# Experience with MELCOR 1.8.5 and transition to 1.8.6 in VEIKI

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# MELCOR Past experince

## Successful application of MELCOR 1.8.3-1.8.5

1992- 2008

- SBLOCA d=40mm, d=100mm, d=500mm, d=2*500mm
- Loss of Feed-Water
- Station-Black-Out
- Interface LOCA – Containment bypass
- PRISE – Primary to Secondary  Leakage
- Cross Comparison of MELCOR-MAAP-RELAP-SCDAP

# MELCOR experimental verification - recalculations

Successful application of MELCOR 1.8.3-1.8.5 in VEIKI to

- STORM
- KAEVER
- VANAM
- Phebus FPT-0
- Phebus FPT-1

# Major deficiencies of MELCOR eliminated with 1.8.6

Compared to MAAP4 – MAAP VVER

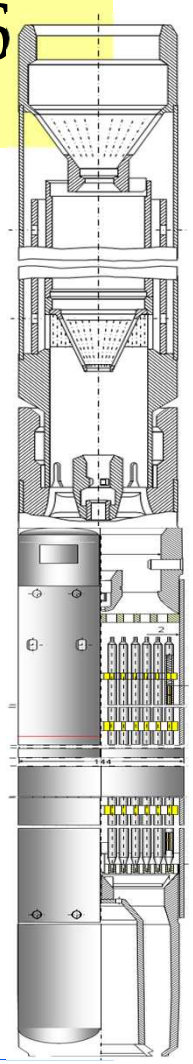
•Lower head heat loss and failure by creep rupture

•Calculation of molten pools resulting in reduced H2 production from steel

•Problems to model VVER-440 rod followers – to be resolved by independent heat source in LP

•Lower head failure is very sensitive to in-vessel degradation – still unclear

# MELCOR VVER-440/213 model in 1.8.6



## Unresolved modeling issues

„Neutron Trap” type control rods BWR model seems better

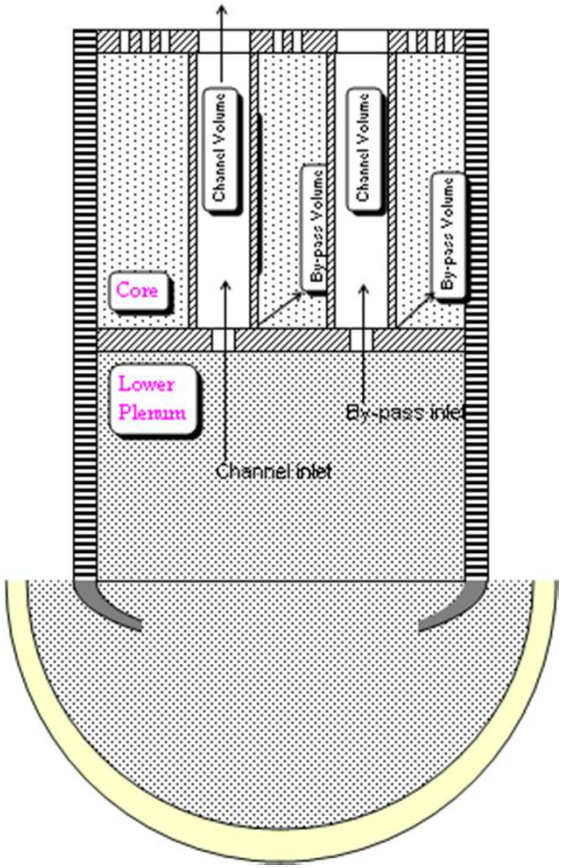
Rod followers in the Lower Plenum extend core to LP

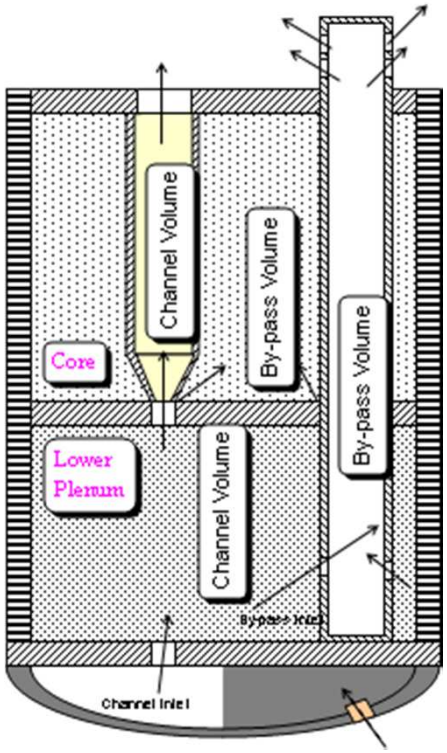
Melt bypass to LP – extra resistance is the core „basket”

