

# OVERVIEW OF MELCOR ACTIVITIES IN CIEMAT (2012)

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*CIEMAT, SPAIN*



## Scenarios Addressed

- **Plant analysis**

**BWR:**

Spanish NPP (CSN) → MELCOR 2.1 ▶

BSAF (CSN, OECD project) → MELCOR 2.1 ▶

**PWR:**

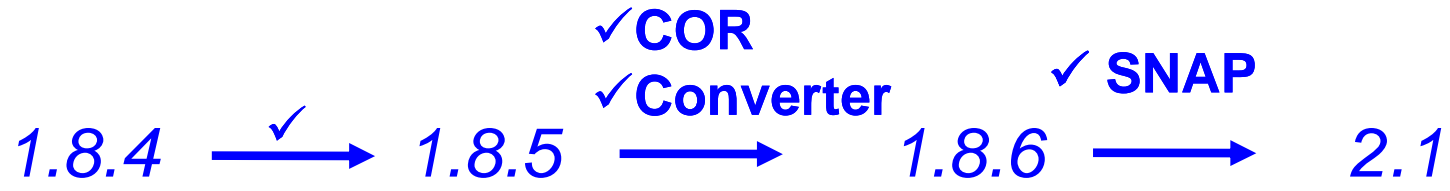
Spanish NPP (ARTIST-Ext ) → MELCOR 2.1 ▶

- **Fuel degradation in the presence of air**

SFP (OECD-SFP project) → MELCOR 1.8.6 YV 3084 SFP ▶

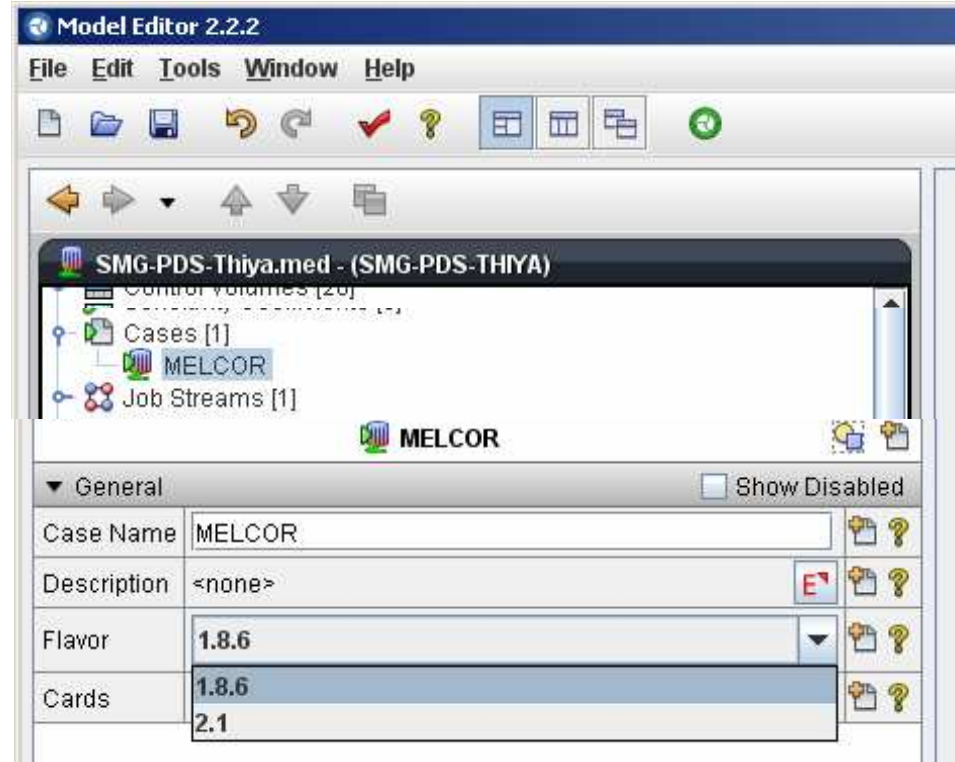


# Inputs updating: Plant analysis BWR, PWR



## Automatic conversion to 2.1:

- MELGEN ✓
- MELCOR ✗ *“by hand”*



# Execution

**M2.1.3226   M2.1.4206   M2.1.4803**

<b>BWR</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>PWR</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**Post-processing:**

