

Nodalisation and Visualisation of VVER440/V213 core

2nd EUMUG

SUJB, Prague

1 – 2 March 2010

Juraj Jančovič, Peter Juriš

jancovic@vuje.sk, juris@vuje.sk

Motivation

Development of a new model for PSA L2 analyses (1471.25 MWt)

Detailed core nodalisation, 3-loop primary circuit model

MELCOR 1.8.5 version of the code used

Approach

Development of a brand new nodalisation

Intensified activities to join CSARP/MCAP

Model verification using RELAP5 code calculations and comparison
with ASTEC code results

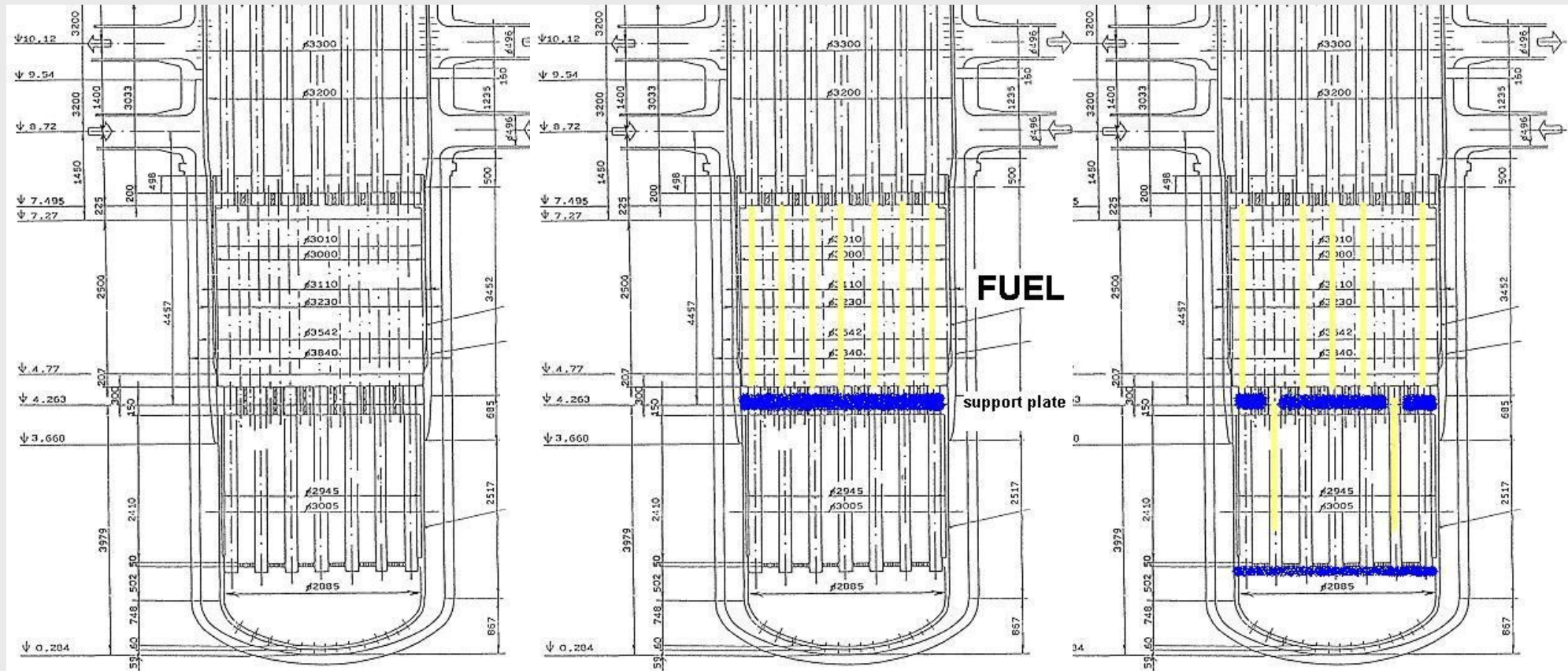
Development of in-vessel core behaviour visualisation

