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PRESTO-II COMPUTER CODE FOR SAFETY ASSESSMENT ON SHALLOW LAND DISPOSAL OF LOW-LEVEL WASTES+

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INTRODUCTION

In this study, the PRESTO-II (Prediction of Radiation Effects from Shallow Trench Operations) computer code [1] has been applied for the following sites; Koteyli, Balikesir and Kozakli, Nevsehir in Turkey. This site selection was based partially on the need to consider a variety of hydrologic and climatic situations, and partially on the availability of data [2-4]. The results obtained for the operational low-level waste disposal site at Barnwell, South Carolina, are presented for comparison.

The PRESTO-II model is an implementation of the PRESTO methodology that was developed in 1983 for the U.S. Environmental Protection Agency (EPA). PRESTO-II version of the code may be characterized as to its intended applicability, the methods of solution, code limitations, the existence of supporting software, and required libraries. The purpose of the model is to estimate possible health effects from low-level radioactive waste buried in shallow trenches. The accumulation and distribution of radionuclides in and through the environment is a complex process involving both radionuclide decay and many interaction forms of physical transport. It can take from hundreds to thousands of years for a radionuclide to reach its maximum concentration at a particular point in the environment. Radionuclide transport must be represented by a model which emphasizes the dominant features in radionuclide distribution over an extended time period. PRESTO-II is intended to serve as a non-site-specific screening model for assessing radionuclide transport, ensuing exposure and health impacts to a static local population for a 1000-year period following the end of the disposal operations.

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The methodology that this code takes into consideration is versatile and explicitly considers percolation of surface water downward into the trench, leaching of radionuclides, vertical and horizontal radionuclide transport at a retarded velocity, and use of contaminated groundwater and contaminated surface water farming, irrigation, and ingestion. Ponding of water in trenches, leachate overflow, cap erosion, and radionuclide suspension and transport by winds are also considered.

RESULTS AND DISCUSSION

The PRESTO-II computer code has been applied to obtain a preliminary estimate of maximum doses for selected release and exposure scenarios associated with proposed Low-Level Waste (LLW) disposal sites in Turkey.

The Barnwell low-level radioactive disposal facility is located 8 km west of the town of Barnwell, South Carolina. The Koteyli, Balikesir site is in southern Marmara region of Turkey and the Kozakli, Nevsehir site is in the Middle Anatolia Region. Annual summaries of the concentrations of several nuclides in and leaking from the trench at Koteyli are given in Figs 1 and 2. As these figure show tritium and ^{14}C activities decrease rapidly with respect to time. But these radionuclides may cause important health impacts to human because of their tendency to move freely through biological systems, and their association with their abundant stable element counterparts. Other radionuclides which have very long half lives may also have important health impacts to a static local population living near shallow land disposal areas.

Table 1 summarizes the simulation results of the dose and health effects calculations for sites at Barnwell, Koteyli and Kozakli using the radionuclide inventory data set believed representative of the LLW disposal facility in Barnwell, South Carolina [5]. The simulation results presented in Table 1 indicate that relative human radiological impacts for these sites vary according to the relative gross radioactivity of the streams. On the basis of estimated transport of radionuclides from the low-level disposal sites, the doses to the critical group individuals are found to be small.

Table 1. Summary of population doses and health effects for sites at Barnwell, Koteyli and Kozakli

	Kozakli	Koteyli	Barnwell
Lifetime fatal cancer risk	$3.52\ 10^{-6}$	$1.68\ 10^{-4}$	$0.56\ 10^{-5}$
Health Effects (deaths/y)	$4.82\ 10^{-4}$	$2.04\ 10^{-2}$	$5.53\ 10^{-4}$

Table 1 shows the simulation results of PRESTO-II indicating that the sum of all radiological impacts (both low- and high linear energy transfer) from exposure of the local residence of Barnwell (population of 7033) to contaminants is 5.53 10^{-4} deaths/y. The linear energy transfer (LET) classification considers alpha particles and the resultant recoiling nuclei to be high-LET radiation. Beta particles and gamma rays are classified as low-LET radiation. By comparison, the current annual death rate from cancer for a representative population of 7033 would be 13 persons [6]. The waste disposal-associated death rate is less than the background cancer death rate by a factor of 4.2 10^{-5}.