<b>PTFread1.76.xla</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>PTFread1.77.xla</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**PTFread \*.xlam**      **Not supported (Office 2003)**



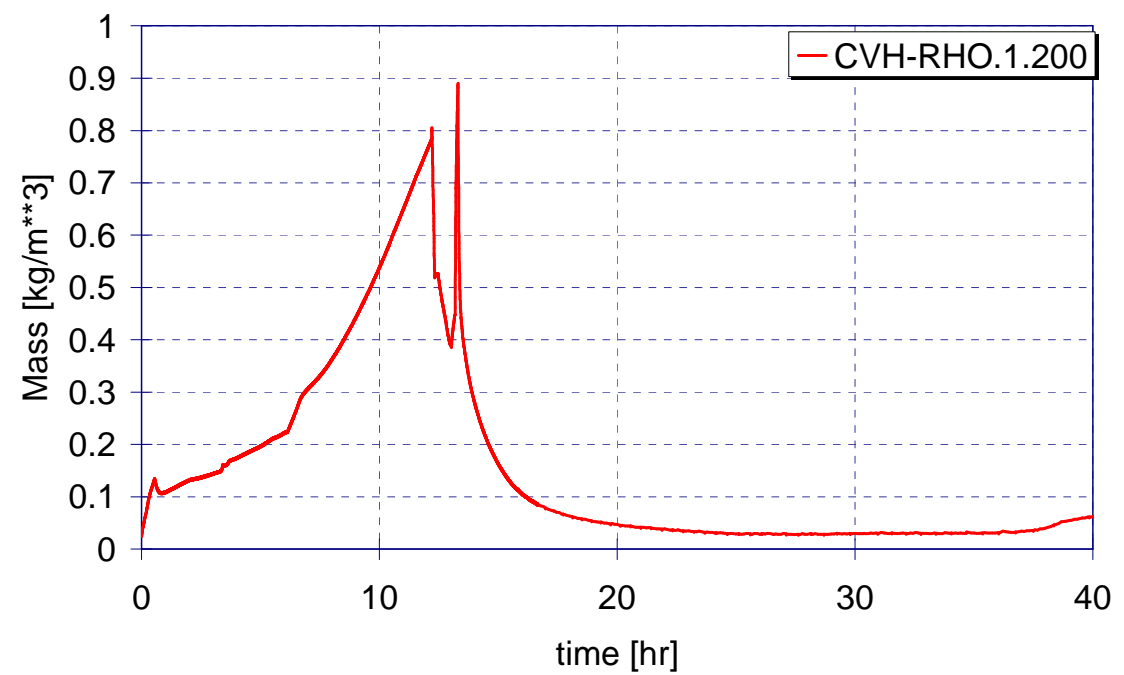
## Others:

- Corruption of files sent by e-mail:

license.request → \*.zip

- Post-processing of MELCOR 2.1 case with PTFread1.76:

