



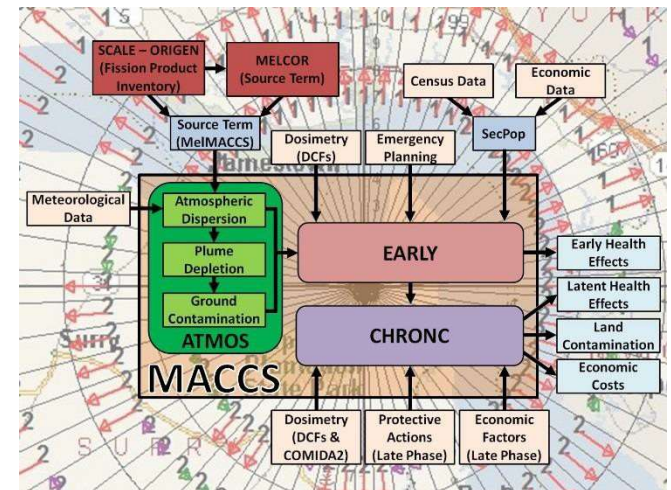
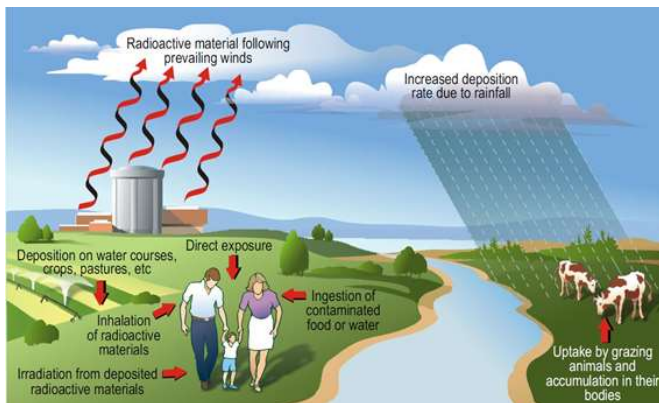
# U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

*Protecting People and the Environment*

## Accident Analysis Branch Overview

September 2017



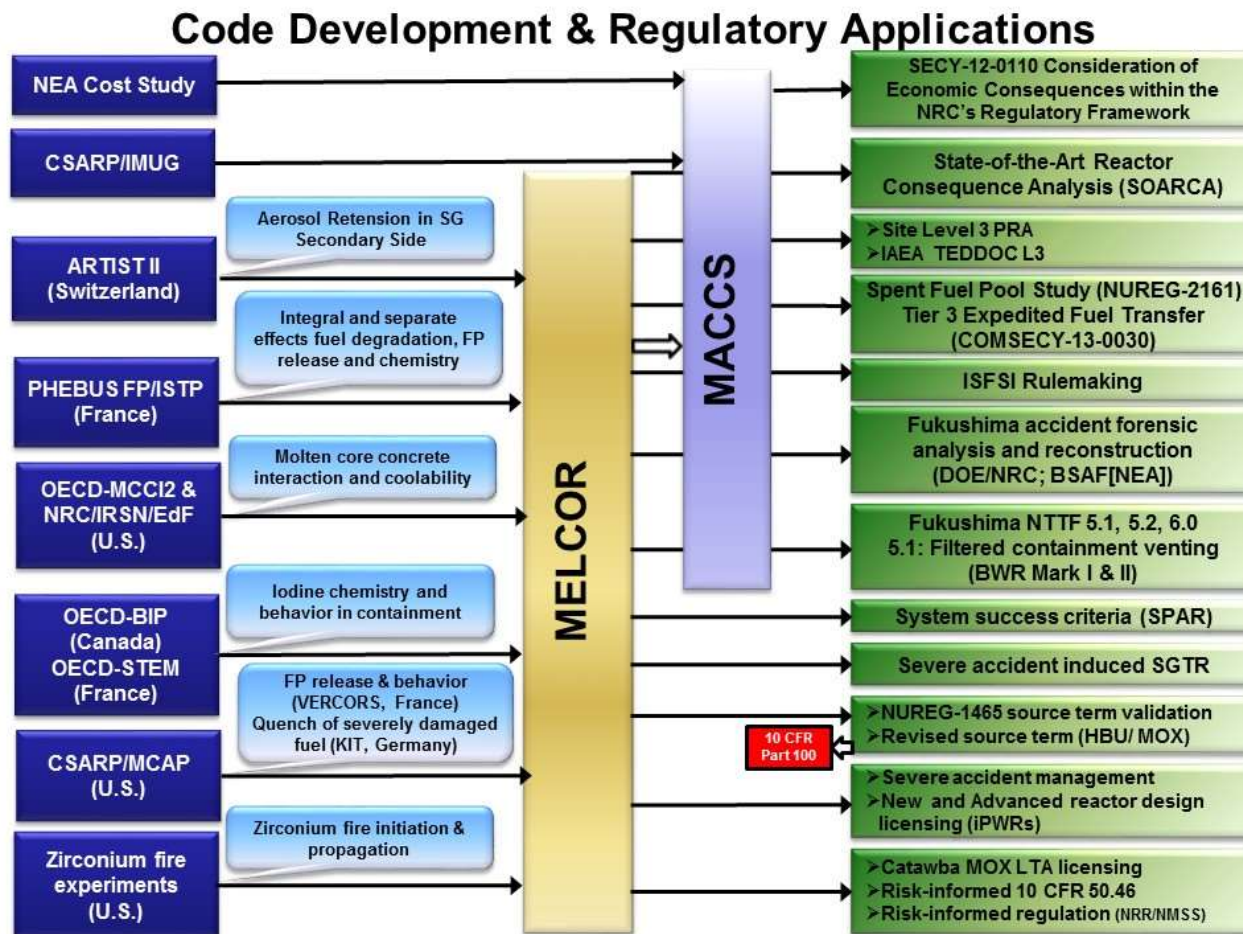
Patricia A. Santiago, Chief  
Accident Analysis Branch  
Division of Systems Analysis  
Office of Nuclear Regulatory Research



