relates airborne contamination to contamination in other parts of the environs, necessary samples are gathered and analyzed, and the data are examined to correlate surface deposition of contamination with soil and vegetation contamination and assimilation, and assimilation of radioisotopes by animals.

WATER SAMPLING AND ANALYSIS

Samples of drinking water, industrial water, and surface water such as springs, reservoirs, and ponds are collected and analyzed for gross alpha and beta, and specific low-energy-beta emitters. Drinking water and exposed surface water are analyzed qualitatively if significant concentrations are indicated. Random samples of industrial water also are analyzed qualitatively.

The study of water contamination is rounded out by the analysis of surface water collected from (1) surface locations (springs, wells, reservoirs) and (2) subsurface sources. Comparing these two sets of samples with each other provides information on the relative contributions of ground-water contamination and fallout to total water contamination. (And, as described earlier, a comparison of water samples with air samples collected nearby indicates the amount of contamination introduced to the water--at its origin in the water table or at its appearance at the surface--by airborne contaminants only.) Hence, a comparison of these two sampling methods indicates the relative amounts of (1) airborne contamination introduced to water at its surface destination; (2) airborne contamination introduced to water at its underground source; (3) contamination transported from its underground origin to its surface destination; (4) contamination dissipated between the underground source and surface destination; and (5) the relative extent of concentration due to evaporation from surface water at its surface destination.

The effect of water transport related to radionuclide concentration is becoming increasingly important. Accordingly, the relationship of fallout to the concentration of radionuclides in both ground and surface water is documented.

Data from water (and air) samples can be related to test activity and to seasonal changes for short-term studies. For long-term studies, the relation of standing-water contamination to contamination at the source, the rate and nature of flow, and the effects of evaporation and sedimentation will be quite valuable.

VEGETATION SAMPLING AND ANALYSIS

Vegetation is collected at water-collection and air-sampling locations. The samples are analyzed to determine the relative extent to which plants have assimilated various isotopes through the soil or water in contrast to what has been deposited through the atmosphere.

Analysis of vegetation is valuable not only in relating plant contamination directly to soil and water contamination and indirectly to air contamination, but also in determining future effects of plant contamination on animals. Plant analysis also facilitates understanding of the movement, by natural forces, of contamination from one location to another. For this reason the data will be of value in the management and control of dump and waste areas at the Nevada Test Site and at other nuclear installations as well.

Because it is extremely difficult to remove externally deposited contamination from vegetation, much care is required to distinguish between plant contamination resulting from fallout and that which is assimilated from the soil or water.

Newly germinated plants are protected from external contamination by plastic bags until they are harvested for analysis. Then, similar unprotected plants also are harvested for analysis, and the data are compared. Excess contamination in the unprotected plants is attributable to fallout.

Because the assimilation of different isotopes varies from one plant species to another, a wide range of samples is collected, and data are recorded according to species.

SOIL SAMPLING AND ANALYSIS

Soil samples are studied in conjunction with vegetation and animal samples in order to determine the movement of contamination and its assimilation by plants and then by animals.

In Areas 4, 8, and 11, where residual radiological conditions are stable, the following phenomena are studied for interrelation: concentrations of isotopes; resuspension and translocation of contamination by wind and water; dilution by leaching and erosion; soil-contamination concentrations as a function of depth and elapsed time since deposition; and eventual assimilation of plant contamination by animals.

ANIMAL SAMPLING AND ANALYSIS

Small animals with a limited home range in radiologically stable areas are captured and analyzed for uptake of radiation. Assimilation amounts and rates are correlated with data on vegetation and soil contamination in the same location. As a result, data on changes in body-burden levels over time are obtained and related to soil, water and vegetation conditions. This is done for carnivorous, omnivorous, and herbivorous animals.

AIRBORNE-DUST SAMPLING AND ANALYSIS

Trays coated with sticky material to trap airborne dust are used for two purposes. When placed near air samplers they collect dust samples that supplement the samples from low-volume air samplers. Elsewhere, they are used to gather information on the resuspension and translocation of airborne contamination.

Trays both parallel to the ground and perpendicular to the ground are placed around specified areas. The horizontal trays collect mainly particulate matter from fallout; the vertical trays, mainly particulate contamination resuspended and transported by the wind. Thus, gross counts of radioactivity from the trays provide a way of comparing freshly deposited contamination from fallout with translocated surface contamination.

SURFACE-DUST SAMPLING

Surface swipes are taken routinely from buildings and equipment in all permanent work areas and all living areas. Cafeterias, dispensaries, and ambulances are surveyed daily; other buildings and equipment, weekly.

Because swipes are taken primarily to monitor the effectiveness of radiological housekeeping, samples are analyzed first for gross alpha and beta. Samples that indicate activity above background are qualitatively analyzed for further evaluation and followed by remedial cleaning of the facility, and additional sampling.

MEASUREMENT AND DOCUMENTATION OF BACKGROUND GAMMA AND COSMIC RADIATION

The objective of this phase of the program is first to distinguish between natural radiation and man-induced radiation, and then to compare the two with respect to levels and effects. Toward this end, continual low-level-gamma measurements are obtained at all permanently established sampling stations. In this way, gamma contributions to the biosphere by nuclear tests are measured and documented, and the rate of change between tests is determined. This history of gamma levels will increase in value for future biological studies.

Two complementary measuring systems are used to gather data on radiation levels. For continuous surveillance at permanent stations, low-range pencil chambers and 1-liter chambers are used. These devices are routinely checked for integrity and are exchanged and calibrated biweekly. For short-term and special measurements, a battery-powered 40-liter air-ionization chamber is used with an electrometer circuit. The instrument is calibrated to measure dose rates on the order of 10 microroentgens an hour.

SUMMARY

A comprehensive program of analysis and documentation of the radiological environment enables the casual exposure of personnel to radiation to be kept to a minimum, and provides a continuing radiological history of the NTS environs. From these data, the AEC-NVOO manager can estimate future land use and facility requirements, and evaluate proposed test requirements by all users. The data accumulated are valuable for relating radiation from tests to off-site-contamination conditions, and will become even more valuable as an industry-wide frame of reference for future installations and nuclear activities at other locations.