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RIC 2016

MELCOR - RECENT DEVELOPMENTS

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Severe Accident Research Activities

- Support Risk-informing Regulations and Address Operating Reactor Issues
  - Maintenance of expertise of severe accident phenomenological knowledge and validated analytical tools
- International Collaboration
  - U.S. NRC Cooperative Severe Accident Research Program (CSARP)
  - Annual MELCOR Meetings
    - MELCOR Code Assessment Program (MCAP) - (Fall/USA)
    - European MELCOR User Group (EMUG) – (Spring/Europe – 8th in London in 2016)
    - Asian MELCOR User Group (AMUG) – (2nd meeting Japan October 2015)
  - NEA/CSNI and European Commission

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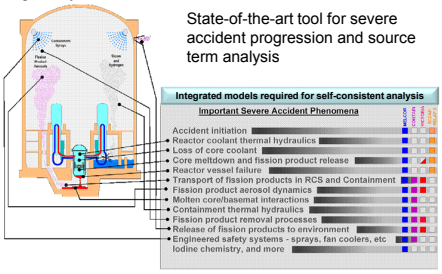
What is MELCOR?

MELCOR is an integrated system level computer code developed at Sandia National Laboratories for the U.S. Nuclear Regulatory Commission



State-of-the-art tool for severe accident progression and source term analysis

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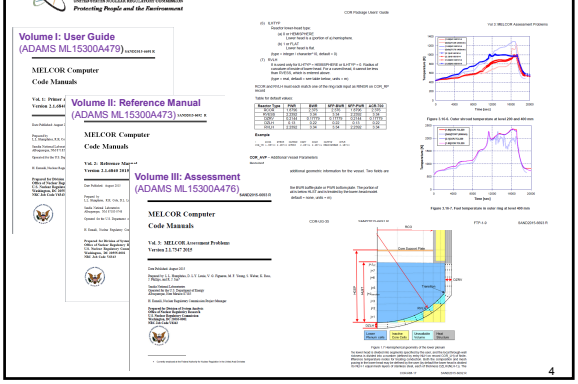
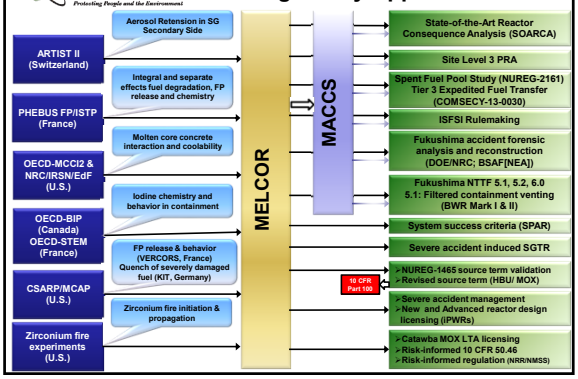
MELCOR Documentation

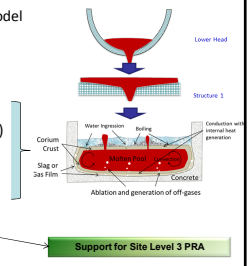


Code Development & Regulatory Applications



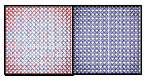
Recent Modeling Improvements

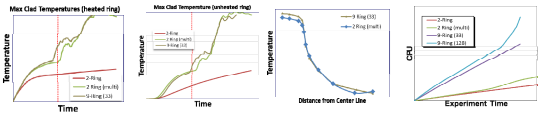
- Homologous pump model
- Multi-heat structure radiation enclosure model
- Aerosol re-suspension model
- Zukauskas heat transfer coefficient
- Simplified bubble swell model
- Debris spreading model implemented
- Core Catcher (multiple containment vessels)
- New debris cooling models added
  - Water-ingression
  - Melt eruption through crust
- MACCS multi-ring release
- Multiple fuel rod types in a core cell



Multi-Rod Model

- Motivation
  - It is desirable to model an entire assembly within a single MELCOR ring
- Challenge
  - When hot assembly reaches ignition, heat transfer to cold assembly is problematic





- Validation
  - Validation was performed against the Sandia PWR Spent Fuel Pool Experiments
  - Comparisons between 2-ring (2 rods) model; 2-ring, (9 rods) model; and 9-ring model.
- CPU time is greatly reduced for multi-rod model
- Simplified input requirements
- Fuel rod degradation modeling in progress

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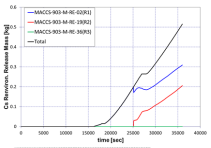
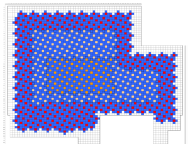
Multi-Ring Release Model

- Motivation
  - Burnup and therefore activity for distinct rings may be vastly different. Recently, MACCS has been modified to allow it to distinguish masses provided by MELCOR by batch (ring). MACCS then will associate different activities for a class, dependent on the ring of origination
  - The problem is that once radionuclide mass is released, it can no longer be distinguished by originating ring.
  - Control function description can be quite lengthy even for a two-ring model





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Summary

- MELCOR ongoing code development and enhancement in response to regulatory needs
- New code capabilities provide more flexibility to the users and improve predictions
- Documentation continues to be improved with more details on the model descriptions and additional code assessment
- Code applications and analysis for emerging issues (e.g., NTTF, Fukushima accident)

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