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ONSITE DISPOSAL OF COMMERCIAL
RADIOACTIVE WASTE: THE
ONSITE/MAXI1 COMPUTER PROGRAM

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ONSITE DISPOSAL OF COMMERCIAL RADIOACTIVE WASTE:
THE ONSITE/MAXI1 COMPUTER PROGRAM^(*)

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Because of uncertainties associated with assessing the potential risks from onsite burials of commercial radioactive waste, the U.S. Nuclear Regulatory Commission (NRC) has amended its regulations to provide greater assurance that buried radioactive material will not present a hazard to public health and safety. The current policy of NRC is to review requests by operators to bury radioactive waste on their property on a case-by-case basis. Technical assessments of onsite disposal requests may, at times, require the use of environmental pathway models to project potential radiation exposure to humans. The objective of this study was to modify an existing environmental pathways-to-humans model and accompanying computer program (MAXI1^{1,2}) for use by NRC staff for assessing potential radiological impacts resulting from the onsite burial of low-level radioactive wastes. As part of this effort, specific human-intrusion scenarios were developed to consider various routes of potential exposure, which included direct external exposure, inhalation, and ingestion of contaminated foodstuffs and drinking water. A computer software package, entitled ONSITE/MAXI1, was developed to project potential exposures based on these scenarios.

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The package contains four computer programs (ONSITE, MAXI1, MAXI2, and MAXI3) and an accompanying data base.

The Environmental Impact Statement (EIS) prepared in support of 10 CFR Part 61,^{3,4} considered potential exposure pathways to humans from buried radioactive wastes. Scenarios were identified to account for the potential intrusion of humans after the loss of institutional control.

A similar approach was applied for assessing the potential risks associated with onsite disposal. That is, radiation-exposure scenarios were established for the maximally exposed individual (an intruder), and a means for estimating the resulting radiation dose was developed. Five scenarios were identified as potentially resulting in radiation exposure to intruders at onsite disposal sites:

1. External Exposure Scenario. The intruder is assumed to work in an area previously used for onsite disposal. External exposures from surface-soil contamination, wastes buried at depths of 0.5 m or 1.0 m, or entry into a room (or vault) that is used for waste storage or disposal are considered.
2. External Exposure Plus Inhalation Scenario. The intruder is assumed to work in an area with limited surface-soil contamination. Inhalation of resuspended contaminated soil is also considered.
3. Agricultural Scenario. The intruder is assumed to farm the site that produces all or part of his annual diet. External exposure and inhalation of resuspended radionuclides in soil are also considered.
4. Irrigation/Drinking-Water Scenario. The intruder is assumed to use water contaminated with radionuclides from an onsite disposal site for irrigation and/or drinking. External exposure and inhalation of

resuspended radionuclides deposited on the soil surface by irrigation water are also considered.

5. User-Defined Scenario. The user may construct his own scenario by selecting exposure pathways and defining conditions from options described in the ONSITE/MAXI1 computer software package.

Estimates of the maximum annual radiation doses based on selected exposure scenarios can be made by furnishing available site-specific information to the ONSITE/MAXI1 software package. The user interacts with the ONSITE computer program to select one of the five exposure scenarios identified above. The program prompts the user to identify the source and location of the contamination and to quantify the inventory. The user may modify assumptions concerning the maximally exposed intruder's lifestyle in response to questions asked by the program. The ONSITE program checks the user's input for validity, selects appropriate data libraries to be used for the dose calculations, and constructs the input file for the MAXI1 computer program.

The computer program, MAXI1, is used to calculate the maximum annual dose to the maximally exposed intruder for the scenario defined through interaction with the ONSITE program. Exposure pathways considered in MAXI1 include: 1) direct external exposure to contaminated soil or building surfaces, 2) inhalation of resuspended material, and 3) ingestion of contaminated foods, drinking water, and aquatic products. The time of the maximum dose rate to individual organs of reference is determined and the annual dose for that organ is reported.

The MAXI1 program calculates doses to humans based on dose-conversion factors developed for a given setting or "environment." An "environment"

defines the radionuclides likely to be present at the waste site, general agricultural and aquatic practices of the geographical area, and the general lifestyle of the maximally exposed waste-site intruder. A reference onsite disposal "environment" was defined, and the MAXI2 and MAXI3 computer codes were used to calculate dose-conversion factors. These dose-conversion factors are contained in data files included in the software package. The five scenarios defined above can be simulated within the context of this "environment."

The ONSITE/MAXI1 computer program package was designed to provide dose estimates for commercial low-level waste disposal sites, as well as for radioactive wastes disposed of onsite. The computer codes were designed in a modular fashion and written to meet ANSI-FORTRAN-77 standards.⁵ Complete listings of the computer programs and a technical description of the environmental pathway models, including six sample problems provided for benchmarking purposes, are found in Napier et al. (1984)¹ and Kennedy et al. (1985)².

REFERENCES

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