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IN REPLY
REFER TO: H8-77-349
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June 13, 1977

0816 TA-54

Mr. Gerald H. Daly, Chief
Operations Branch
Division of Waste Management,
Production and Reprocessing
U.S. Energy Research & Development
Administration
Washington, D.C. 20545

Dear Mr. Daly:

Attached is the May, 1977, report on three programs being pursued at LASL dealing primarily with shallow land burial of radioactively contaminated solid waste materials.

Sincerely,

LaMar J. Johnson
H-8 Group Leader
Environmental Studies

LaMJ:kr
Attachment: Report a/s
Distribution List
(A414, A415, A420)

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MONTHLY PROGRESS REPORT

MAY 1977

- LS-14-1-7A
  EVALUATION OF TRU-CONTAMINATED WASTE BURIAL SITES
- LS-15-1-7A
  LASL RADIOACTIVE SOLID WASTE DISPOSAL SITE STUDIES
- LS-20-1-7A
  RADIOACTIVE WASTE BURIAL TECHNOLOGY
- RELATED ACTIVITIES

LOS ALAMOS SCIENTIFIC LABORATORY

ENVIRONMENTAL STUDIES GROUP H-8

WORK PERFORMED FOR

DIVISION OF WASTE MANAGEMENT,
PRODUCTION, AND REPROCESSING
U.S. ENERGY RESEARCH
AND DEVELOPMENT ADMINISTRATION

los alamos
scientific laboratory
of the University of California
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UNITED STATES
ENERGY RESEARCH AND
DEVELOPMENT ADMINISTRATION
CONTRACT W-7405-ENG. 36

EVALUATION OF TRU-CONTAMINATED WASTE BURIAL SITES, LS-14-1-7A

Efforts during the month have continued the formalization and documentation of the techniques developed during the previous years. Work began during the month on the third and final portion of the documentation for the Biological Transport Model used to simulate movement of plutonium or other radionuclides in plant and animal ecosystems. This portion of the documentation will provide explanations of how the various equations in the model were developed, justification of the equations using available knowledge, and references to the modeling concepts used in the model. This documentation will permit critical evaluation of the model by someone unfamiliar with it, and will greatly facilitate its use or modification in the future.

Two papers were presented at Symposia during the month. These papers served to expose the evaluation techniques to scientific peer review, and to formalize the methodology developed. A paper was prepared on "LASL Models for Environmental Transport of Radionuclides" and presented at the Eighth Annual Conference on Modeling and Simulation, Pittsburgh, PA. The paper described the status of this project, and concentrated on a description of the developed simulation capability and an example application. Output from a short simulation of a warm- and cool-season grass ecosystem was displayed as an example of the capabilities of the Biologic Transport Model. A second paper entitled "Considerations for the Long-Term. Perpetual is Not Forever," was presented at the Symposium on the management of Low-level Radioactive Waste. This paper discussed the environmental changes which may occur in a time period of several hundred years that could result in changes in burial site containment potential. Mechanisms considered included changes in site hydrology and surface condition due to climatic changes, uptake and dispersal by plants and animals, and the potential for inadvertant excavation by man. Copies of these papers are included for reference.

Finally, a request was received from ERDA Idaho Operations Office for LASL participation in a technical meeting to discuss long term risk analysis for buried transuranic waste. In preparation for that meeting, the application of LASL's evaluation system to long-term risk analysis has been described. The LASL system differs from traditional risk analysis in that it does not compute the individual or population doses resulting from releases from burial grounds. It is believed that determination of doses, for the time frame of possible burial ground releases, cannot be realistically accomplished. Rather, the emphasis has been placed on describing all possible release mechanisms in a sufficiently dynamic fashion that their extrapolation into the future is well founded. This permits comparison of various long-term management alternatives, and identification of the significant release processes at any given site.

