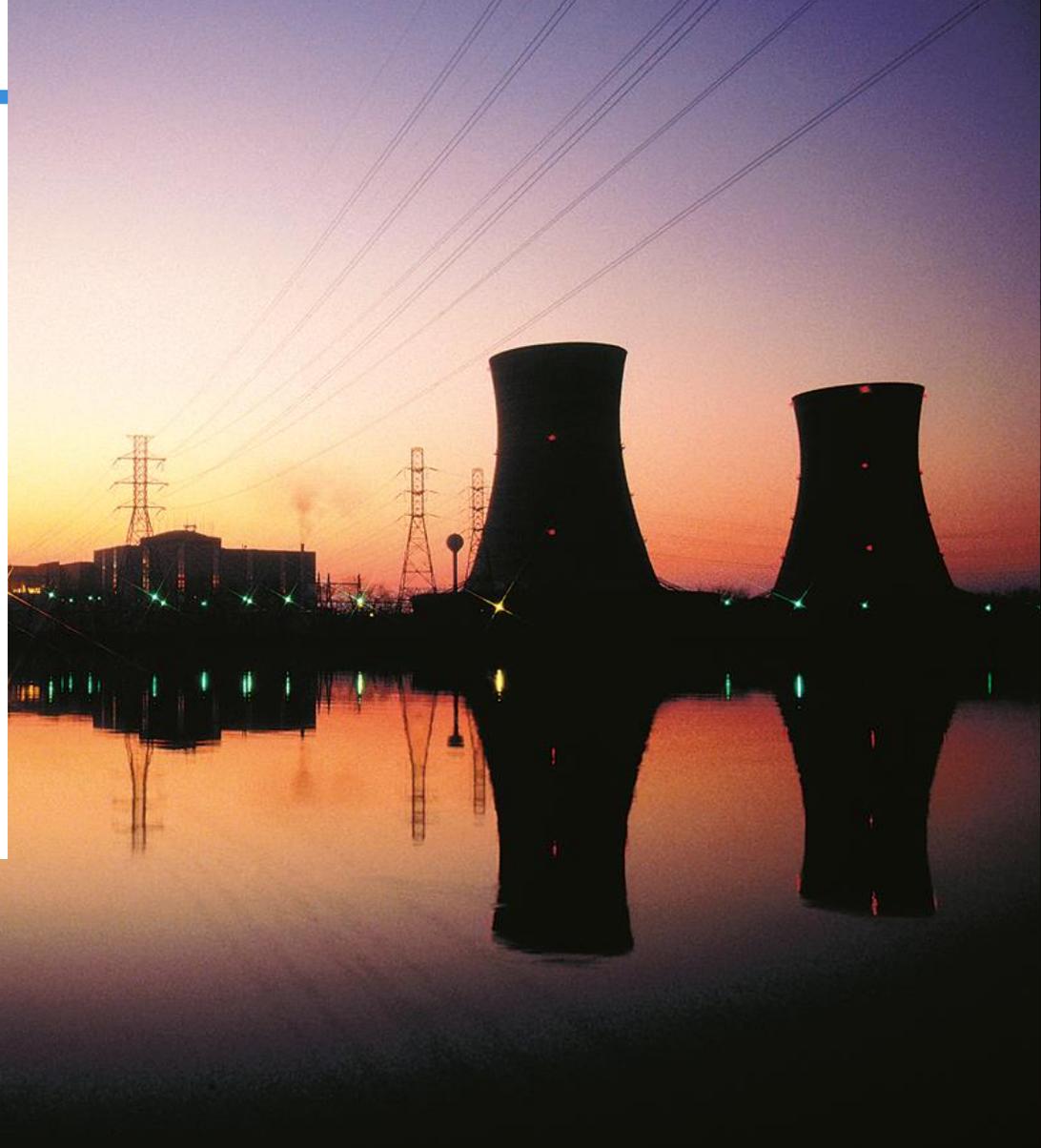

The RApid Source Term Prediction (RASTEP) concept

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Overview



- Provides emergency preparedness organisations with an independent view of the accident progression and possible off-site consequences
- Model starting point:
 - Something goes wrong at a nuclear power plant unit
- Model end point / results:
 - Release path, source terms with related probabilities
- The model development started in 2009
Graphical user interface launched in 2015

RASTEP web page: <https://www.lr.org/rastep>

Demo case using generic BWR model

Fukushima Daiichi - Unit 1

- The earthquake (11 March 2011, 14:46) lead to scram and containment isolation. Residual heat removal was initially achieved by the isolation condensers (IC) without problem. The ICs were shut off before the tsunami and never restarted.
- A tsunami of ~14 m at 15:36 lead to station blackout and loss of ultimate heat sink. Neither primary depressurization nor containment spray was achieved.
- The containment venting system was unfiltered.

List of Observable Nodes

Nr	Node
27	Water supply to independent containment spray
28	Activation of independent containment spray
29	Status of main feedwater system
30	SRV LOCA (SRV stuck open)
31	Containment long-term pressure development
32	Status of emergency core cooling system
33	Temperature outside containment
34	Leakage indications outside containment
35	Pressure outside containment
36	Activity outside containment
37	Rapid pressure drop
38	Restart of core cooling
39	Status of automatic depressurization
40	Automatic depressurization activation

Description:
Availability of automatic depressurization. Depressurization is needed for operation of ECCS for all IEs except large LOCAs (top/bottom), for which sufficient depressurization occurs through the break.