# VVER-440/213 Rod followers

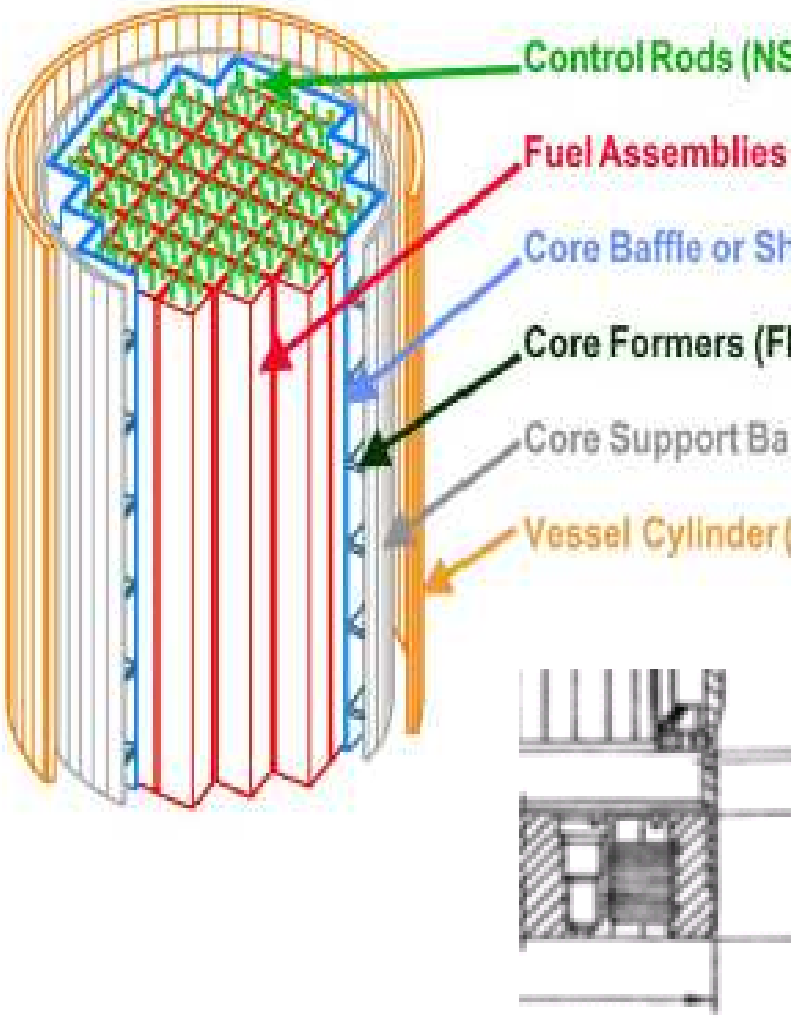
BWR model

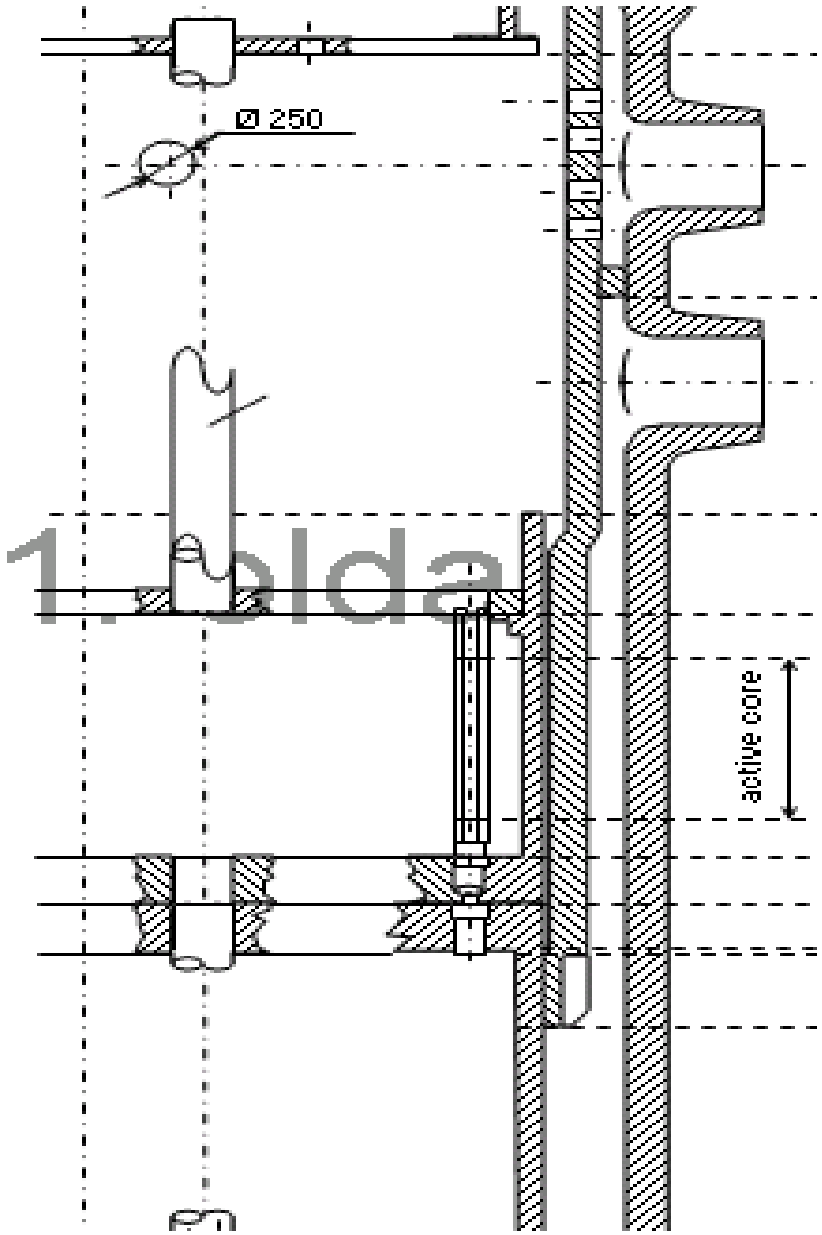
Equivalent VVER-440
problem with fuel in bypass



# Melt bypass to LP



# Sensitivity to melt blockages