LASL RADIOACTIVE SOLID WASTE DISPOSAL SITE STUDIES, LS-15-1-7A

Field work was initiated during the month to define the location and geometry of burial pits in some of the older LASL disposal sites. Records of the pit locations do not exist. Geophysical properties of earth resistivity and seismic velocity are expected to differ between the filled pit and the surrounding volcanic tuff. Determination of these properties along horizontal profiles through the disposal area will be used to locate the pit boundaries. The basic principles of seismic techniques are illustrated in Fig. 1 and field use of the instrument is pictured in Fig. 2. Rarely are field results as distinct as those illustrated. In general, results of these investigations are ambiguous and must be supported by additional measurements (such as earth resistivity). The stress at the present time is to develop sufficient familiarity with these measurements that reliable data interpretation can be performed.

Geologic mapping work of the laboratory area continued during the month. A report was prepared summarizing previous work on the stratigraphy of the Bandelier tuff, including a summary of major correlations. The stratigraphy of an area is

a description of the characteristics, areal extent, and interrelationships of the various geologic units. This information is important in tracing the variation in physical and hydrologic properties from point to point. Various interpretations of the stratigraphy are possible, in part dependent on the amount of data available. The present mapping efforts are thus aimed at obtaining large amounts of data. The data will be used, where possible, to resolve interpretational difference, and to present a single cohesive picture of the local geology. The geology then provides a framework for hydrologic measurements related to waste migration.

Work continued on developing instrumentation for rapid analysis of environmental samples. Previous work had resulted in a detection level of 20 pCi/g for ^{239}Pu. Soil samples spiked with ^{241}Am were used to establish a detection limit of 0.5 pCi/g for a 4-hour count at the 3σ level with a 20 gm sample. The detection is made by measuring the yield of the ^{241}Am gamma at 59.5 keV with an Intrinsic Germanium Planar (16 P) Photon System. The detection limit for ^{241}Am is considered adequate for most of the envisioned applications. However, for several planned and ongoing studies of plutonium in soils, a lower detection limit is desirable. The two major factors hindering this are the self-absorption in the sample and the background radiation due to natural radioactivity in the sample. One solution to the self-absorption problem is to increase the size of the detector. Negotiations with a detector vendor have been completed, arranging for the evaluation, on a loan basis, of one of the largest IGP detectors ever built. This detector is over 50% larger than the one currently used for these measurements at LASL. Development work with this detector will begin shortly. Selective chemical reduction of the soil matrix is also being considered; both as a way to reduce self-absorption, and to eliminated background radiation. A possible procedure for isolating the plutonium has been identified.

RADIOACTIVE WASTE BURIAL TECHNOLOGY, LS-20-1-7A

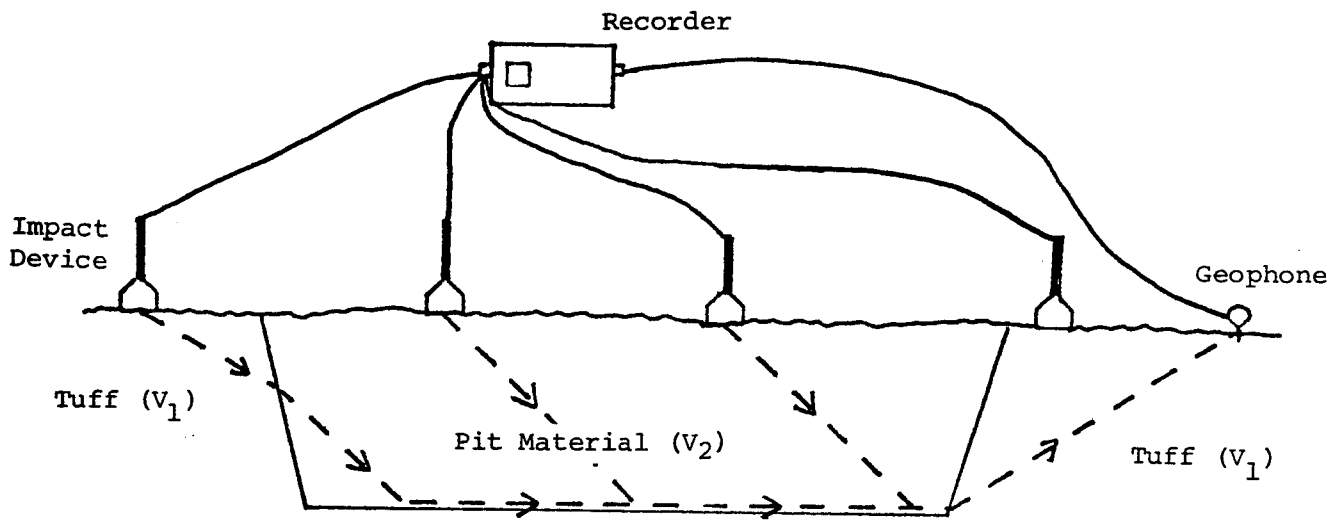
A primary objective of this program is to define the factors controlling radionuclide migration under dry soil conditions. The investigation is using data from existing waste disposal sites as well as data from laboratory experiments to measure such things as moisture flow rates, migration characteristics of various radionuclides, and the effect of both moisture and chemistry on the migration. Samples were collected previously from beneath a liquid waste disposal site, and analyzed for plutonium and americium content. Portions of these samples are now being leached to determine the chemical form of the radionuclides, and the composition of the stable chemicals present in the ground beneath the disposal site. This information will be used to reconstruct the processes leading to the present distribution.

