Overview of Recent MACCS Developments

Session W18 – What's New in the Area of Severe Accident and Offsite Consequence Analysis

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Outline

- Overview of MELCOR Accident Consequence Code System (MACCS)
- Applications and Analyses
- Recent Code Developments
- Ongoing Initiatives

MACCS Overview

- Tool used to assess the risk and consequence associated with a hypothetical accidental release of radioactive material to the atmosphere
- Office of Nuclear Regulatory Research directs code development and maintenance under contract to Sandia National Laboratories
- Evolved from codes used in the 1970's and the 1980's
- Accounts for
  - Transport and dispersion in the atmosphere and deposition to ground
  - Exposure due to inhalation, ingestion, and external irradiation
  - Protective actions during emergency and long-term phases
- Estimates consequences in terms of:
  - Health effects from short and long-term exposure
  - Economic impact of short and long-term protective actions
  - Land area / population potentially subject to protective actions

MACCS Applications at the NRC

- Regulatory Analyses
- National Environmental Policy Act Analyses
- Applied Research
- Expert Support

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Current Applications and Analyses

- Analysis of options for containment protection and release reduction for BWRs with Mark I and Mark II containments
- Second uncertainty analysis for the State of the Art Reactor Consequence Analysis (SOARCA) project – Surry plant, PWR with large dry subatmospheric containment
- Third SOARCA plant analysis – Sequoyah, PWR with ice condenser containment
- Development of Site Level 3 Probabilistic Risk Analysis

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International Collaboration

- International MACCS User Group (IMUG)
- US NRC Cooperative Severe Accident Research Program (CSARP)

- Expert support to external stakeholders (e.g., International Atomic Energy Agency (IAEA), Nuclear Energy Agency (NEA), etc.)

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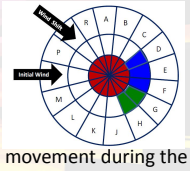
Recent Improvements

- MACCS Version 3.9 (released Sep 2014)
- MACCS Version 3.10 (released May 2015)
- SecPop 4.3 (released Sep 2014)
- MelMACCS 2.0 (released June 2015)

MACCS 3.9 Major Features

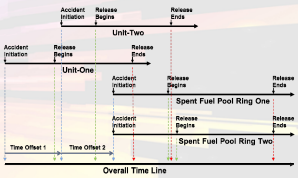
- Implemented keyhole evacuation model
- User interface enhancement to define geographic location of emergency phase cohorts



- More outputs to evaluate cohort movement during the emergency phase
- Usability improvements: Flexible input/output units, increased allowable number of chemical groups and plume segments, etc.

MACCS 3.10 Major Features

- Added capability to model releases from multiple sources (with MelMACCS 2.0)
- Extended phase durations to facilitate modeling of prolonged releases



- Additional output to evaluate size of population affected by both short- and long-term countermeasures

SecPop 4.3 Improvements

- Population data from 2010 U.S. Census
- Economic data from 2007 and 2012 databases
- Improved algorithm for assigning economic regions
- Improves code interface for greater ease of use
- Capability to produce site files compatible with the MACCS alternative economic consequence model

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What's under development

- Incorporation of alternate model for estimating economic consequences
- Incorporation of state of the art model (HYSPLIT) for atmospheric transport, dispersion, and deposition
- Flexible dosimetry model
- Improved documentation for recommended parameter values

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Alternate Economic Consequence Model

- Peer-reviewed model to evaluate economic disruption (GDP losses) at regional and national scales following severe accidents
- Uses input-output models to capture the upstream supply chain impacts of affected industries outside the directly affected area (indirect impacts)
- Based on REAcct code developed for DHS for modeling economic impacts of manmade and natural events such as hurricanes and earthquakes
- Completing internal testing and review; initial version expected in late 2016

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Alternate Atmospheric Transport Model

- Current atmospheric model (ATMOS) based on Gaussian plume segment model
- HYSPLIT can model transport using either a Gaussian puff or a Lagrangian particle tracking approach
- Use of HYSPLIT to develop time-dependent atmospheric and ground level concentrations as input to dose, health, and economic impact models
- Currently undergoing internal testing, initial version expected in late 2016 or early 2017

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More Flexible Dosimetric Model

- Current version of MACCS limited to nine organs for estimating radiogenic cancer risks
- Use of the increased set of organs defined in dose coefficient files will allow direct use of the larger set of cancer risk coefficients available from current guidance documents

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Input Parameter Documentation

- Technical basis for many input parameters under review
- Use of newer information to evaluate costs of protective actions such as decontamination
- Focus on parameter development process and recommended data sources

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SUMMARY

- MACCS and supporting codes continue to be upgraded
- New capabilities being exercised in ongoing analyses
- Additional improvements under consideration to add capabilities and improve usability

QUESTIONS?

http://maccs.sandia.gov/maccs.aspx

http://www.nrc.gov/about-nrc/regulatory/research/obtainingcodes.html