# AAB Overview

- Plans, develops, and manages analytical research projects on the progression, response, and probabilistic consequence analysis (PCA) of postulated severe accidents at nuclear facilities
- AAB maintains and develops technical basis and computational tools for PCA and conducts analyses in support of regulatory decision making
- AAB staff possess multidisciplinary technical expertise and accrued knowledge in the following areas
  - Atmospheric dispersion modeling
  - Health physics
  - Emergency response modeling
  - Macroeconomic analysis
  - Uncertainty analyses
- AAB staff also provide consultation and expert advice to NRC offices, external domestic stakeholders, and international stakeholders regarding safety and licensing decisions, development of guidance, and other regulatory needs.

# Overview of MELCOR/MACCS Application





# MACCS Applications at the NRC

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



# 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 (UA) for the State of the Art Reactor Consequence Analyses (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



# Applied Research

- Support improved understanding of nuclear power risks by carrying out analyses of risks from severe accidents
  - Including the uncertainty in estimates
  - State-of-the-Art Consequence Analysis (SOARCA, NUREG-1935, and UA studies)
  - Consequence of Beyond Design Basis Earthquake on Spent Fuel Pool (NUREG-2161)
  - Offsite Consequences supporting a site level assessment of risks (SECY-11-0089)



# Expert Consultation

- Provide expert technical support
  - Training
  - Expert Support for Litigation
  - Technical Review of NRC National Environmental Policy Act (NEPA) analyses
  - Stakeholder Support
- External Support
  - Level 3 Probabilistic Risk Assessment Methodology/Standard
  - Support to IAEA Tecdoc development
- Internal Support
  - Update guidance for treatment of economic impacts
  - Evaluation of health impacts for regulatory analysis