at core entrance and core bypass

Full blockage at core entrance

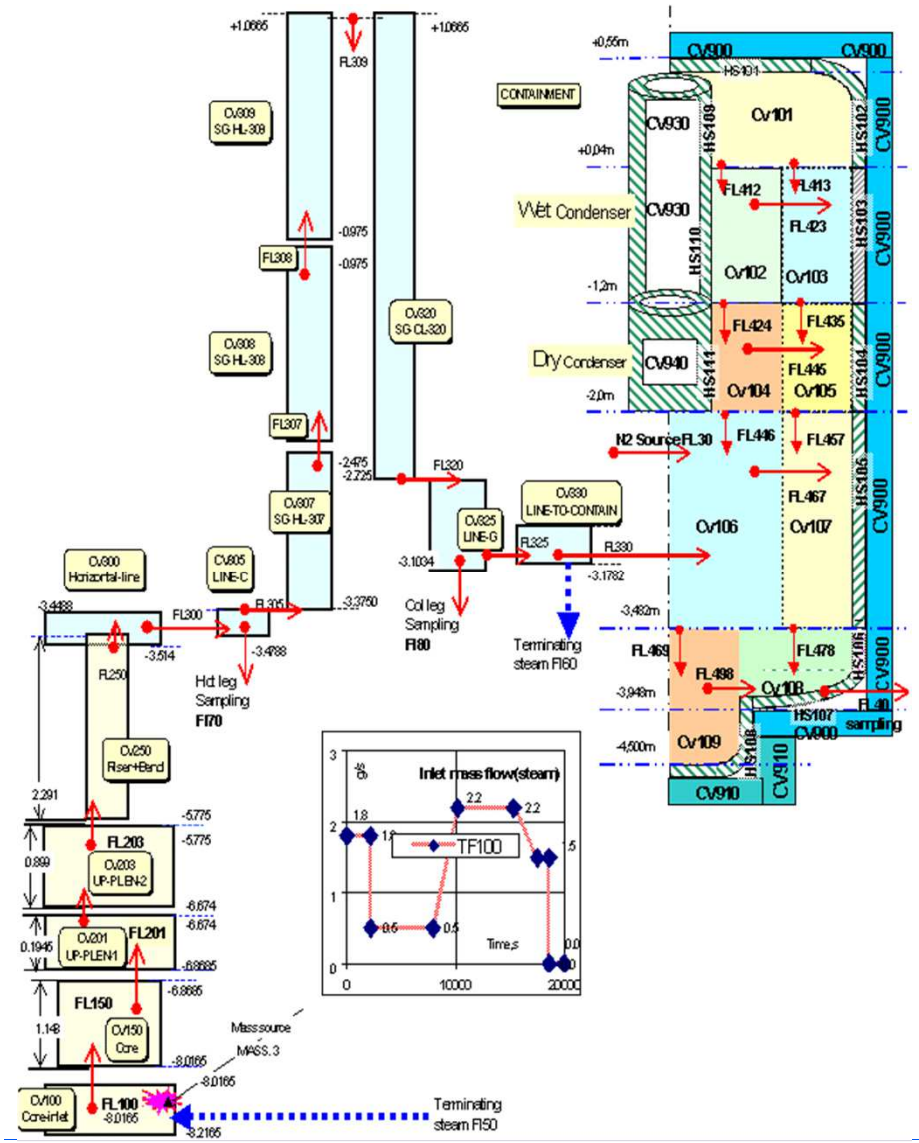
- depresses the LP level
- depresses the core level
- results in early melting of the followers
- enhances H2 production

