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PNNL-SA-41882

**Pacific Northwest National Laboratory**
Operated by Battelle for the U.S. Department of Energy

## Radiological Science and Engineering Group

# Environmental Dose Assessment

Pacific Northwest National Laboratory (PNNL) and its Radiological Science and Engineering Group (RSEG) develop and use state-of-the-art computer codes to perform complex environmental radiological dose assessments. The GENII, FRAMES, MEPAS, APGEMS and RASCAL code packages are used to investigate doses to people and the environment, with applications to environmental health challenges. Our work in environmental dose assessment helps risk managers and health physicists, among others, determine doses from airborne, terrestrial, and aquatic releases of radioactive materials.

## Internal Dosimetry

GENII is a set of state-of-the-art programs for calculating radiological doses from radionuclides released to the environment. GENII incorporates the internal dosimetry models recommended by the International Commission on Radiological Protection into updated versions of pre-existing environmental pathway analysis models. Developed for use at the Hanford Site (Washington State, USA), the GENII programs accommodate a wide variety of input parameters that affect many real-world applications.

## Selective Environmental Scenarios

FRAMES (Framework for Risk Analysis in Multimedia Environmental Systems) is designed to provide meaningful information about environmental risk management to business and technical managers. FRAMES allows you to develop environmental scenarios and select the best computer codes for human and environmental risk management analyses. FRAMES incorporates models that integrate scientific disciplines while also allowing for tailored solutions to specific activities.

## Environmental Monitoring Support

We provide support for environmental monitoring through direct dose measurements (thermoluminescent dosimetry) and *in situ* gamma specs. We also arrange for sample collection and detailed analysis.

## Multimedia Impact Assessment

Because doses come from a variety of pathways, the MEPAS software (Multimedia Environmental Pollutant Assessment System) combines all major exposure pathways into a multimedia computational tool, essential for assessing impacts from both active and inactive release sites. Unusual among computational tools, MEPAS includes transport and exposure pathways for chemical and radioactive releases and helps determine their potential impact on the surrounding environment, both individuals and populations. MEPAS uses a physics-based approach, coupling contaminant transport (contaminant release, migration and fate) with exposure routes and risk/health consequences. MEPAS models carcinogens and non-carcinogens, both radiological and non-radiological.

## Atmospheric Transport and Diffusion

Environmental dose assessments can also be performed using APGEMS (Air Pollutant Graphical Environmental Monitoring System), a PNNL-developed atmospheric transport and diffusion model. Flexible and widely applicable, APGEMS uses a three-dimensional diagnostic wind model to compute the vertical and horizontal spatial variation in winds at each time step in a simulation.

APGEMS can be used for areas with relatively uniform terrain or complex terrain environments, source-to-receptor transport distances from as little as one hundred meters to a few hundred kilometers, and such features as flow channeling, blocking by major terrain features, drainage flows, wet and dry deposition, radioactive decay, and first-order chemical transformations of the released material. APGEMS balances a user's needs for technical precision, speedy performance, and simplicity of use in dose assessment applications.

## Consequence Analysis

RASCAL 3.0 (Radiologic Assessment System for Consequence Analysis) is the latest version of a series of codes for consequence analysis. RASCAL consists of three consequence models: *STDose, FMDose,* and *DecayCalc. STDose* estimates (1) source terms for radiological accidents, (2) atmospheric transport, diffusion, and deposition of effluents from the accidents, and (3) doses from exposure to the effluents. *FMDose* calculates doses from environmental measurements of radioactivity in the air and on the ground. *DecayCalc* calculates activity of radionuclides present at a future time following decay and in-growth.