# 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





# Domestic and International Collaboration

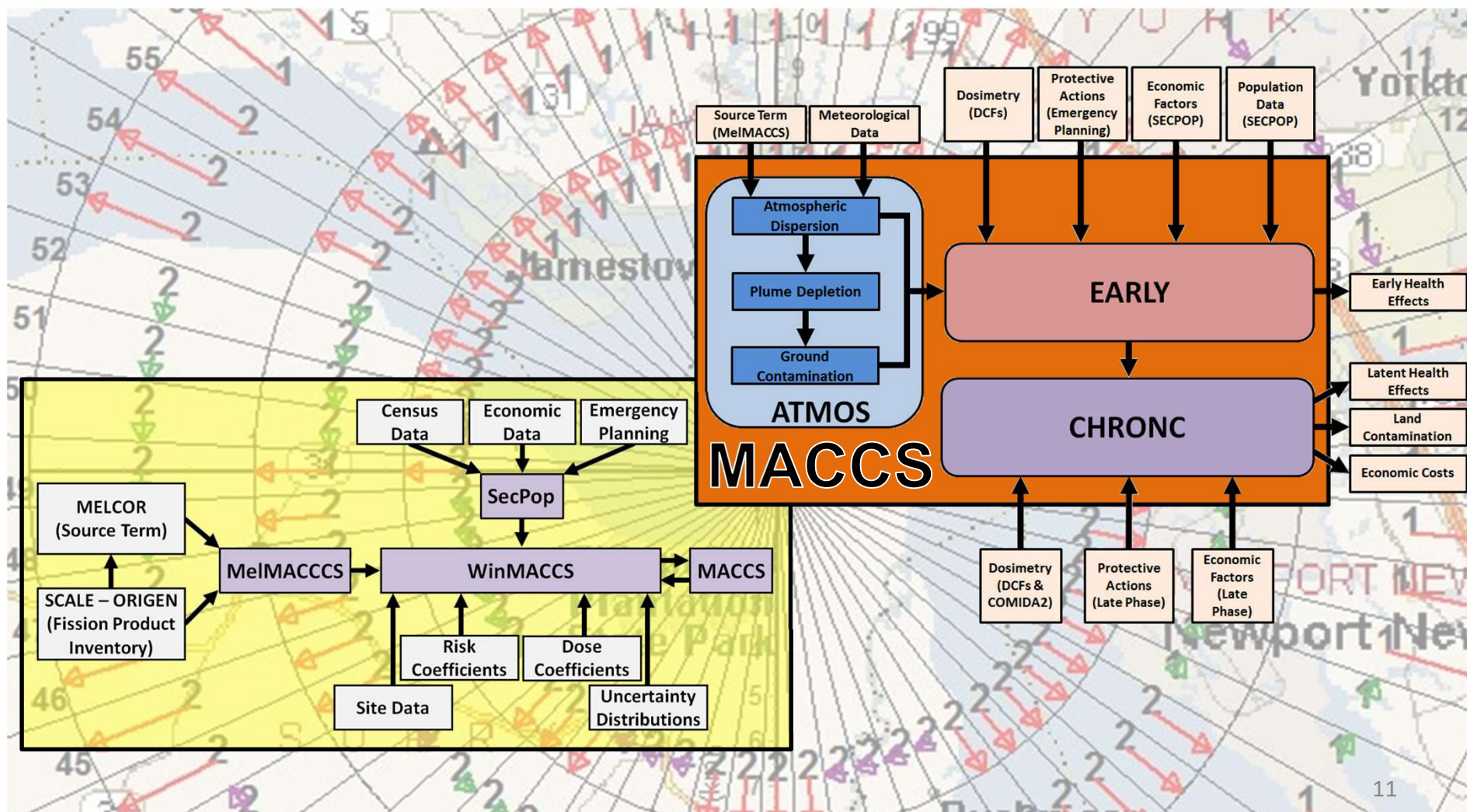
- Cooperative Severe Accident Research Program (CSARP)
- International MACCS User Group (IMUG)
- European MELCOR User Group (EMUG)
- Asian MELCOR and MACCS User Group (AMMUG)
- MACCS dosimetry and V&V.



# Domestic and International Collaboration

- Bilateral, Multilateral, and Cooperative Arrangements
  - Maintains NRC's commitment to international safety organizations (IAEA)
- Participation provides:
  - Acquiring experimental data generated at international and domestic facilities
  - Helps validate and improve (as needed) safety analysis tools
  - Exchanging safety-related information and experience with collective bodies of international experts
- Future Needs for Outstanding and Emerging Safety Issues
  - Need to revisit certain outstanding safety issues where uncertainties remain
  - New information and data are to be utilized to improve NRC's guidance and technical bases and/or validate NRC's severe accident and consequence analysis tools

