GENII Training for Novice Users

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Outline

- Introduction to GENII
- Workbook Example 5
- User Questions

Throughout this GENII training session we will be answering user questions in the chat and we have a designated breakout room for one of the trainers to provide one-on-one assistance

GENII

- Originally developed at PNNL as an environmental dispersion code for the Hanford Site

- Later generalized for the EPA by PNNL to handle a variety of sites and scenarios

- Powerful environmental dispersion software

- It is now officially an NRC RAMP code

What is the Assessment Question?

- Are we compliant?
  - Often regulatory requirements of facility operations are posed in terms of radiation dose limits

- Design requirements
  - How much material may be released and still meet the criteria?

- Safety analyses
  - How much redundancy is necessary to prevent this event?

- Accident Planning
  - How bad could this event be?

Scenario Analysis

- All of these questions can be answered through the analysis of a *scenario* that considers:

  - Radionuclides inventories

  - Radionuclide releases

  - Environmental transport

  - Environmental accumulation and dilution

  - Subsequent human exposure

Scenarios

- A *scenario* is a conceptual model that describes patterns of human activity, events, and processes that result in radiation exposure to people

- GENII is designed to allow flexible application to most scenarios of interest in a regulatory setting at an appropriate level of detail

Types of Scenarios

- Far-Field scenarios
  - Atmospheric transport (Acute or chronic)
  - Surface water transport (Acute or chronic)

- Near-Field scenarios
  - Spills
  - Buried waste
  - Groundwater Use (Ground water transport modeling is NOT an explicit part of GENII)
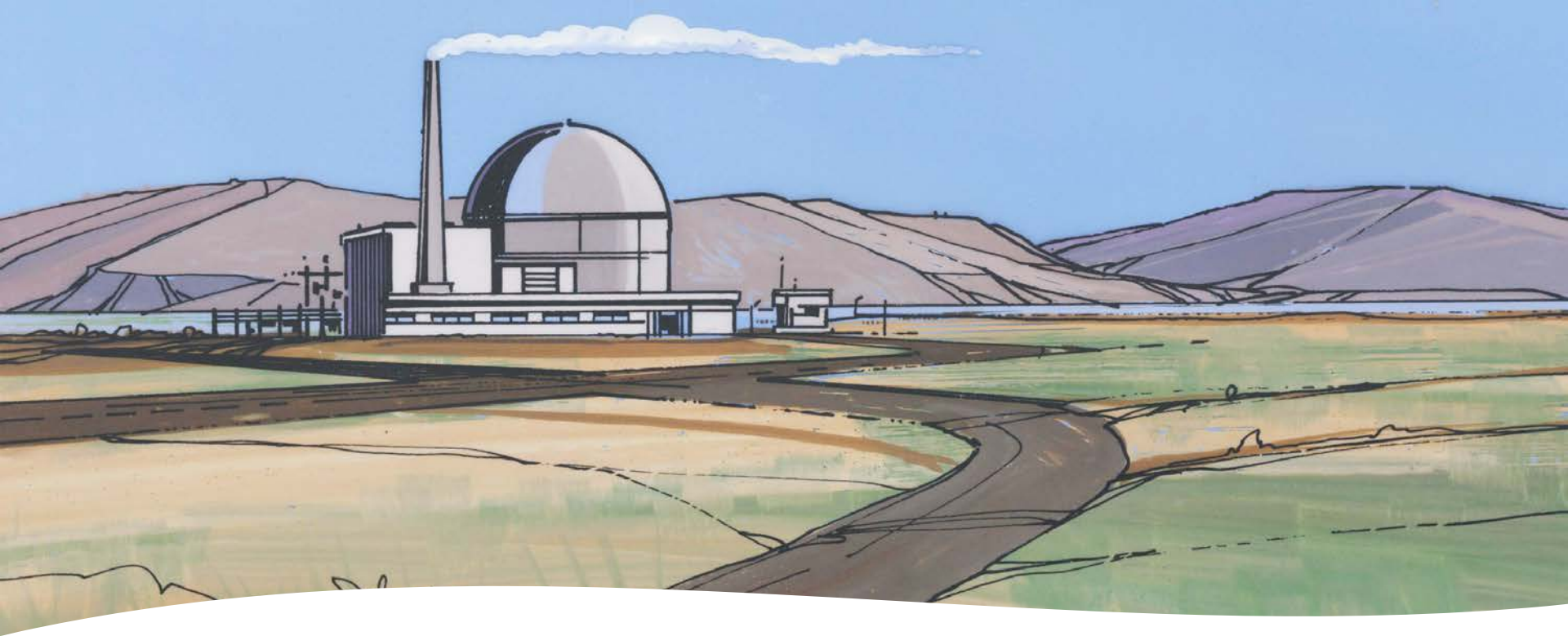
Radionuclide Source Terms