CONCLUSIONS

A methodology has been developed at the Oak Ridge National Laboratory to assist in assessing the potential human health impacts from disposal of low-level radioactive waste. This methodology is called PRESTO-II. In this study, the PRESTO-II computer code was chosen to evaluate radionuclide transport and human health effects, and has been applied for various low-level waste disposal sites in Turkey. Results of these simulation suggest that there would be small health impact associated with burying these wastes in low-level disposal area in either of the Turkish sites described in this study. The predicted level of health effects for the Kozakli site is comparable to that for the Barnwell site but the predicted level of health effects for the Koteyli site is greater then Barnwell site. Predicted population radiation exposures for each of the three sites are well below background levels.

REFERENCES

1. Fields, D. E, C. J. Emerson, R. O. Chester, C. A. Little, and G. Hirimoto. PRESTO II: A Low Level Waste Environmental Transport and Risk Assessment Code, Oak Ridge National Laboratory Report, ORNL-5970 (1986).

2. Devlet Su Isleri Genel Mudurlugu. Koteyli Projesi Planlama Raporu, Ankara, Turkey (1984).

3. Devlet Su Isleri Genel Mudurlugu. Nevsehir-Kozakli Doyduk Baraji Projesi Planlama Raporu, Kayseri, Turkey (1984).

4. Uslu, I., D. E. Fields, and M. G. Yalcintas. Low level Waste Studies in Turkey, Presented in 32nd Annual Meeting of Health Physics Society in Salt Lake City (1987).

5. Fields, D. E. and C. J. Emerson. Unrestricted Disposal of Minimal Activity Levels of Radioactive Wastes: Exposure and Risk Calculations, Oak Ridge National Laboratory Report, ORNL-6001 (1984).

