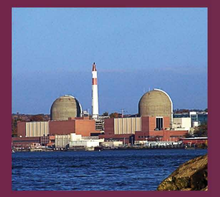
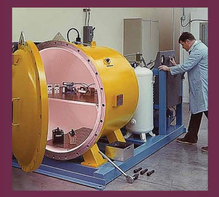
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

RIC 2013 March 12–14

OFFICE OF NUCLEAR REGULATORY RESEARCH

Overview of MELCOR

MELCOR Code Development

Design Objectives

- Model severe accidents and provide reasonable prediction of accident progression, source term, and their uncertainty
- Model containment thermal-hydraulic phenomena for design basis accident (DBA) analysis
- Properly scale phenomena important to DBA and severe accidents from separate effects tests (SET) and integral effects tests (IET) to full-size reactors
- Modeling consistent with lumped parameter code framework (simplified vs. complex)

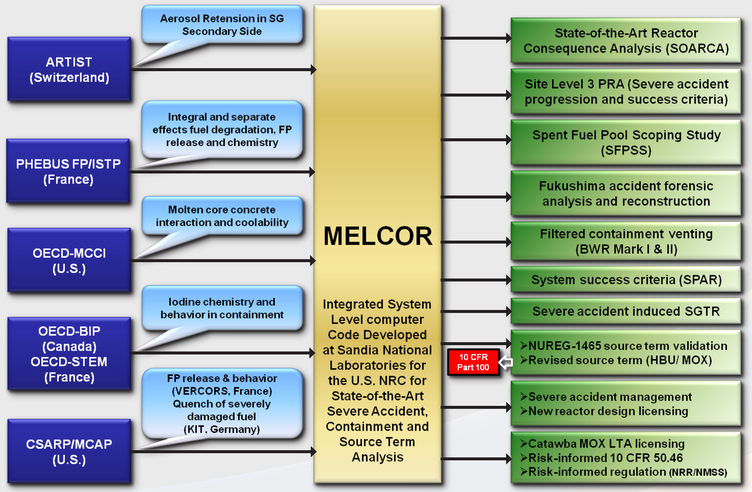
Targeted Applications

- Conduct plant-specific integrated analysis under postulated beyond DBA events and application to probabilistic risk assessment (PRA)
- Perform containment response analysis under postulated DBA or beyond DBA events
- Perform accident analysis of nonreactor systems (e.g., spent fuel pool)

Success Criteria

- Prediction of phenomena is in qualitative agreement with current understanding of physics and uncertainties are in quantitative agreement with experiments
- Focus on mechanistic models where feasible with adequate flexibility for parametric models
- Code is portable, robust, and relatively fast running, and the code maintenance follows established software quality assurance (SQA) standards
- Availability of detailed code documentation (including user guide, model reference, and assessment)

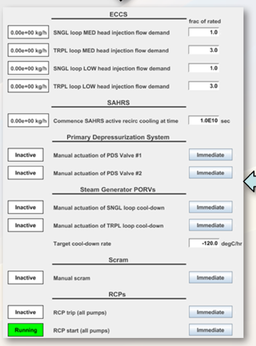
Code Modeling and Regulatory Applications



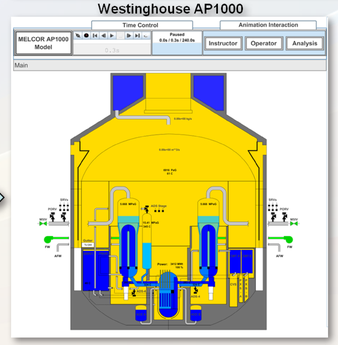
MELCOR Accident Simulation using SNAP (MASS)

Symbolic Nuclear Analysis Package (SNAP) provides a standard graphical user interface for NRC codes. MELCOR/SNAP coupling in the safety system logic to initiate, fail, or adjust system functionality.