- water density



→ Output ✓



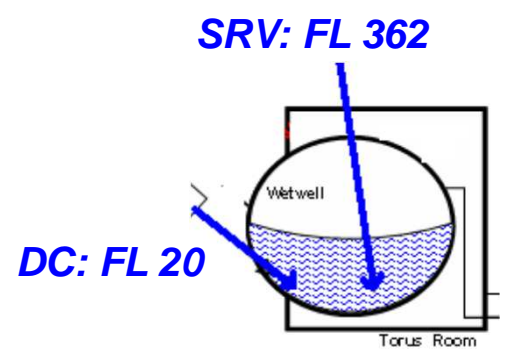
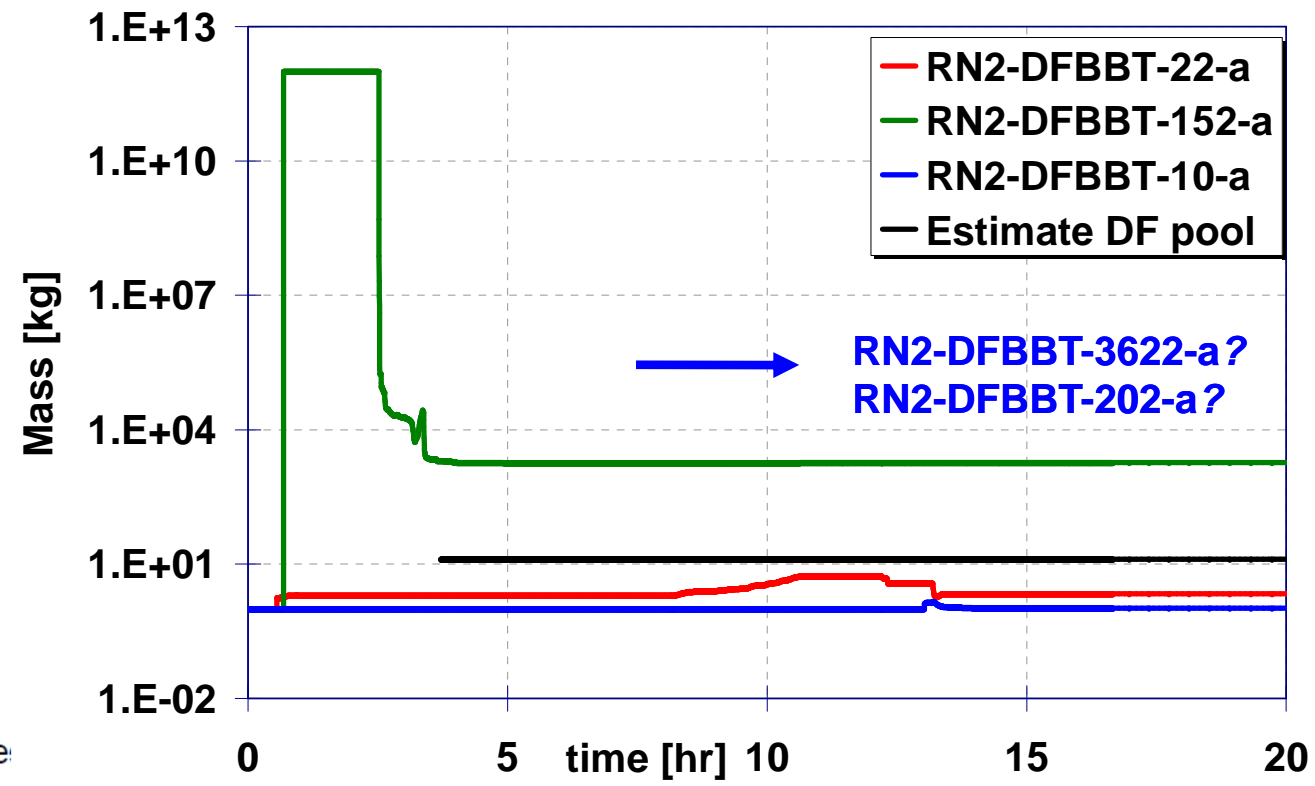
## Others:

- Corruption of files sent by e-mail:

license.request → \*.zip

- Post-processing of MELCOR 2.1 case with PTFread1.76:

- water density
- Cumulative DF



RN2-DFBBT-ip-a ip=10\*NFL+2 for the to volume:



## **Others:**

- Corruption of files sent by e-mail:

license.request → \*.zip

- Post-processing of MELCOR 2.1 case with **PTFread1.76:** ?
  - water density
  - Cumulative DF





