Human Health Impact Evaluation Methods for a Multiple Source Analysis using the Multimedia Environmental Pollutant Assessment System (MEPAS)

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Abstract

The evaluation of human health impacts in the Hanford Solid Waste Environmental Impact Statement required evaluation of simultaneous atmospheric releases from several sources. Each source included both radionuclide and chemical contaminants with the amount released varying in time over many years. The evaluation of the human health impacts was performed for onsite workers and for members of the general public. The analysis was performed using the Multimedia Environmental Pollutant Assessment System running under the Framework for Risk Analysis in Multimedia Environmental Systems. The analysis involved eighteen types of waste streams with various combinations of radioactivity and chemical contaminants. Releases to the atmosphere were evaluated for four facilities, each with their own release point characteristics. The requirements of the calculation, methods used to address the complexity of the analysis, health impact metrics addressed, and a description of the software are described.

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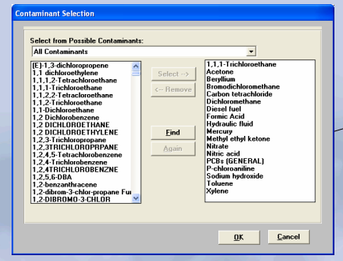
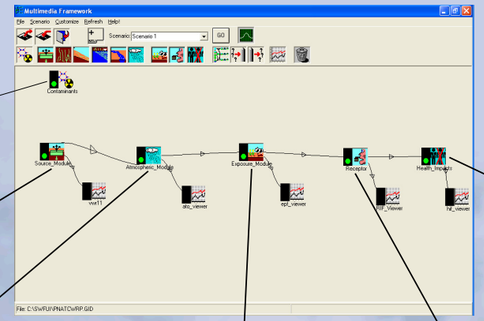
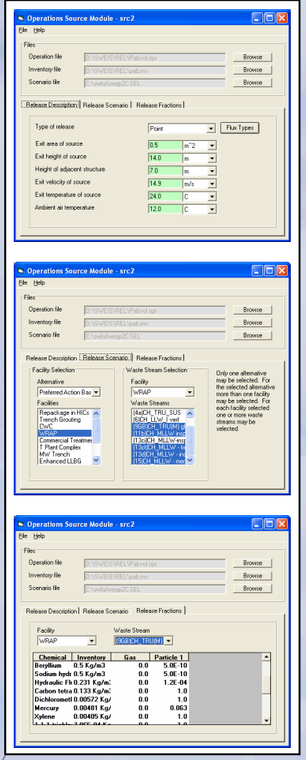
Steps in Analysis

Define Waste Stream Processing Volumes
  By stream and year
Define Average Concentration in Each Waste Stream
  Chemicals and radio nuclides
Define Physical, Chemical, and Toxicological Properties of Contaminants
  Chemicals: Non-carcinogenic, carcinogenic
  Radio nuclides: 0.06 Cancer Risk per Sv
Setup Analysis Components Using the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES)
  Release generation
  Atmospheric Transport
  Exposure Pathway Scenario
  Receptor Intake
  Health Impact Analysis
Run Analysis and Summarize Results