# Induced break of Hotleg

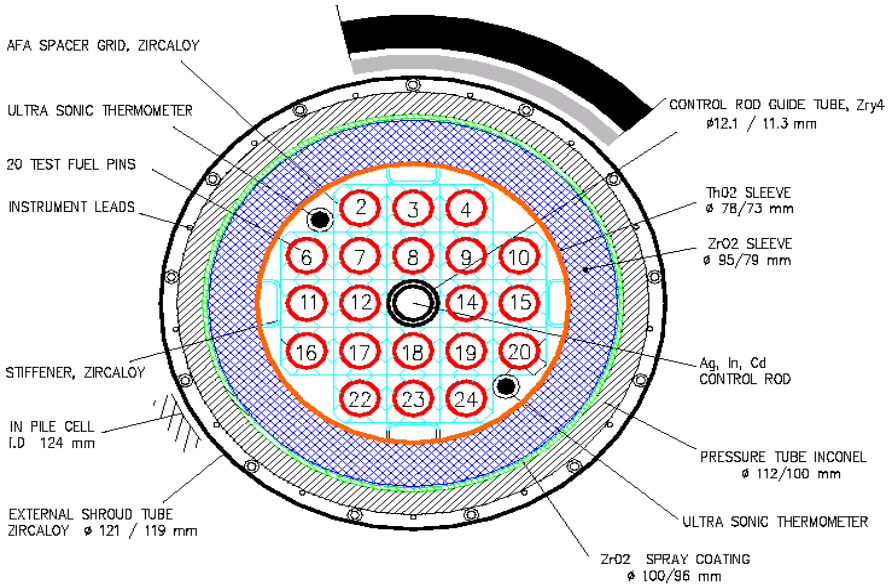
**Important in high pressure sequences:**

- **Evaluated by Hotleg vs. Lower Head temperature**
- **MELCOR 1.8.3 only 1.8.6 has to be calculated**
- **Hotleg reaches high temperatures earlier than LH**
- **Counter-current flow NOT investigated**

# MELCOR 1.8.6 application: Phebus FPT-1, *ISP-46*




***Whole Circuit Model:***
***provides input to***
***Stand Alone Containment Model***



# MELCOR 1.8.6 application: Phebus FPT-1, *ISP-46*

***Experience of sensitivity studies with Whole Circuit Model***

## TNSmax-range: 1273-1623K

Optimum to reproduce the high structural aerosol release=1273-1300K

## TRDfai-range: 2500-2800K

No optimum found: 2500K – all fuel turned to
2800K - all fuel remained intact

## FcelR-range: 0.25-0.5 Deficiency: FcelR not radial dependent

Optimum for degradation found: 0.5 (with TRDfai=2500K

## DhyPD-range: 8-6-4mm Deficiency: PD-constant 186 pools?

Optimum for structural aerosol release found: 6mm (radiation cracks in pellets)