- GENII dose not calculated reactor inventories
- Input is flexible; chain decay progeny grow in

Atmospheric Transport Models

- Chronic Plume
- Acute Plume
- Acute 95th Percentile Plume
- Chronic Puff
- Acute Puff
- Chronic X/Q
- Acute X/Q

Surface Water Models

- Chronic River
- Chronic Flow Dilution
- Acute River
- Near-shore Lake/Ocean
  - Once-through pond
  - Fully-mixed pond
  - Partially-mixed pond

Accumulation/Exposure Models

- Initial contaminated conditions
- Acute deposition
- Chronic deposition

Biotic Transport and Exposure

Accumulation in plants and animals for both direct evaluation of environmental effects and human exposure

Human Intrusion

Models for evaluating transfer of buried waste to soil surface, resuspension; etc.

- External
  - Transported air
  - Soil
  - Swimming
  - Shoreline
- Inhalation
  - Transported air
  - Resuspended soil
  - Volatilized indoor air pollutants from water

Human Exposure Pathways

Human Exposure Pathways – Ingestion

- Leafy Vegetables
- Other Vegetables
- Fruit
- Grain
- Meat

- Milk
- Poultry
- Eggs
- Fish Crustaceans
- Mollusks

- Water Plants
- Drinking Water
- Shower water
- Swimming water
- Soil

Acute-Deposition Food Pathways

- GENII V.2 presents results for 4 seasons (Winter/spring/summer/autumn)

- "Seasons" are surrogates for complex sets of underlying assumptions about plant growth, weathering, uptake, and time-to-harvest

- Selection of season depends on meteorological input (this is related to the uncertainty capability)

- *Seasons below the equator are reversed! A minor change in an external file to adjust…*

Human Exposure

- Up to 6 age groups allowed, following ICRP-56,67,69 (International Commission on Radiological Protection)

ICRP Age Group	GENII Age Range
3 months	0-1 year
1 year	1-2 years
5 years	2-7 years
10 years	8-12 years
15 years	13-17 years
20+ years	17-110 years

External Exposure – Doses

- Dose rate conversion factors from Federal Guidance Report 12, provided by Keith Eckerman, ORNL
  - Air Submersion
  - Water Immersion
  - Soil Plane
  - Soil Volume

Eckerman, K. F. and J. C. Ryman. 1993. Federal Guidance Report No. 12: External Exposure to Radionuclides in Air, Water, and Soil, Oak Ridge National Laboratory. FGR 12.

Internal Exposure - Doses

- Effective dose equivalent: ICRP-30
  - Adult only

- Effective dose: ICRP-72
  - 6 age groups
  - 24 organs/tissues
  - Inhalation classes F, M, S

Risk Calculations – FGR 13

US Federal Guidance Report 13 provides coefficients for 15 cancer sites

- Inhalation (risk/Bq)
  - Inhalation classes F, M, S

- Ingestion (risk/Bq)
  - Accounts for different consumption patterns with age
    - Drinking water
    - Food crops

Eckerman, K.F., Legget, R.W., Nelson, C.B., Puskin, J.S., Richardson, A.C.B. 1999. Federal Guidance Report No. 13: Cancer Risk Coefficients for Environmental Exposure to Radionuclides. EPA 402-R-99-001.

Uncertainty Analysis

- Parameter uncertainty and sensitivity may be addressed using the SUM^3 processor in FRAMES.

- All non-control parameters are allowed to be varied, using description files to define 'available' parameters

- Acute atmospheric releases are an important subset. SUM^3 is used to vary start times, creating distribution functions of dose.

Example 5

- We will now begin our guided use case of GENII

- Please access the training workbook to follow along with our guided examples

- If at any time you have a questions about the code, please enter it in the chat
  - Questions relevant to the whole class will be answered through the main training room
  - Simple questions will be answered directly via chat when possible
  - Any people experiencing difficulties with the GENII example will be directed into the breakout room for one-on-one help with a GENII trainer

- We will stay online after the GENII Training to help people who may have questions about GENII.

- Any questions on GENII after the Webinar has closed can be asked through the RAMP website by navigating to the GENII Support Page or emailing Bruce Napier or Caitlin Condon at PNNL.

Questions?

Thank you!