**THANK YOU FOR YOUR ATTENTION!!**



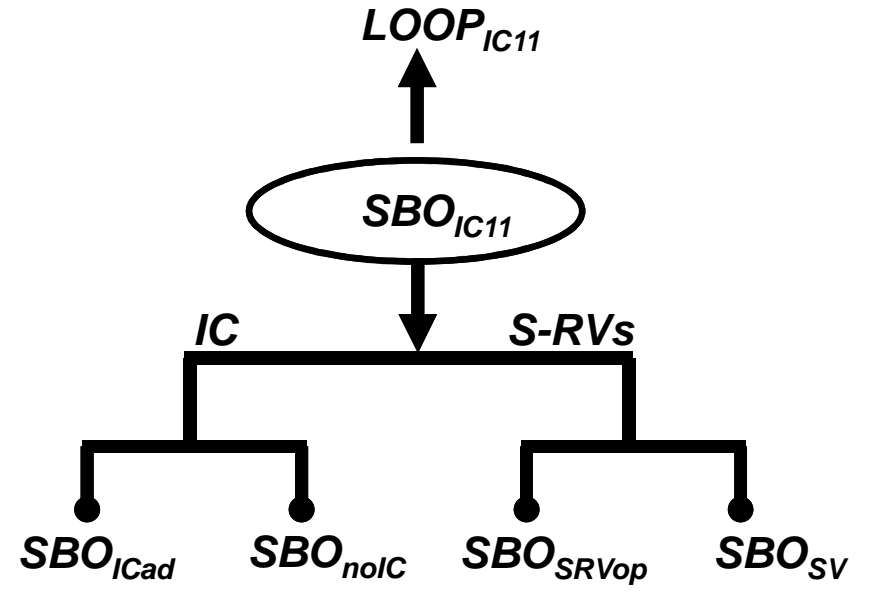
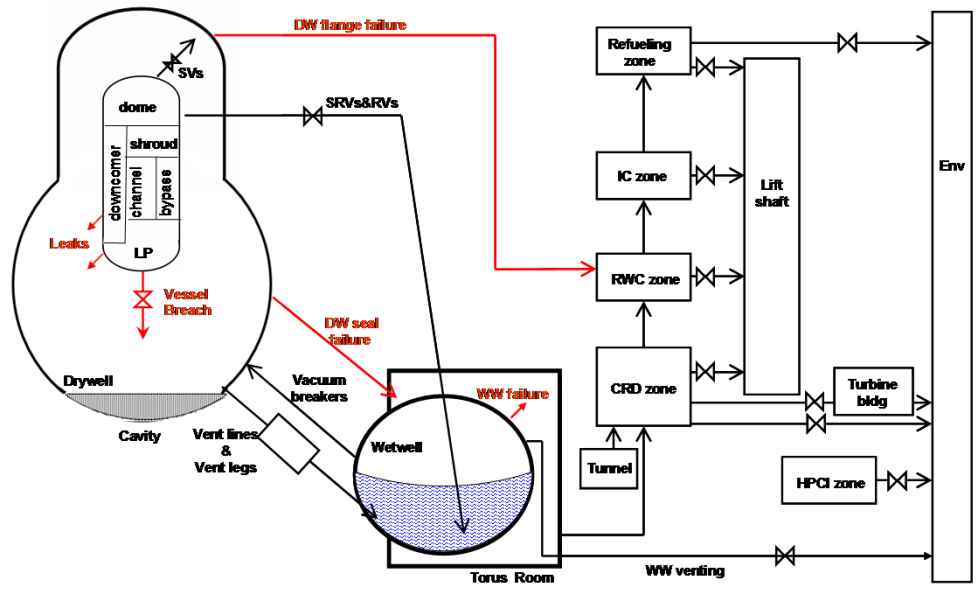