The chemistry and migration of radionuclides in earth materials is sufficiently complex that, often, a simulation model is required to interpret the results of experiments. The chemical interactions involved are not unlike some geologic phenomena, such as weathering or hydrothermal alteration, where the exchange of material between solid and liquid phases is governed by thermodynamic principles of chemical petrology and solution chemistry to the study of geochemical processes in earth materials. It permits quantitative prediction of the interaction between solutions and specific geologic environments.

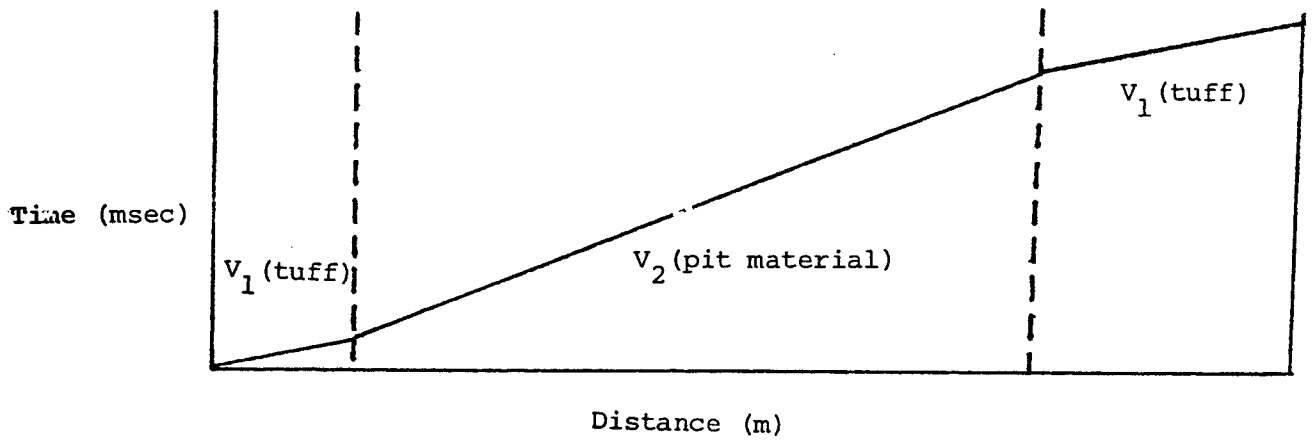
A given geochemical process can be represented by a series of reversible and irreversible chemical reactions. These reactions can be described by a series of equations. Solution of these equations provides a statement of the nature and extent of composition changes for both the liquid and solid phases. The simulation program performing the calculations is currently in use at the University of British Columbia. This version has been released for geologic research at LASL. It is designed primarily for analysis of hydrothermal ore deposits. Conversion from IBM to CDC computer formats is required. The

calculational data base is being expanded to include the elements pertinent to waste management.

Fig. 1. Use of Seismograph to Locate Pit Boundaries



a. Instrument Array



b. Velocity Profile

Fig. 2. Field Use of Seismograph

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Scientific Laboratory
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June 1977

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