# MACCS Suite of Computer Codes





# Agenda – Day1

<u>Time</u>	<u>Topic</u>	<u>Presenter</u>
8:00-8:30	<b>Registration</b>	
8:30-9:00	<b>Welcome and Introductions</b>	Mike Weber (NRC)
9:00-10:30	<b>Session 1: MACCS Code Suite Development Status</b>	
	Topic 1 - Accident Analysis Branch Overview	Patricia Santiago (NRC)
	Topic 2 - MACCS Code Development Status (1 of 2)	Nate Bixler (SNL)
	Topic 3 - MACCS Code Development Status (2 of 2)	Nate Bixler (SNL)
10:30-11:00	<b>Break</b>	
11:00-12:00	<b>Session 2: Severe Accident Consequence Modeling Applications</b>	
	Topic 1 - Verification & Validation Documentation for Department of Energy Toolbox	Matt Dennis (SNL), Sergio Gonzalez (NRC)
	Topic 2 - State-of-the-Art Reactor Consequence Analyses - Surry Uncertainty Analysis	Tina Ghosh (NRC)
12:00-1:00	<b>Lunch</b>	
1:00-1:30	<b>Session 2 Continued: Severe Accident Consequence Modeling Applications</b>	
	Topic 3 - State-of-the-Art Reactor Consequence Analyses - Sequoyah Analysis	Trey Hathaway and Tina Ghosh (NRC)
1:30-2:30	<b>Session 3: Atmospheric Transport and Dispersion</b>	
	Topic 1 - MACCS-HYSPLIT Atmospheric Transport and Dispersion Model Benchmarking	Dan Clayton (SNL) & Keith Compton (NRC)
	Topic 2 - North America Reanalysis Data for Dispersion Applications and Recent HYSPLIT Updates	Glenn Rolph and Fantine Ngan (NOAA)
2:30-3:00	<b>Break</b>	
3:00-4:30	<b>Session 4: Severe Accident Consequence Modeling</b>	
	Topic 1 - Use of MACCS2 to Support Dispersion Protocols Options for Department of Energy Nuclear Facility Safety Applications.	Kevin O'Kula
	Topic 2 - Study of Consequences of a Hypothetical Severe Nuclear Accident and Effectiveness of Mitigation Measures	Hayat Chatri (CNSC - Canada)
	Topic 3 - Level 3 PSA in the KHNP-SOARCA, Plan and Expected Outcomes	Sung-yeop Kim and Kwang-II Ahn (KAERI), Seokwon Hwang and Hyungyo Lee (KHNP-CRI)

# Agenda – Day 2

<u>Time</u>	<u>Topic</u>	<u>Presenter</u>
<b>8:30-10:00</b>	<b>Session 5: Severe Accident Consequence Modeling</b>	
	Topic 1 - Development of a Pre-processor to Convert Source Term and Korean Site-specific Data for MACCS	Sung-yeop (KAERI - South Korea)
	Topic 2 - Challenges Using MACCS	Zuzana Korenova (UJD - Slovak Republic)
	Topic 3 - Level 3 Probabilistic Risk Assessment Consequence Analysis	Keith Compton (NRC)
<b>10:00-10:30</b>	<b>Break</b>	
<b>10:30-12:00</b>	<b>Session 6: Emergency Response Research and Modeling</b>	
	Topic 1 - Evacuation Time Estimate Study	Todd Smith (NRC)
	Topic 2 – Modeling of Emergency Planning	Fotini Walton (SNL)
	Topic 3 – Offsite Response Organization Protective Actions	Tom Park (Cadmus)
<b>12:00 -1:00</b>	<b>Lunch</b>	
<b>1:00-2:00</b>	<b>Session 7 Continued: Economic Consequences</b>	
	Topic 1 - Cost-Benefit Analysis - NRC Staff Guidance Updates	Amy Sharp, Tina Ghosh (NRC)
	Topic 2 - MACCS Alternative Economic Consequence Model	Amy Sharp (NRC)
<b>2:00 – 3:00</b>	<b>Session 8: Research Benchmarking of Consequence Models</b>	
	Topic 1 – Source Term and Atmospheric Transport and Dispersion Modeling of the Fukushima Daiichi Accident	Nate Bixler (SNL)
	Topic 2 – Verification and Validation of MACCS ATMOS Model	Matt Dennis (SNL)
<b>3:00-3:15</b>	<b>Closing Remarks</b>	<b>Patricia Santiago (NRC)</b>