# 1. BWR: CSN

Spanish NPP  
BWR-Mark I  
1400 MWth



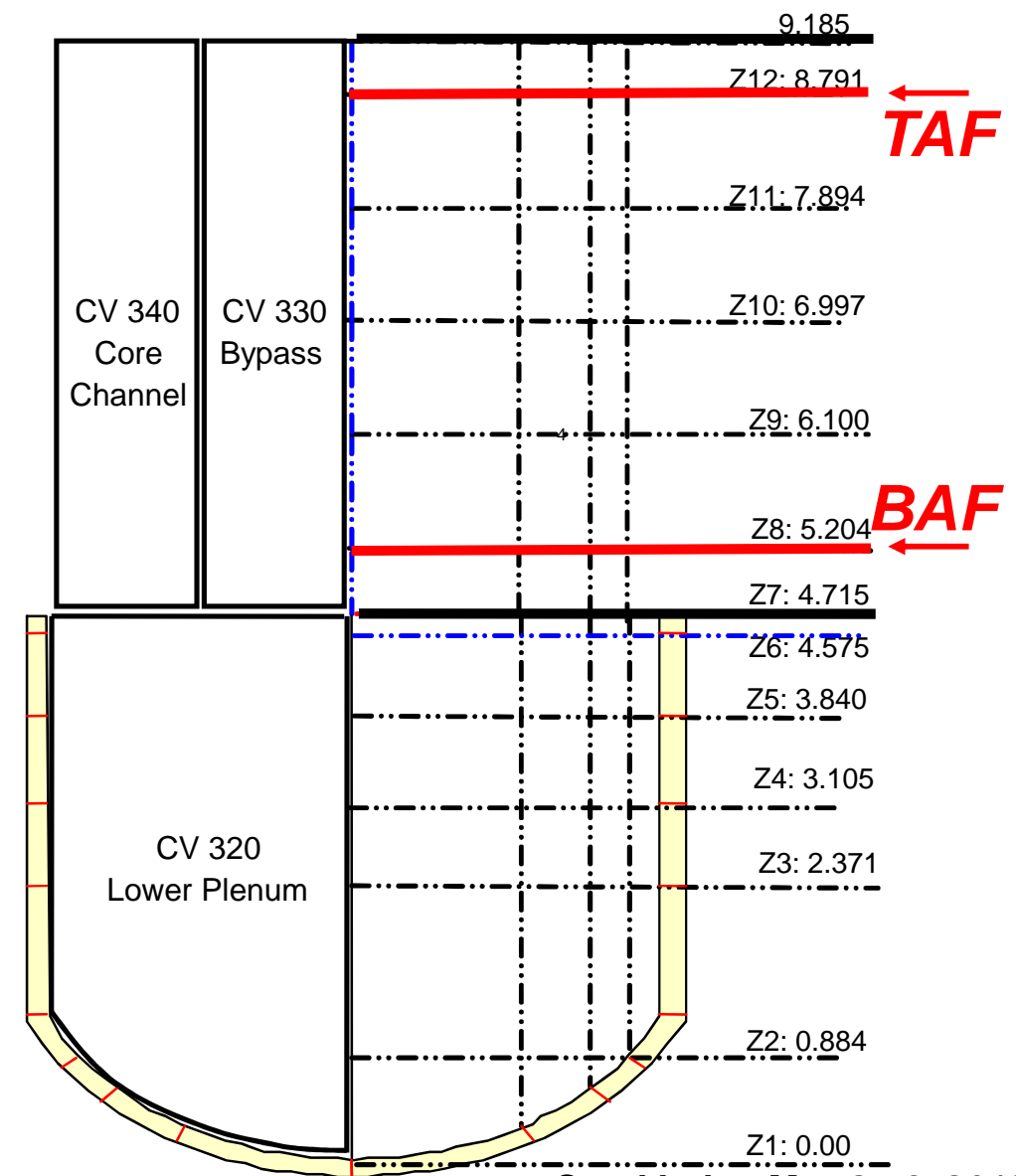
Systems analyses:  
Unit 1 Fukushima-like scenario