# MELCOR 1.8.6 application: Phebus FPT-1, *ISP-46*

## *Major conclusion*

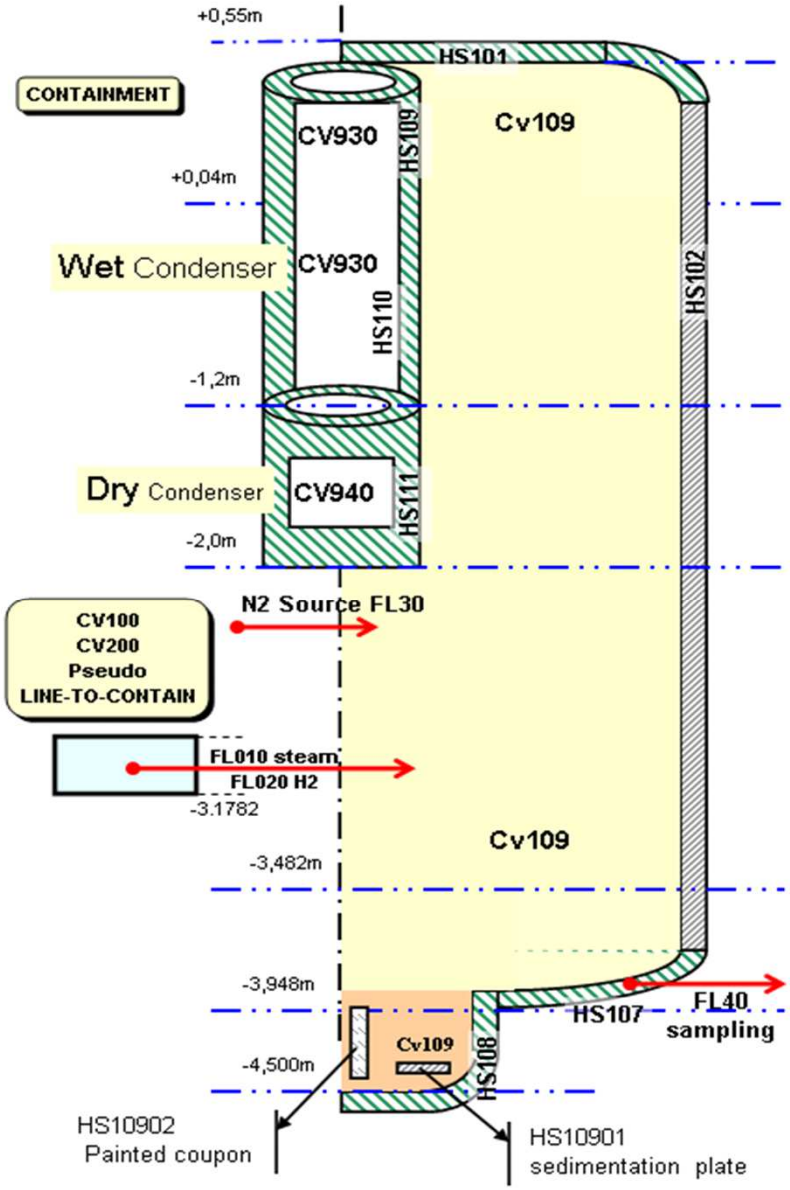
**Inactive structural material aerosol release is unresolved**