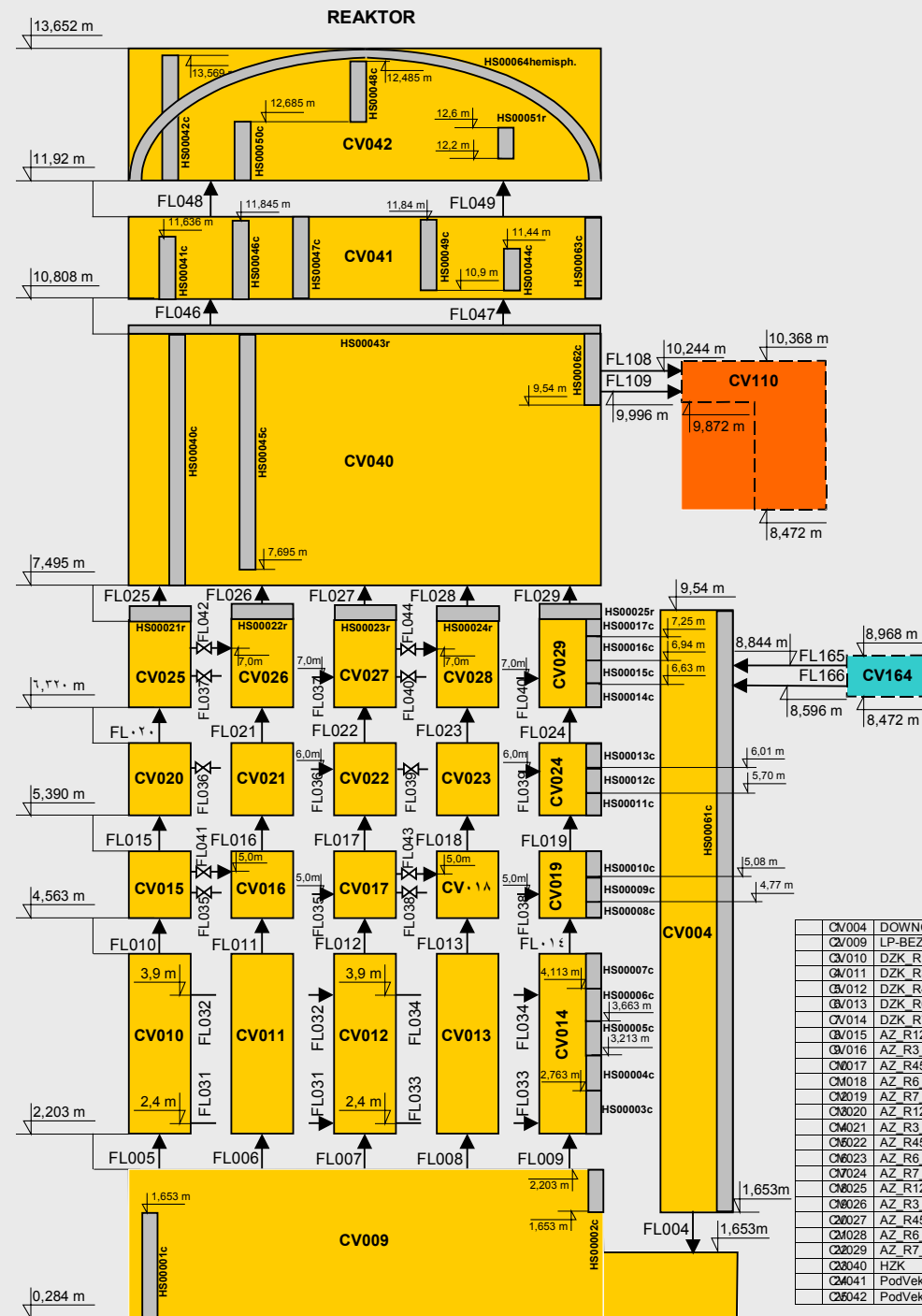
MELCOR 1.8.5 model

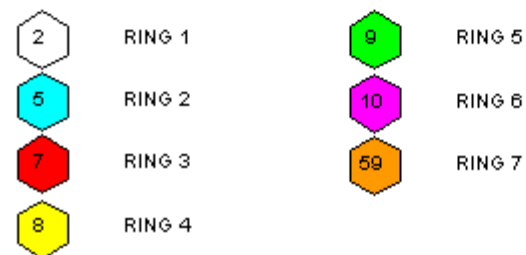
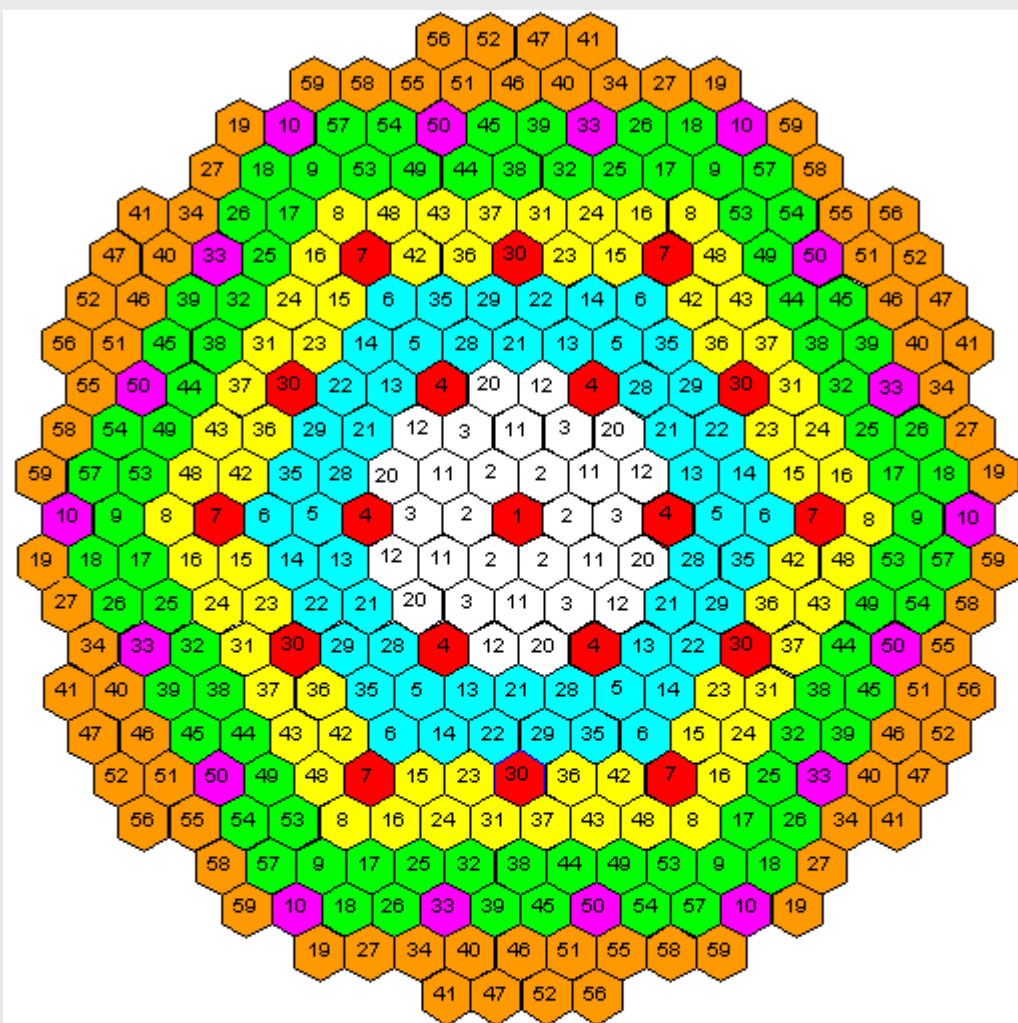
Integral model allowing modelling of a scenario from initiating event up to both in-vessel and ex-vessel phase of severe accidents

Capable of source term calculation, including source term time history in time period 0 s – 172 800 s (2 days)