# 1. BWR: CSN

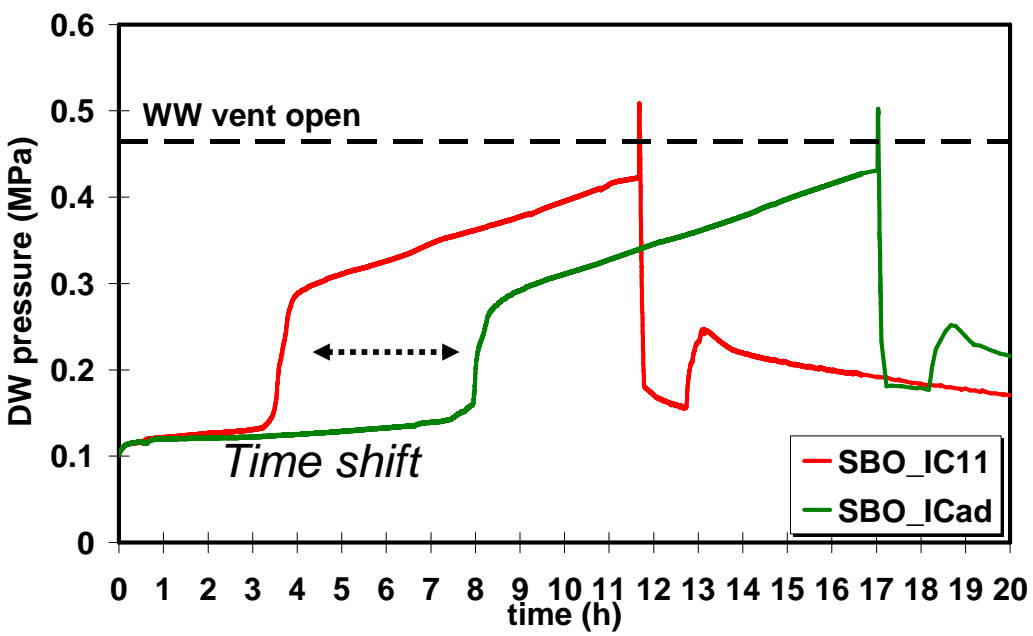
	Core & RPV	PCV	Reactor Building	Total
<b>COR cells</b>	<b>41</b>	<b>-</b>	<b>-</b>	<b>41</b>
<b>CVs</b>	<b>6</b>	<b>3</b>	<b>11</b>	<b>20</b>
<b>FLs</b>	<b>8+5</b>	<b>4+3</b>	<b>15</b>	<b>35</b>
<b>HSs</b>	<b>14</b>	<b>7</b>	<b>25</b>	<b>46</b>

SRVs }  
 SVs } → FL (Valve, TF)  
 Failures }  
  
 IC → CF (Steam Sink)  
 (Water Source)

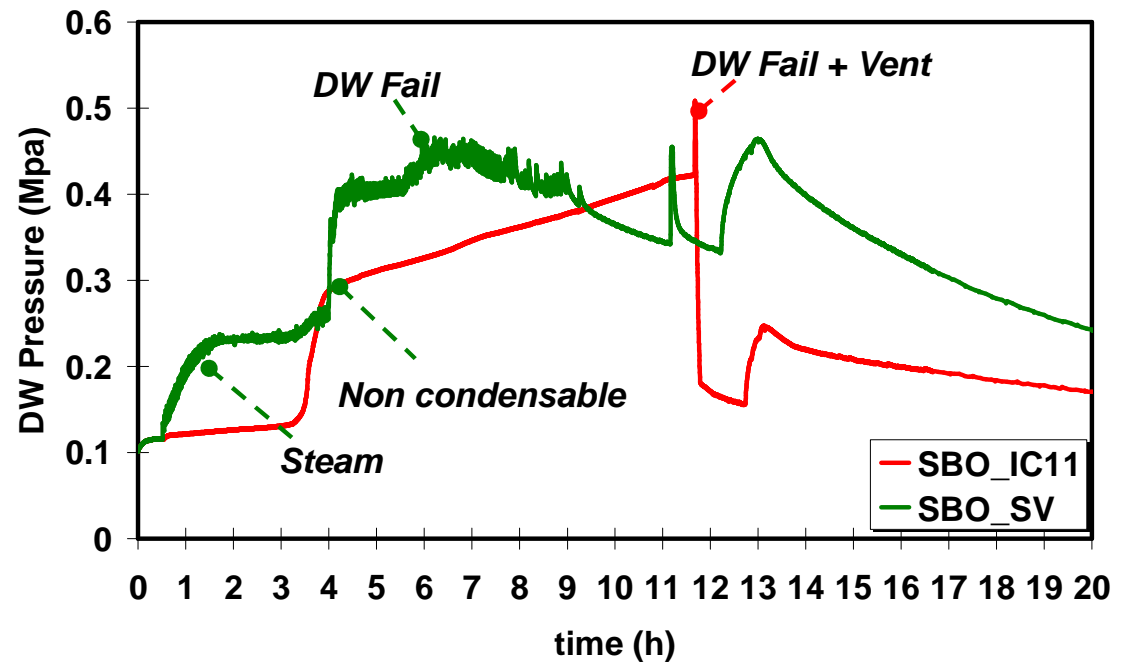


# 1. BWR: CSN

## IC Effect



## SV Effect



IC performance → late and slower  
 degradation of fuel.  
 → similar Containment  
 evolution