Question:
What is the status of the ADS (automatic depressurization system)?

Given Answer:
Unavailable

Question Panel

Initiating Event

Fuel Failure Mode

RPV Failure Mode

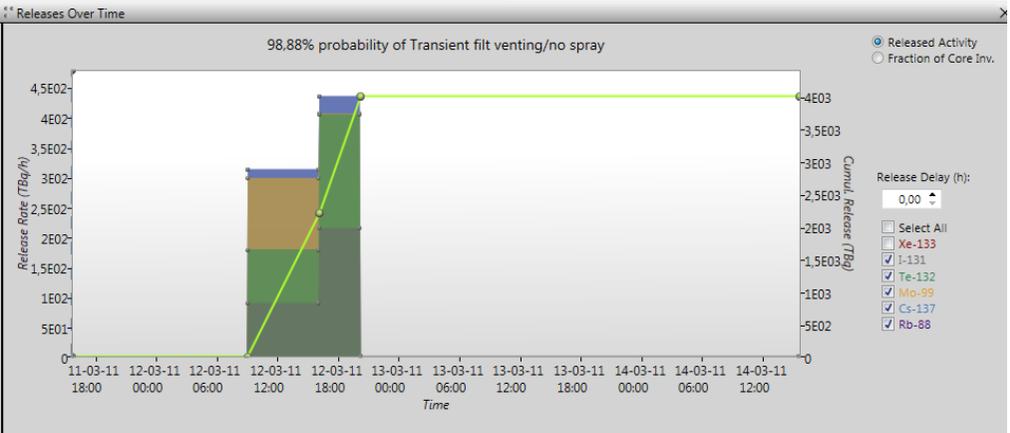
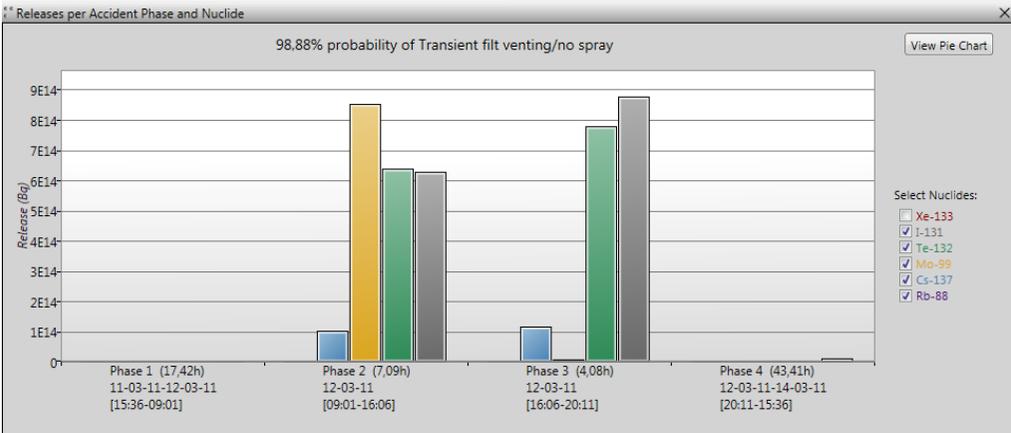
Current Question: What is the status of the ADS (automatic depressurization system)?

Available Responses: Not Known, Available, Unavailable

Comments: [Empty text box]

Navigation: [Prev] 39 [Next]

- Source Term Predictions
- Containment
 - 98.88% probability of Transient fit venting/no spray
 - 1.00% probability of Gap release
 - 0.10% probability of Transient fit venting/spray
 - 0.02% probability of Transient early/spray
 - < 0.01% probability of LOCA fit venting/no spray
 - < 0.01% probability of LOCA fit venting/spray
 - < 0.01% probability of LOCA early/spray
 - < 0.01% probability of Transient early/no spray
 - < 0.01% probability of Transient late/spray
 - < 0.01% probability of Transient late/no spray
 - < 0.01% probability of LOCA early/no spray
 - < 0.01% probability of LOCA late/spray
 - < 0.01% probability of LOCA late/no spray
 - < 0.01% probability of Diffuse leakage
 - Reactor building
 - < 0.01% probability of Melt bypass (filtered)
 - < 0.01% probability of Melt bypass (unfiltered)
 - < 0.01% probability of Gap bypass (filtered)
 - Turbine building
 - 0.99% probability of Melt bypass
 - 0.01% probability of Gap bypass



Concluding remarks

RASTEP is a tool for prognosis and source term estimation

- RASTEP provides the full list of likelihoods of end states or sequences after a nuclear accident, and the associated source terms.
 - The tool can be used for prognosis of source terms unlike conventional estimates in the industry, where the source terms are based on measured dose rates without ability of prognosis.
 - Thus, an independent view on the situation is achieved, in real time.
 - The tool enhances the resolution in the actual understanding of the course of events and the emerging source terms at severe accidents.
 - The interface displays a number of different parameters in real time to facilitate the user's assessment of the situation, and decisions on necessary measures.

Thank you

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