# MELCOR 1.8.6 application: Phebus FPT-1, *ISP-46*

***Stand Alone Containment Model for Iodine Poll Model***

***(Needed to increase calculation speed DTmax=10s)***

***Whole Circuit Model: provides input to Stand Alone Containment Model***

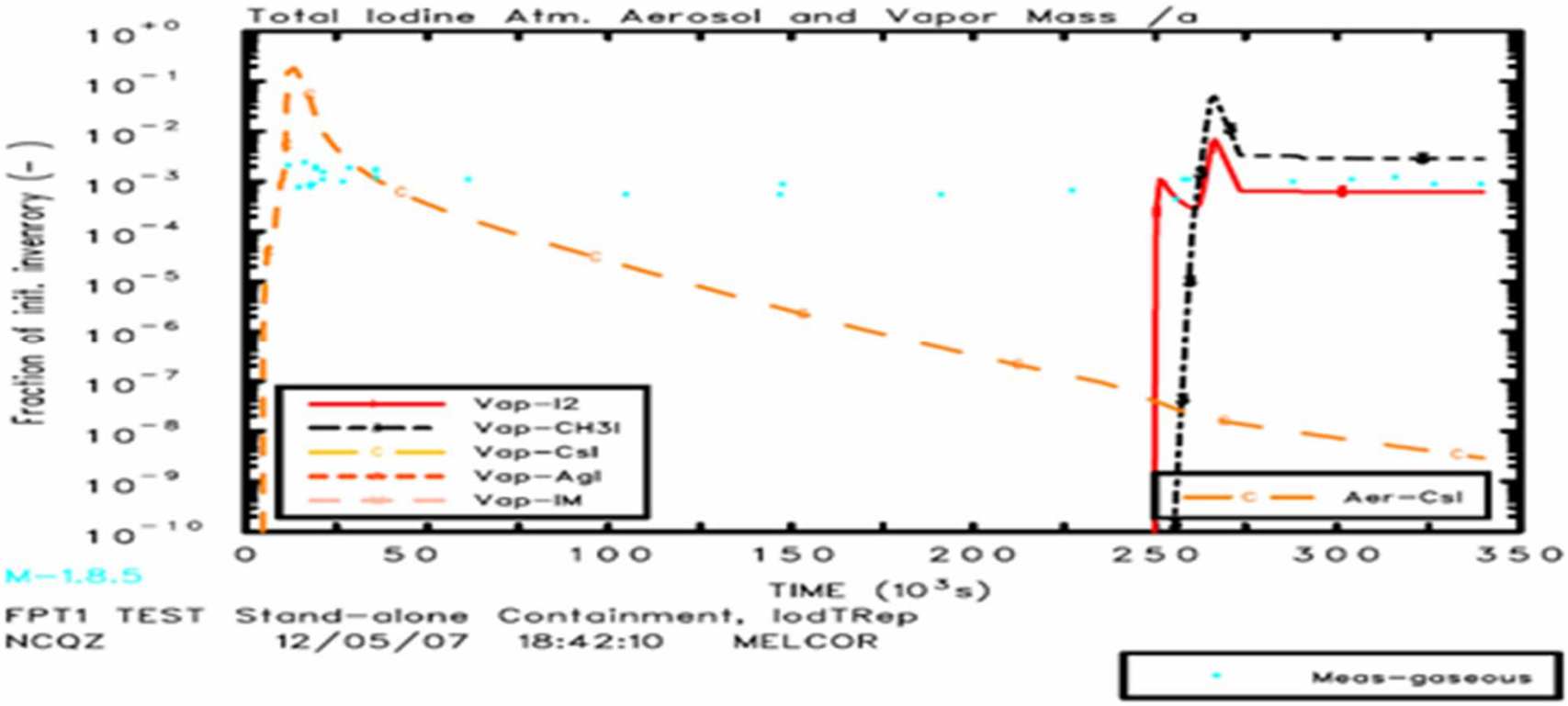


# MELCOR 1.8.6 application: Phebus FPT-1, *ISP-46*

***Experience with Stand Alone Containment Model***

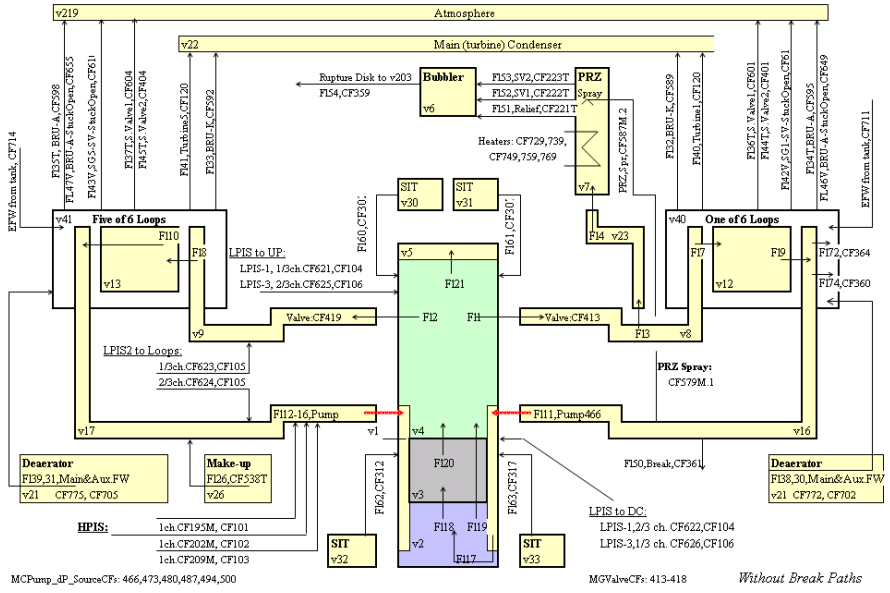
**Reproduced volatile iodine mass in cont.**

