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EPR MELCOR MODEL & ANALYSES

Integral severe accident simulations of EPR nuclear island from initiating event through design mitigation path to safe state

Severe accident simulations of the entire nuclear island in an unified framework

Challenge

The EPR is the first nuclear power reactor featuring a mitigation path in the plant design for severe accidents with core damage.

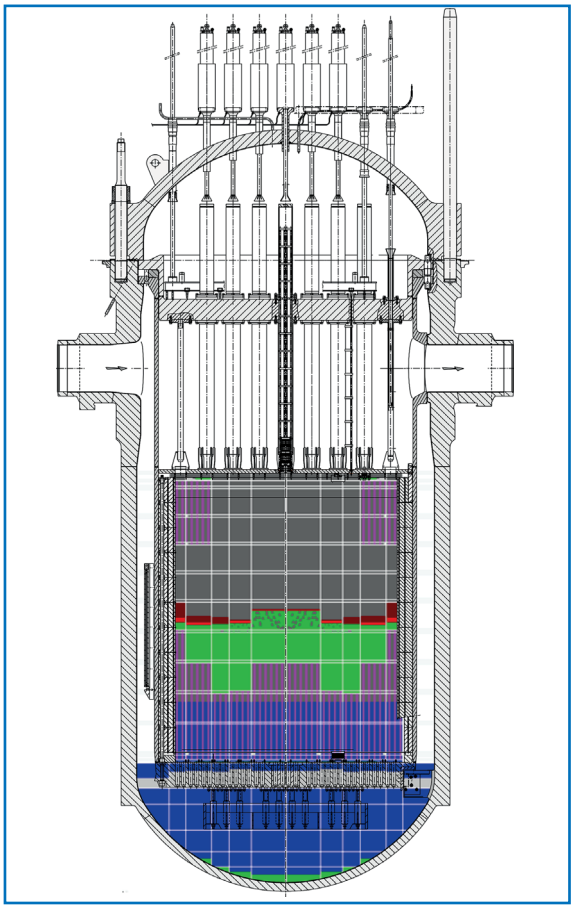
For the design, development and safety demonstration, a series of individual, specialized state-of-the-art mechanistic severe accident codes and tools were used. The interplay of these scientific codes however, cause a high complexity for the simulation of an entire accident sequence.

The plant simulator on the other side is able to cover a large variety of accident sequences. However, for many severe accident related aspects like e.g. radiology, it operates on a phenomenological basis. Thus, complex scenarios of previously not explicitly considered situations profit from additional verification and validation.

Solution

To bridge the gap between the specialized scientific codes on one side and the phenomenological plant simulator on the other side, Framatome offers simulations of the nuclear island with the MELCOR software package. The internationally accepted and validated MELCOR code allows for an integral simulation of an entire accident sequence from initiating event, through severe accident conditions up to the safe plant end state.

Thereby MELCOR plant simulations can be used for a broad spectrum of applications such as integral safety analyses, emergency organization training, support of hardware back-fittings and many more.



RPV with core meltdown in progress
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Customer opportunities

- Licensing support/answering regulatory questions
- Independent qualification source for the plant simulator
- Training of the plant emergency organization
- Developing of crisis management tools/accident prediction tools
- Optimization of emergency response measures (OSSA)
- Testing of system qualification profiles for previously not considered accident situations
- Support for hardware back-fittings and newly introduced emergency operator actions
- Support of probabilistic risk assessment (level 2)

Technical information

The EPR MELCOR plant model allows a simulation of the nuclear island, including

- Reactor core and its degradation during a severe accident
- Primary and secondary loops, including their response to emergency actions like e.g. secondary bleed-and-feed
- Containment loads(pressure, temperature, H2, radiation)
- Accident mitigation systems (core catcher, PAR, filtered venting, ...)
- System re- or de-activation late into the accident