6. Lane, H. U., Editor. The World Almanac and Book of Facts Newspaper Enterprises Association, Inc. (1982).

ANNUAL SUMMARY OF SEVERAL
NUCLIDES IN TRENCH AT KOTEYLI

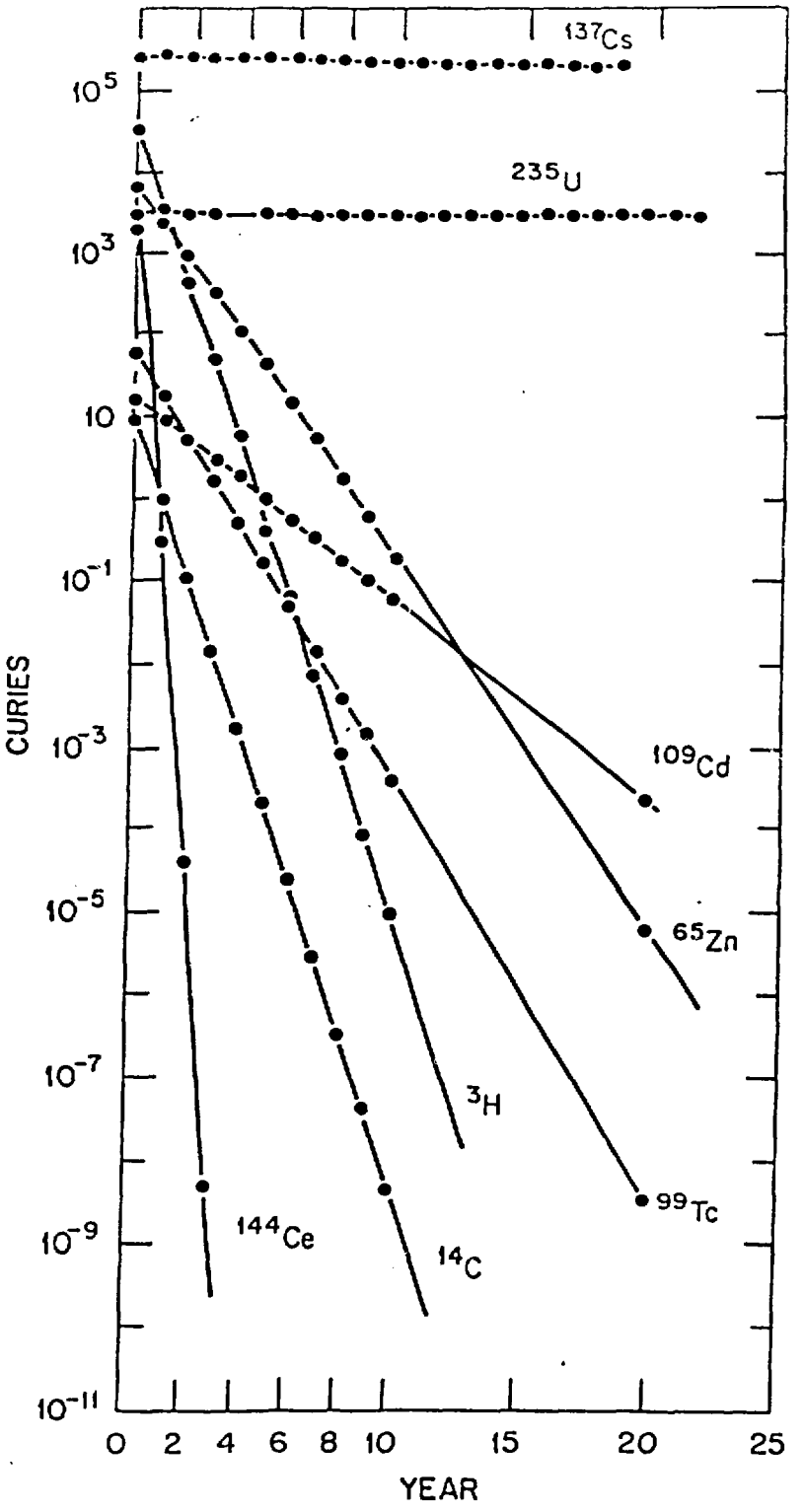
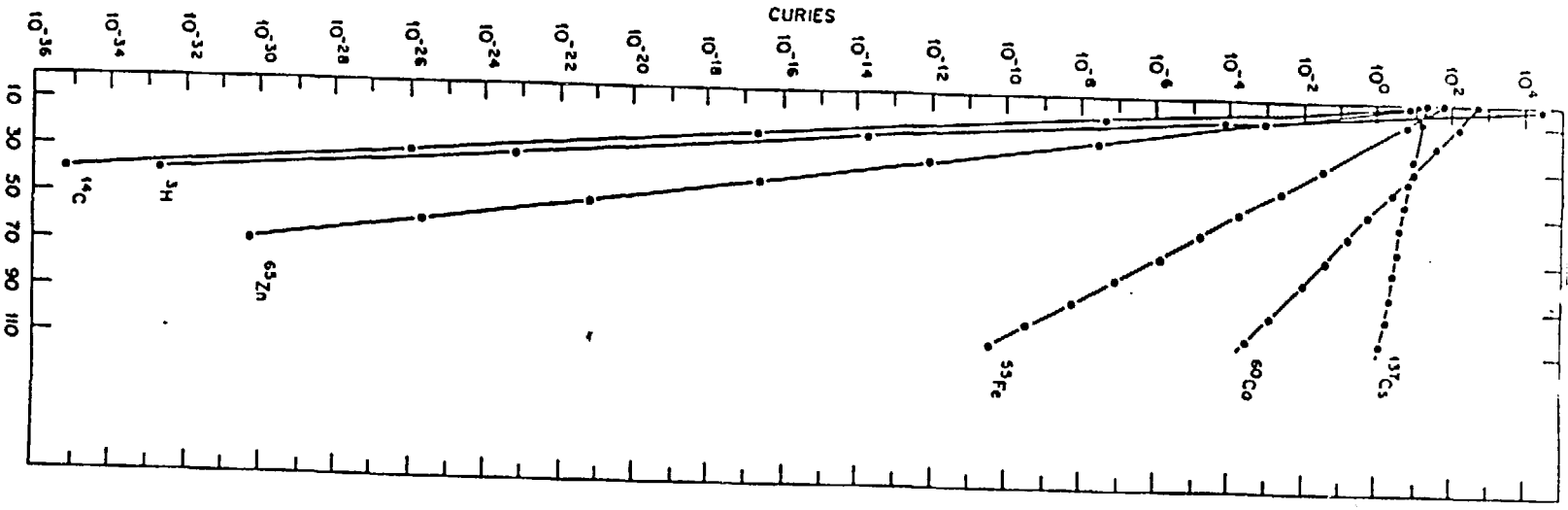


FIGURE - 1



ANNUAL SUMMARY OF SEVERAL NUCLIDES LEAKING FROM TRENCH AT KOTEYLI

FIGURE - 2

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