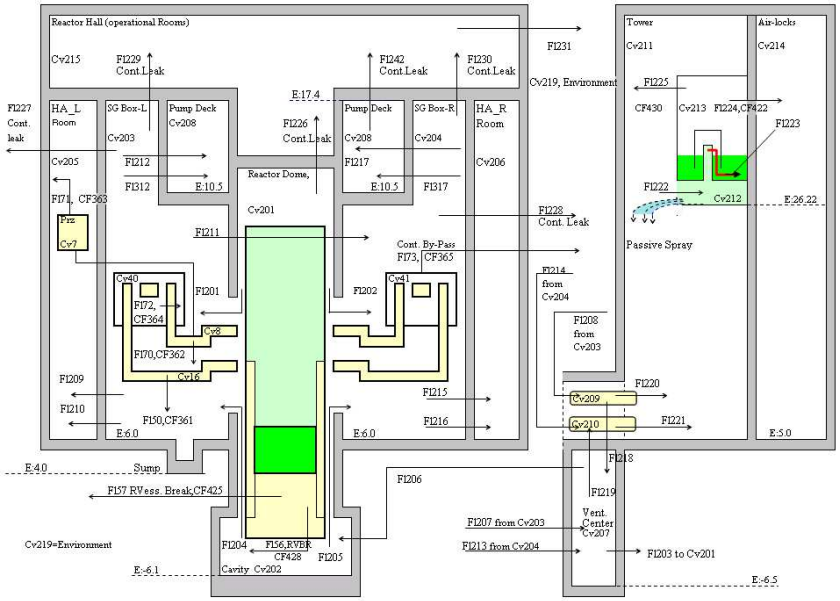
**However with large mass balance error**