Steam generator tube creep rupture model evaluated

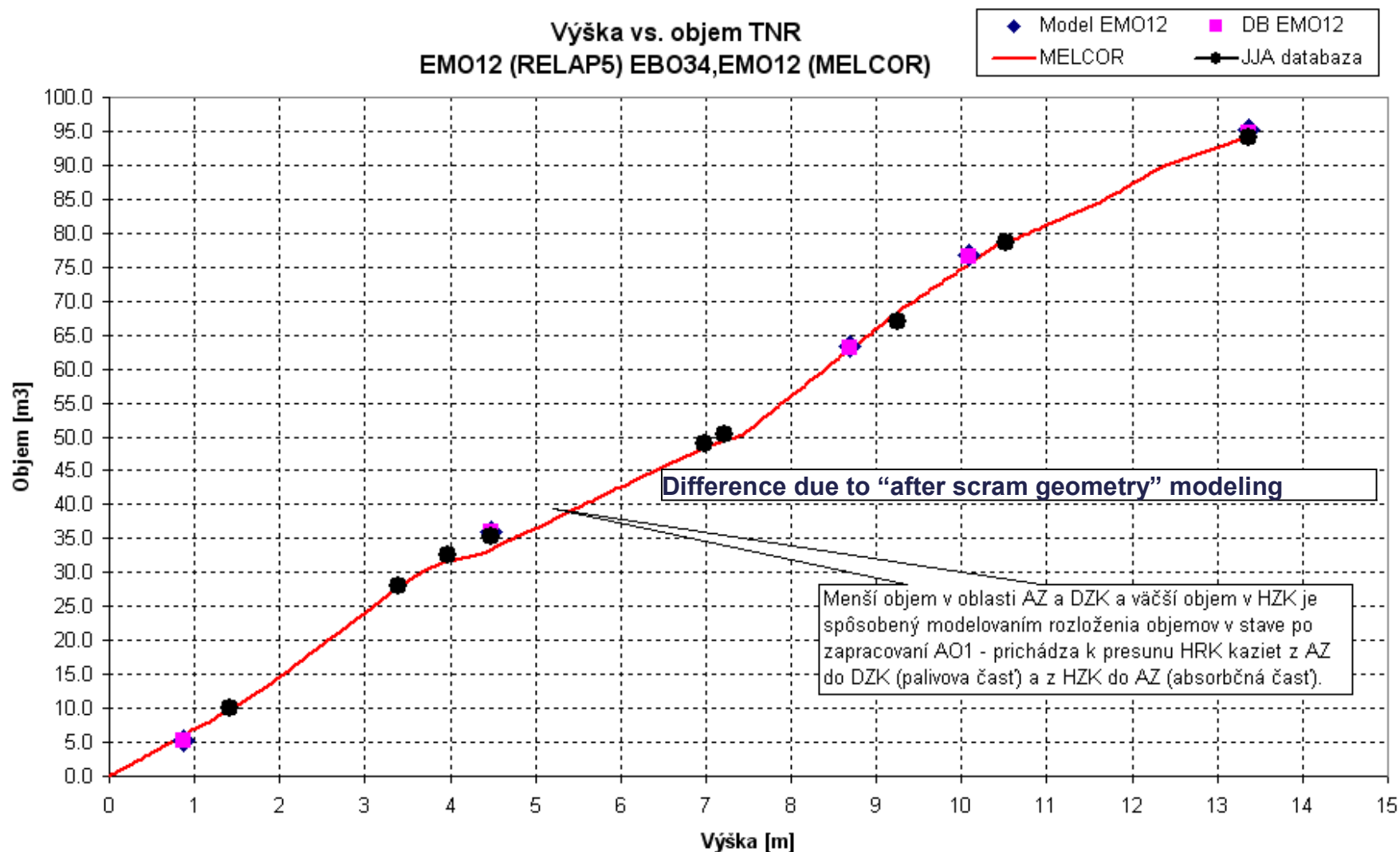






[illegible]

Výška vs. objem TNR
EMO12 (RELAP5) EB034, EMO12 (MELCOR)



Visualisation of core:

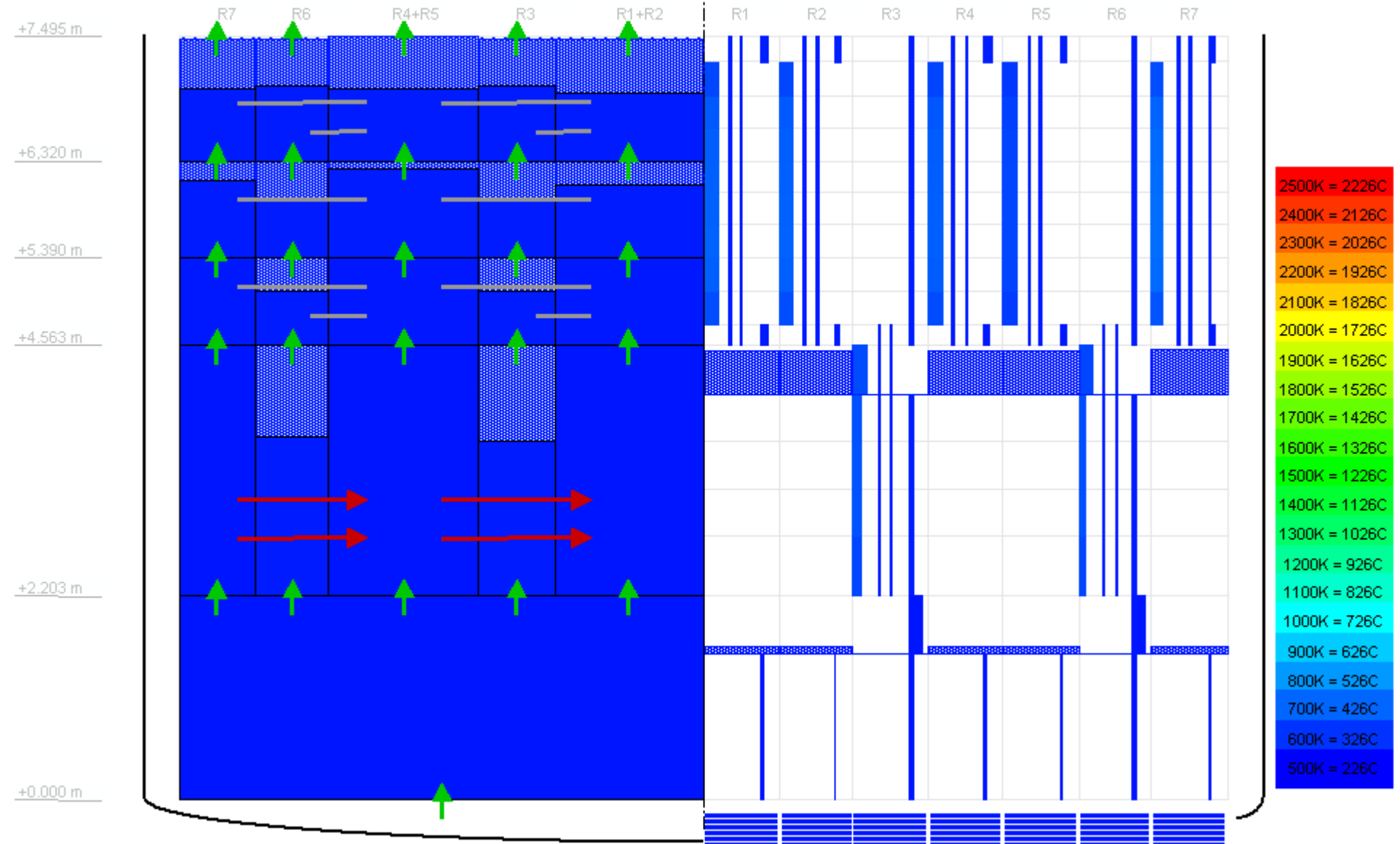
Shows evolution of core degradation

It is run in MS EXCEL

Used in verification of calculations and as a required output for PSA L2 scenario description and documentation.