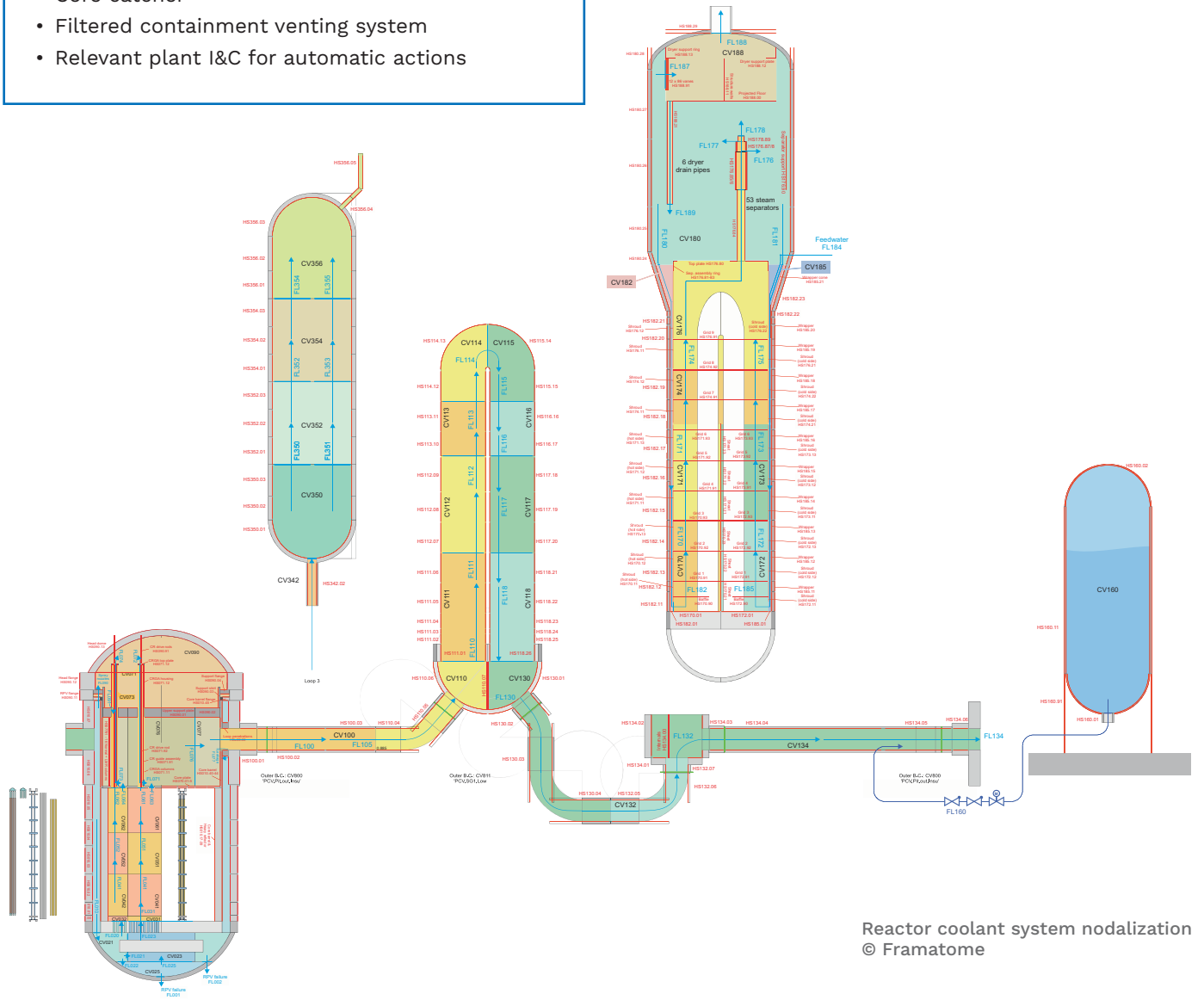
Your performance
is **our** everyday **commitment**

Systems & Structures included in the MELCOR model

- Fuel assemblies / reactor core
- Primary loops (each loop individually)
- Pressurizer and its valves
- Continuous pressurizer spray
- Steam generators
- Feedwater and emergency feedwater
- Main steam valves (isolation & cooldown)
- Emergency core cooling accumulators
- Containment & annulus
- Nuclear HVAC systems
- Hydrogen recombiners
- Core catcher
- Filtered containment venting system
- Relevant plant I&C for automatic actions

Phenomena addressed by MELCOR

- Thermal hydraulics of primary and secondary circuit
- Core degradation and RPV failure
- Creep rupture of pipes
- Fission product release and transport
- Hydrogen release and transport
- Containment response (pressure, temperature, gas concentration)
- Core melt behavior
- Possible leakages from containment to annulus and environment



Reactor coolant system nodalization
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