Power Core Safety Analysis Results

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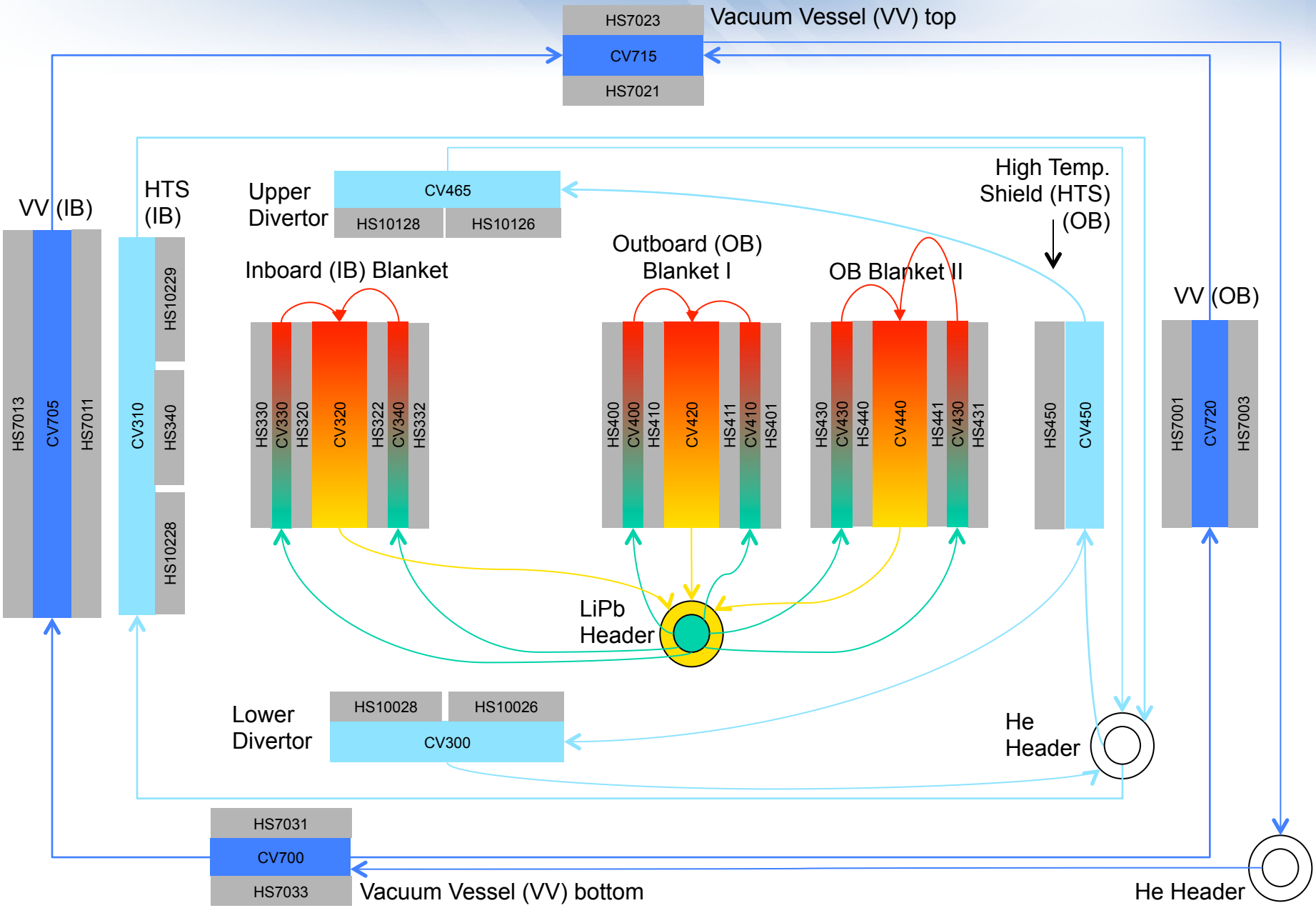
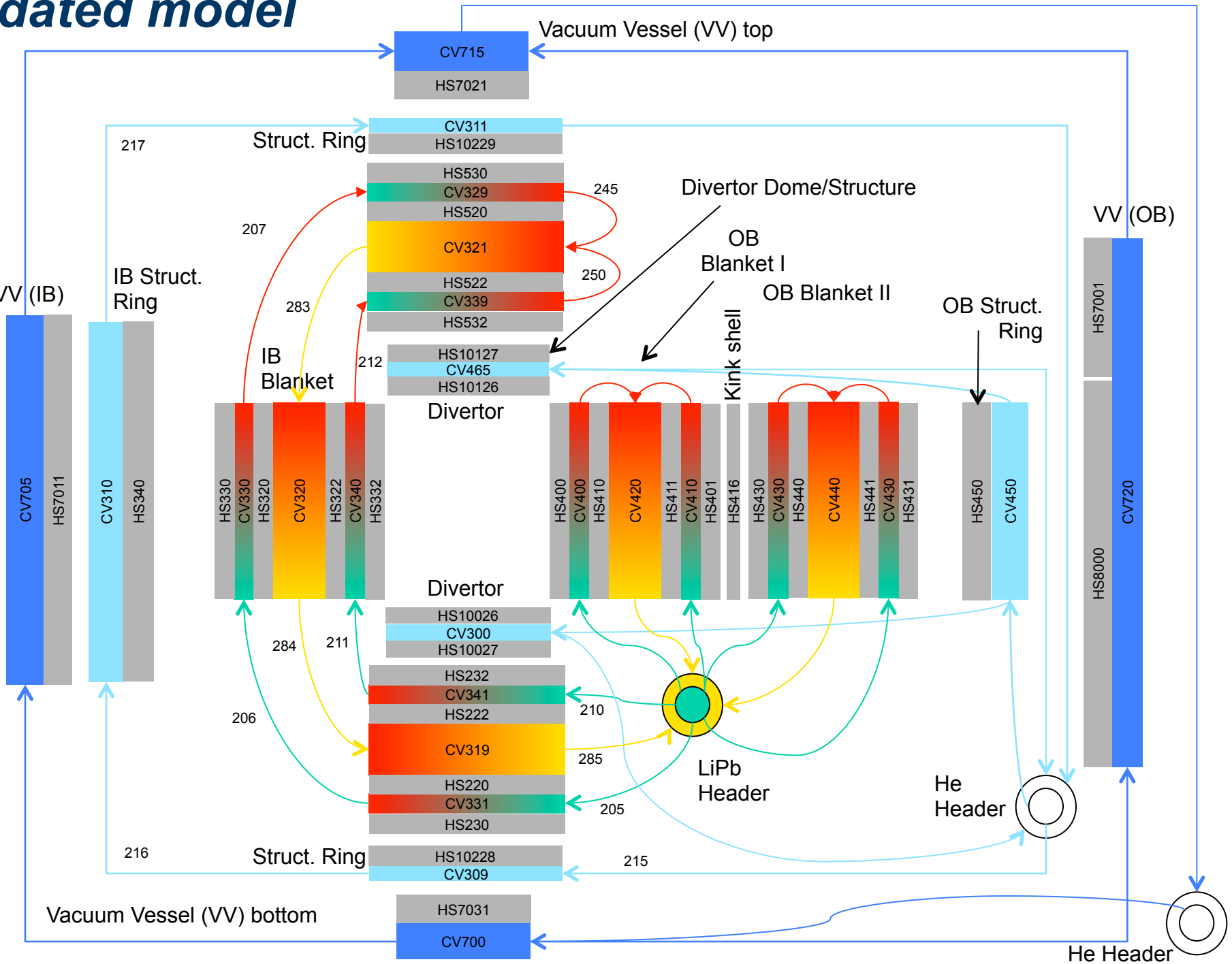
Updates to MELCOR model since February