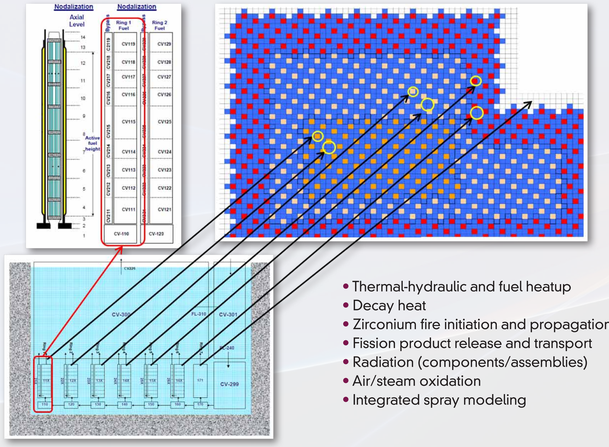
SNAP animation package reads the plot data and performs the display function. The system uses simple and complex elements to display pertinent information from the MELCOR run. It communicates interactive commands from the display page to MELCOR.



Westinghouse AP1000



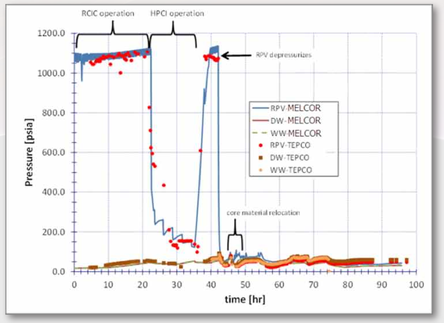
Spent Fuel Pool Scoping Study MELCOR Model

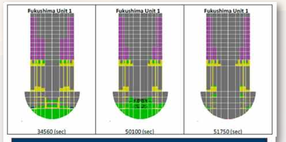


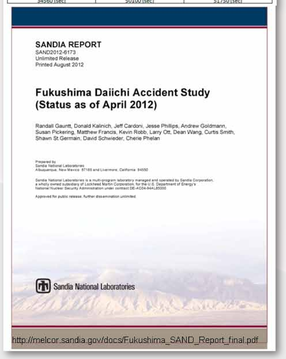
- Thermal-hydraulic and fuel heatup
- Decay heat
- Zirconium fire initiation and propagation
- Fission product release and transport
- Radiation (components/assemblies)
- Air/steam oxidation
- Integrated spray modeling

Fukushima Accident Analysis

Severe accident codes such as MELCOR are capable of predicting complex plant response, including operator response and severe accident mitigation





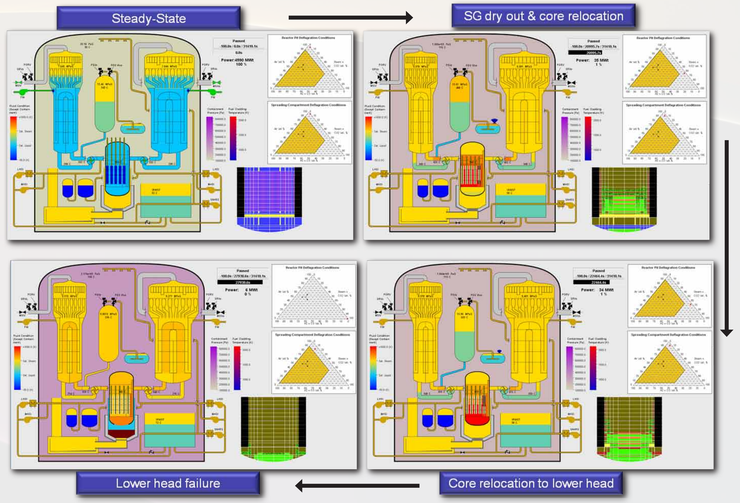

SANDIA REPORT
SAND2012-8171
Unlimited Release
Printed August 2012

Fukushima Daiichi Accident Study (Status as of April 2012)

Sandia National Laboratories

http://melcor.sandia.gov/docs/Fukushima_SAND_Report_final.pdf

EPR MELCOR Model



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