# MELCOR 1.8.6 application: VVER-440/213

***Whole Circuit Model: provides input to Stand Alone Containment Model***



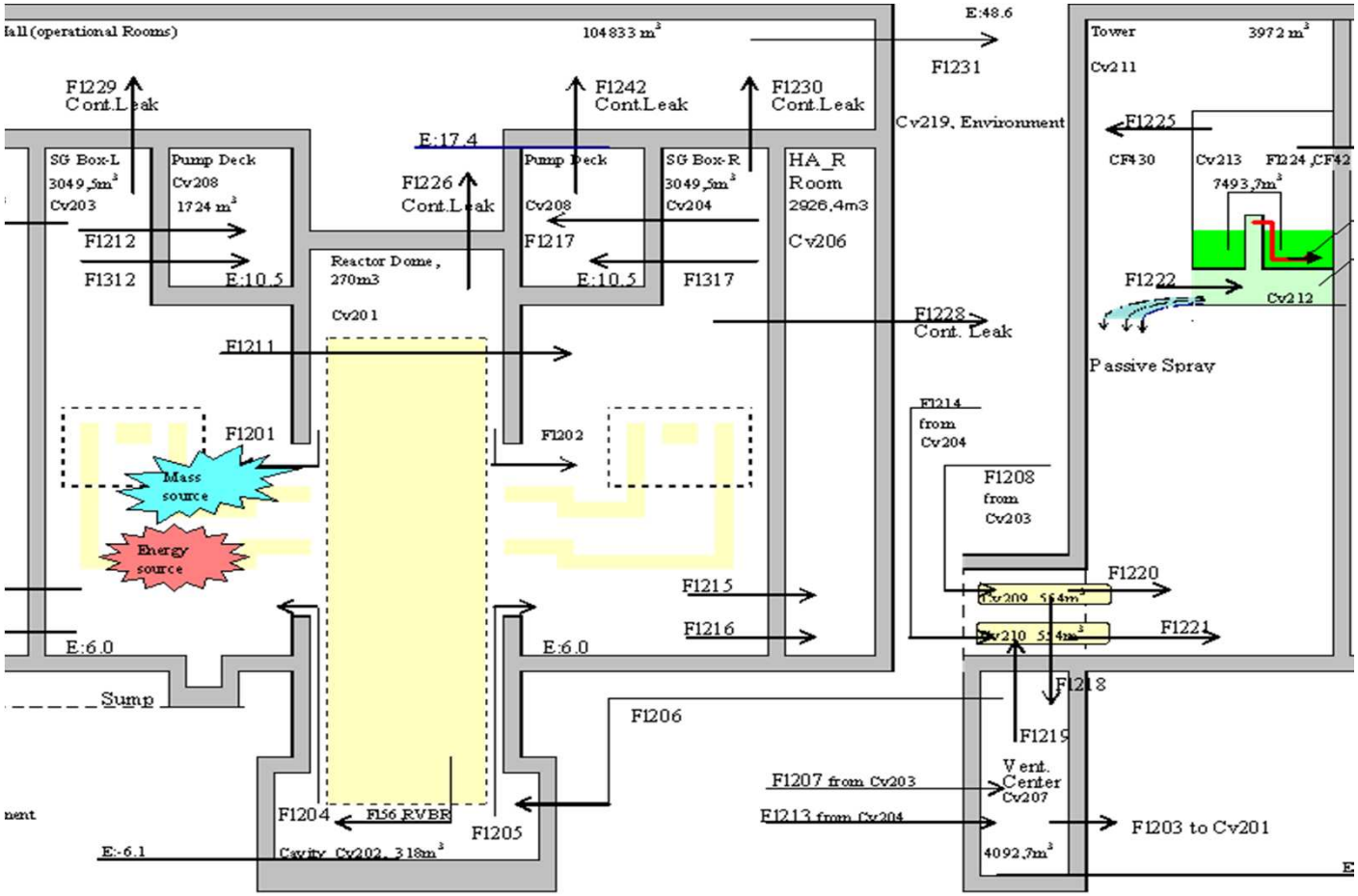



# MELCOR 1.8.6 application: VVER-440/213

***Whole Circuit Model: provides input***

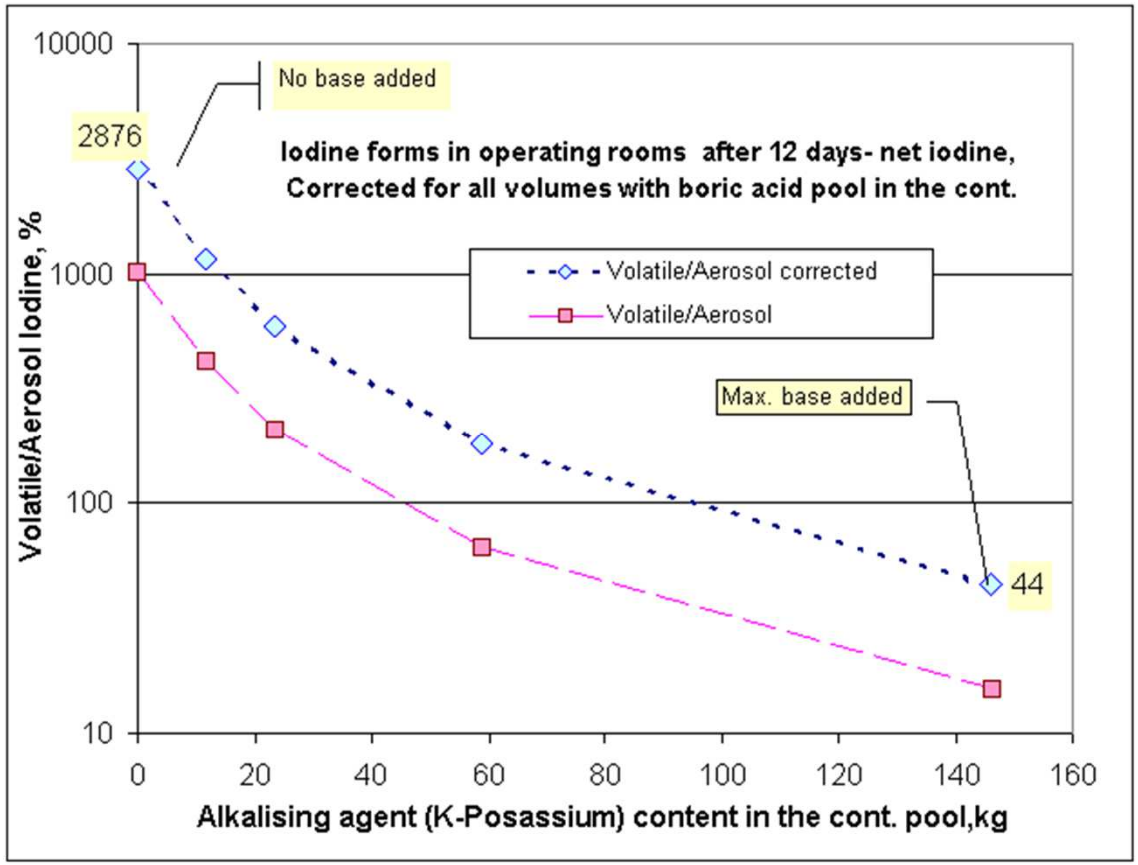
***Stand Alone Containment Model for Iodine Poll Model***

***(Needed to increase calc. speed DTmax=30s)***



# MELCOR 1.8.6 application: VVER-440/213

***Experience with Stand Alone Containment: Iodine Pool Model***




- **With similar pH, iodine inventory fraction is similar to Phebus FPT-1**
- **Mass balance error still large**

# MELCOR 1.8.6 application: VVER-440/213

## *Experience with Iodine Pool Model*

- **Code freezing and unrealistic results if more than 2 CVs activated (RNCVon) - Some CVs may have low pH apart from others generating volatile Iodine**
- **Special additives for VVERs Hydrazine ($N_2H_4$) not handled**
- **Mass balance error still large**

***Thank you for the attention***