- A substantial revision of the base MELCOR model has been undertaken since February to address ACT-1 design changes
  - Final radial build updated
  - Shield plugs added
  - Upper and lower blanket structures and volumes added
  - Kink shell added
  - Divertor dome/steel structure added
  - Modification of decay heats (from Laila) completed
  - Revision of all nuclear heats (Laila's Sept. presentation)
  - He cooling system resized
- Nuclear and decay heats are resulting in higher than desired temperatures

Previous model



Updated model



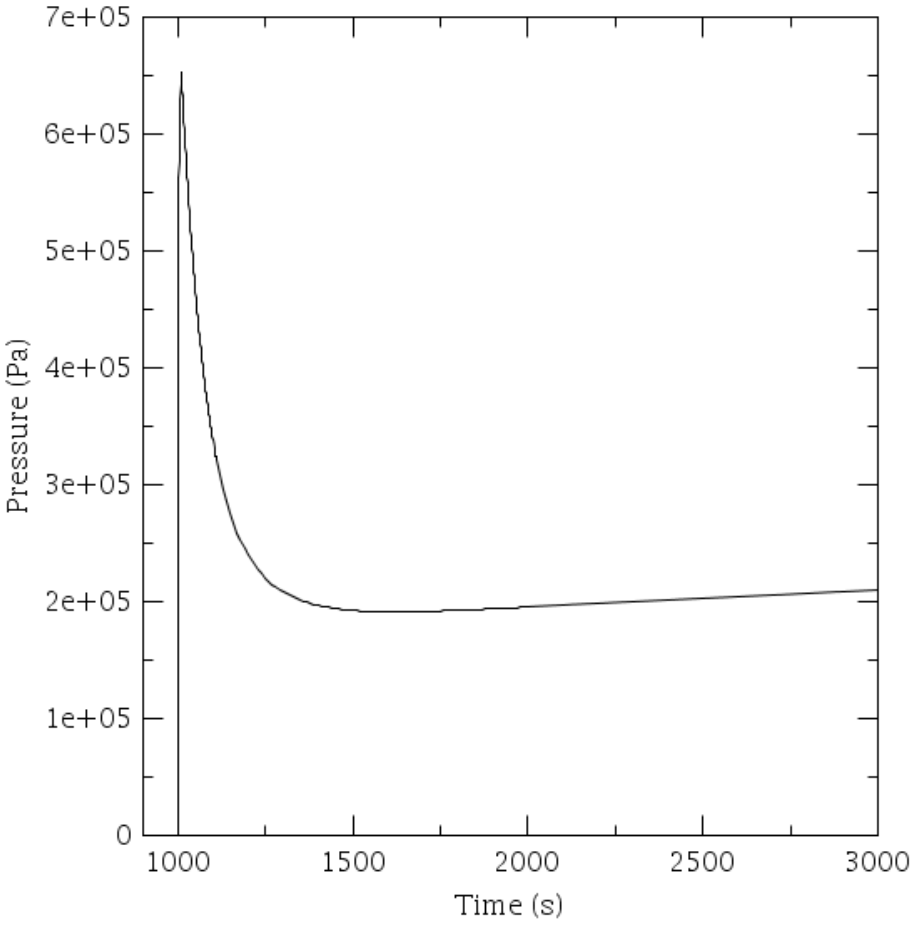
He LOCA Analysis

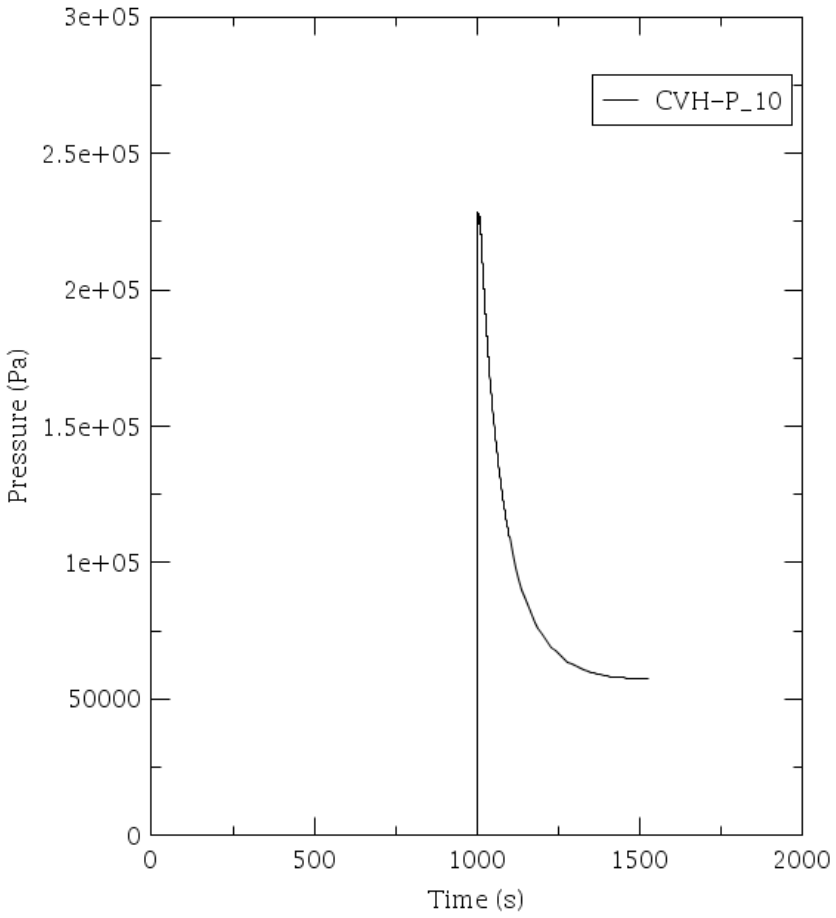
- A Helium (Divertor/steel ring loop) ex-vessel LOCA has been modeled
  - Double guillotine break in outlet pipe
- Primary concern: overpressure in cryostat leading to release of radioactive material
- ARIES-CS guidance: 3×10^5 Pa is pressure limit for the cryostat
- Pressure was too high (~6.5×10^5 Pa) based on previous model
  - Ex-vessel coolant volumes resized such that there is a ratio of 2:1 ex-vessel:in-vessel He