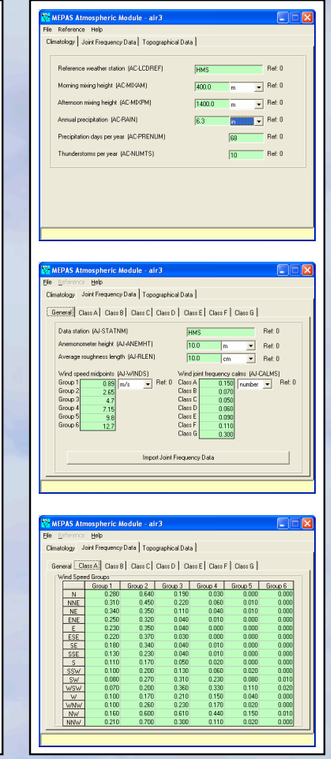




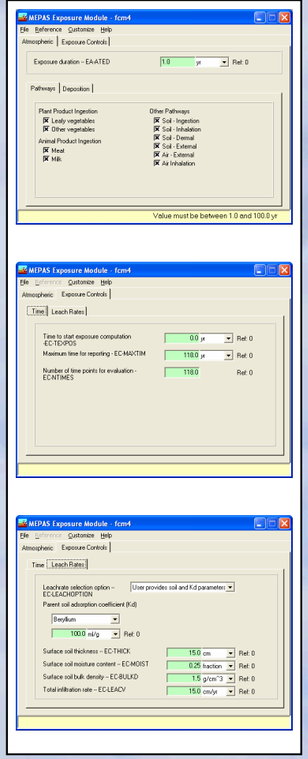
Source Module



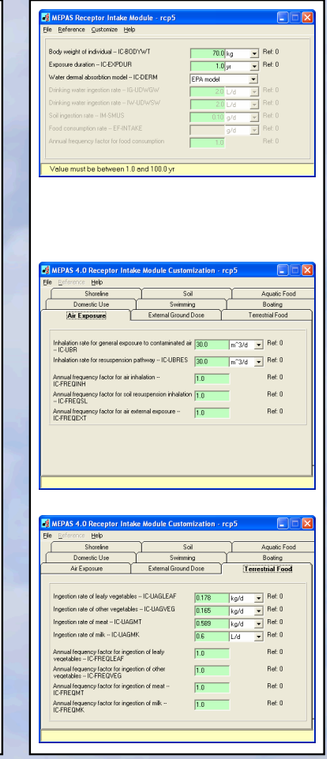
Atmospheric Transport



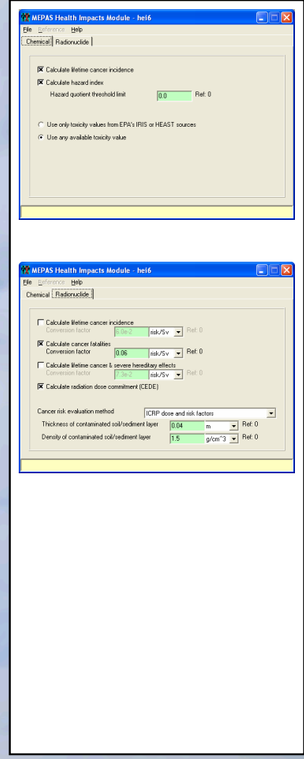
Exposure Pathways



Receptor Intake



Health Impacts



Source Module

The Source Module performs the Release Rate Analysis by combining the waste stream processing volumes, the waste stream concentrations, and the facility release fractions by constituent.

Output from the Source Module is the annual release rate of each constituent as a function of time.

Release Rate Analysis

Annual Release (year, constituent, facility)

= $\sum_{\text{streams}}$ Volume Processed (year, facility, stream)

  * Concentration (constituent, stream)
  * Release Fraction (constituent, facility, stream)

Facilities

Waste Receiving and Handling Facility (WRAP)
T-Plant (RH and special processing)
New Treatment Plant (RH and special processing)
Pulse Drying of MLLW Trench Leachate

Waste Streams
(Partial List)

Low Level Waste Category 1
Low Level Waste Category 3
TRU – Remote Handled
TRU – Contact Handled
TRU – RH from Caissons
Mixed Low Level Waste
Contact Handled Inorganic Solids & Debris
Elemental Lead
Elemental Mercury
MLLW Trench Leachate

Waste Stream Processing Volumes
(example)

Facility: Waste Receiving and Packaging Facility (WRAP)
Waste Stream: Contact Handled TRU (CH-TRU)
Alternative: Baseline

Year	Volume Processed, m^3
2001	265
2002	261
2003	261
2004	261
2005	0
2006	279
2007	279
…	…
2020	279

Waste Stream Concentration Data

Remote Handled and Non-standard Packages (example)

Constituent	Concentration	Units
Cesium-137	7.4E+00	Ci/m^3
Cobalt-60	3.1E-01	Ci/m^3
Iron-55	2.8E+00	Ci/m^3
Strontium-90	2.0E+00	Ci/m^3
Tritium	3.9E-03	Ci/m^3
Acetone	2.0E-01	kg/m^3
Beryllium	5.3E+00	kg/m^3
Nitric Acid	6.7E+00	kg/m^3
Sodium Hydroxide	9.6E+00	kg/m^3
Toluene	1.0E+01	kg/m^3
Xylene	1.0E+00	kg/m^3

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