Uses plot file output

Time = 4.6056 s



Time = 9010 s

+7.495 m

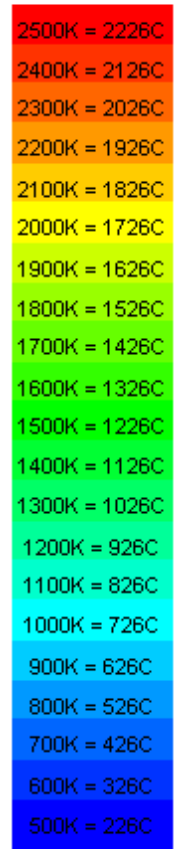
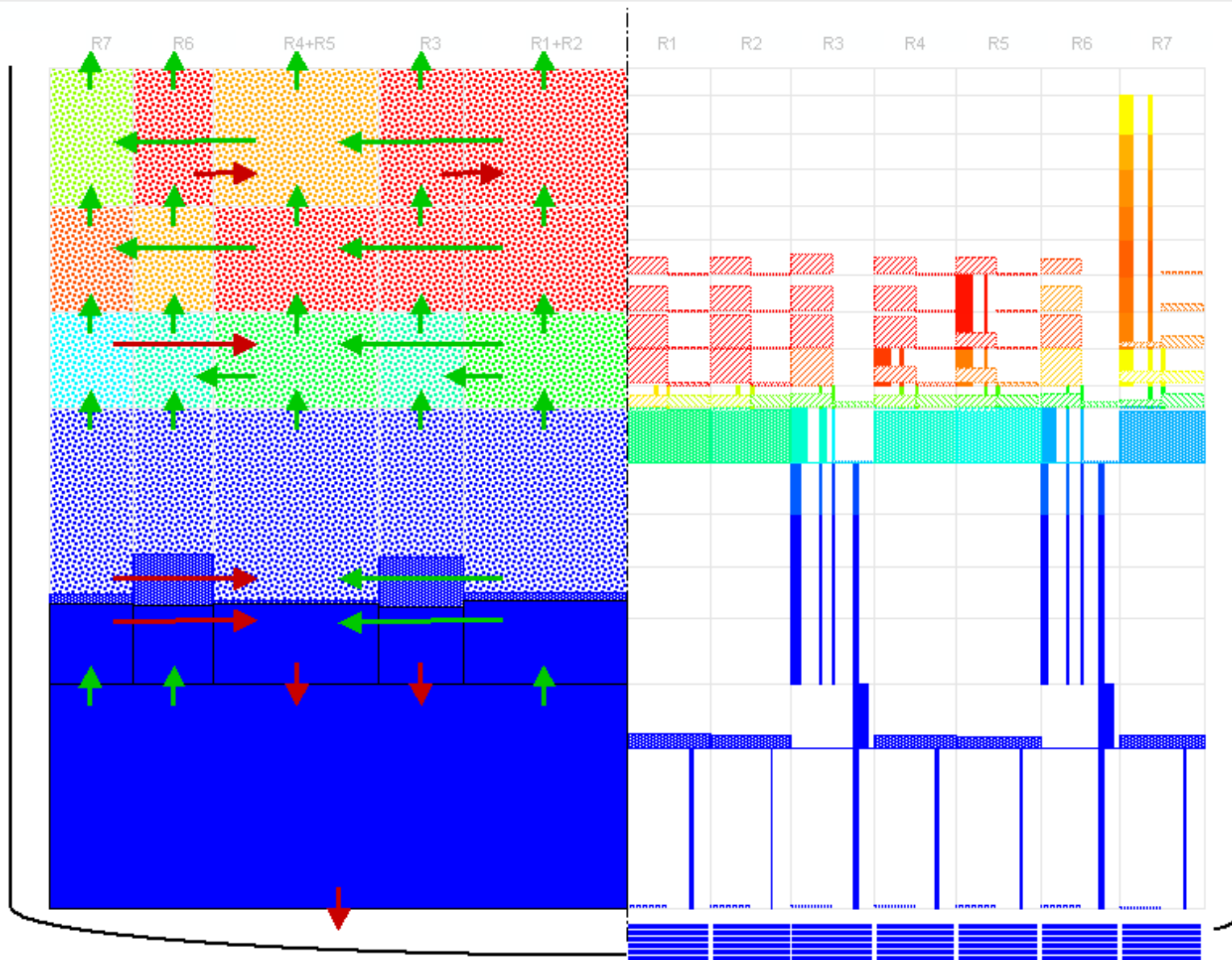
+6.320 m

+5.390 m

+4.563 m

+2.203 m

+0.000 m



Visualisation observations

All mass from core ejected from RPV

In some cases there are large differences in temperature of neighbouring cells

Lower support plate can fail even when submerged in water (with TSFAIL option at 1273 K)

Prolongation of cladding without fuel can support debris and prevent it falling onto support plate for some time

Bugs and experience

CFs creep model „ghostly“ crashes when experiencing negative pressure

Just four valid numbers in RN package (40 030 kg vs. 5.108 kg)

Some test scenarios with vessel flooded experienced large RN class mass numerical error up to ~ 9%

Core crashes with not sufficient explanation, example:

RN package error in VOLUM

Nodalisation and visualisation of core

New nodalisation (along with 3loop PC/SC and ~50 volume containment) reaches addressable memory limits; not a single flow path can be added

Visualisation puts together essential core parameters into one picture

Core composition and relations between components easily seen