He LOCA Analysis

- Previous model

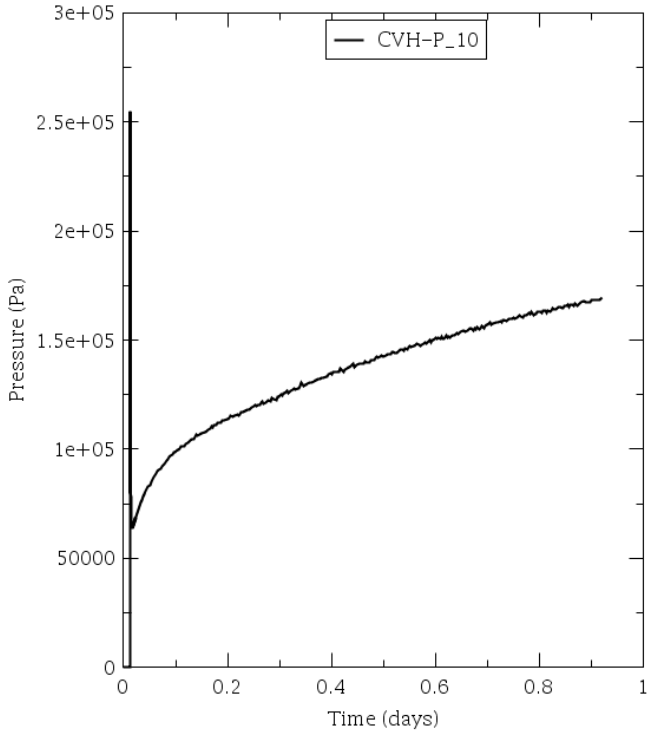
Current model

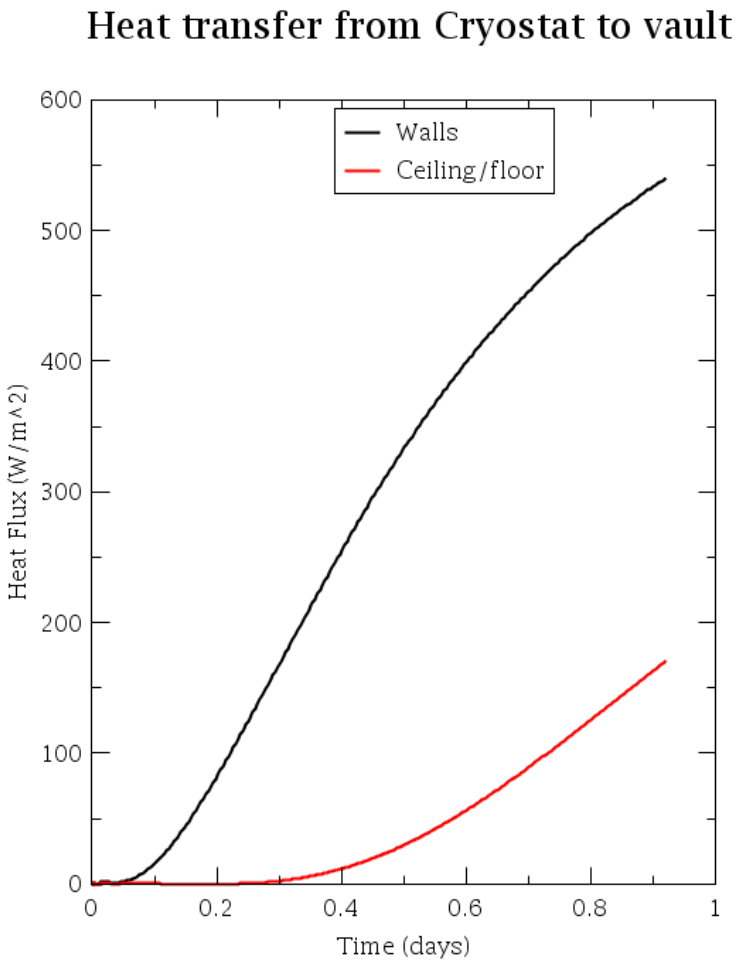




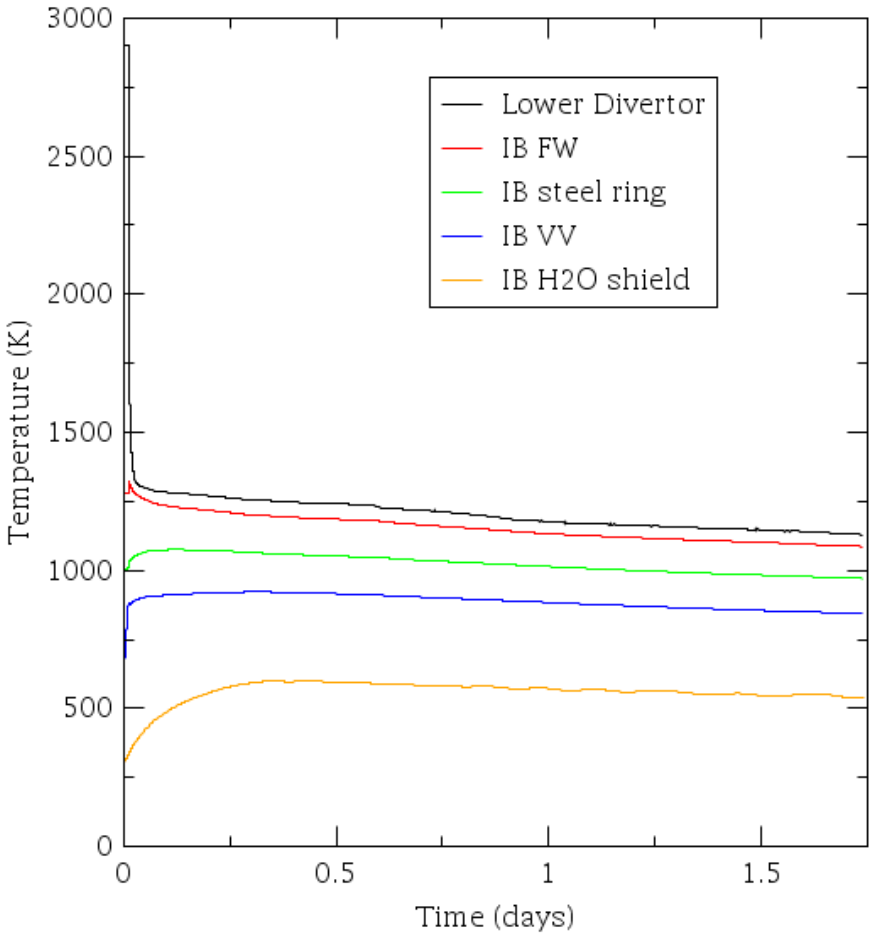
He LOCA Analysis

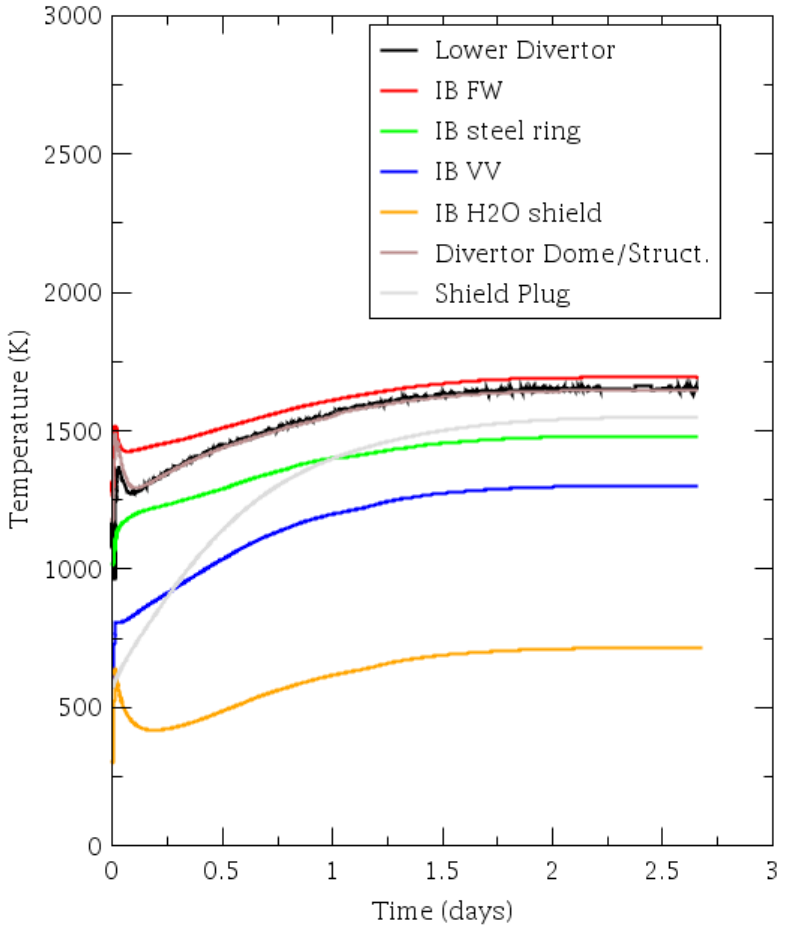
- At longer times, the cryostat pressure builds and heat is transferred through the walls to the environment





Structure temperatures during LOFA





Temperature and Heat Transfer issues

- New nuclear and decay heats have led to high structure temperatures
  - The preceding were for a LOFA
  - They will be worse in the combined LOFA/water LOCA
- In some cases, these are probably resulting from necessary simplifications in MELCOR
  - Divertor is just a slab with default HT correlations
  - Divertor steel structure is a relatively thick slab with cooling on one side
  - Shield plugs are thick (~45 cm) and cooled on one side using the external surface area; presumably there is more heat transfer area in the actual design
  - IB WC shield cannot be maintained at ~300 K with natural convection if the nuclear heating is ~50 MW
  - Flow rates may need to increase
- Any input on the above appreciated

LOFA+LOCA analysis

- LOFA plus water LOCA case is running (a MELCOR bug has been identified by this case and is being resolved)
- Preliminary results show some interesting natural circulation phenomena