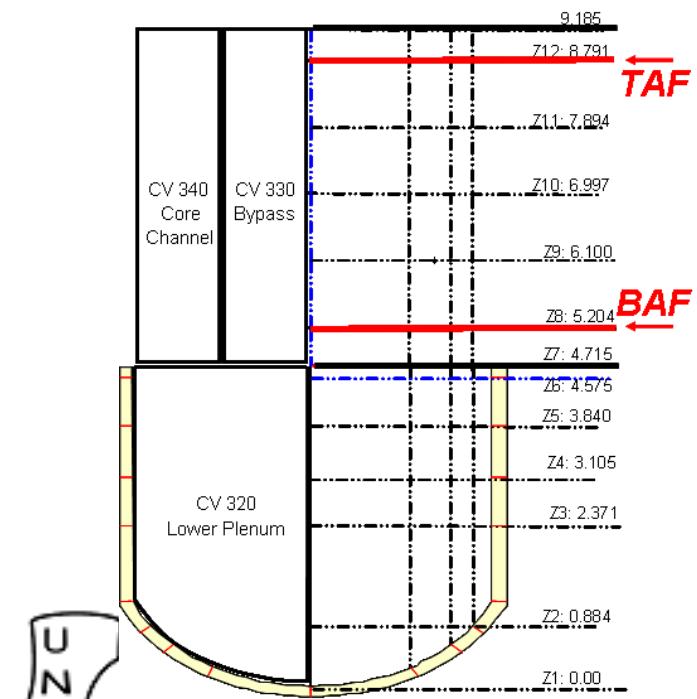
SV operation → similar fuel degradation.  
 → different Containment  
 evolution.



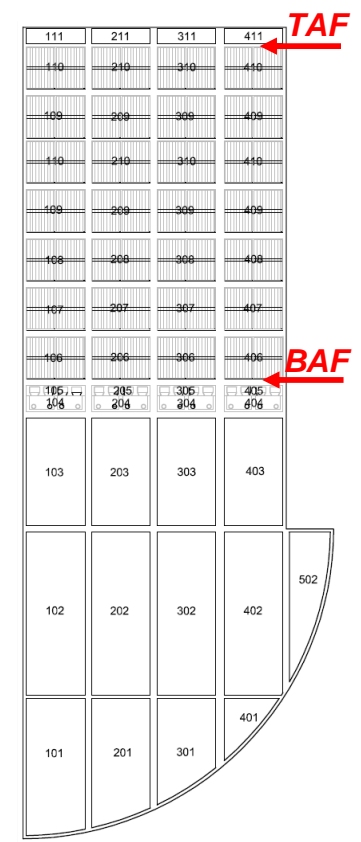
# 2. BWR: CSN, BSAF Project

Starting point: previous BWR NPP

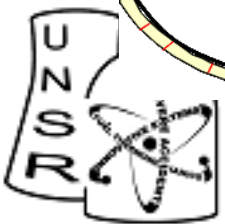
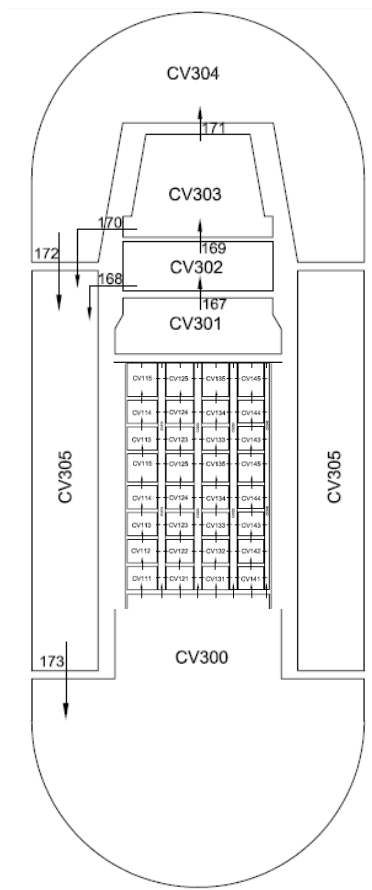
- Detailed plant model



COR: 3 x 12

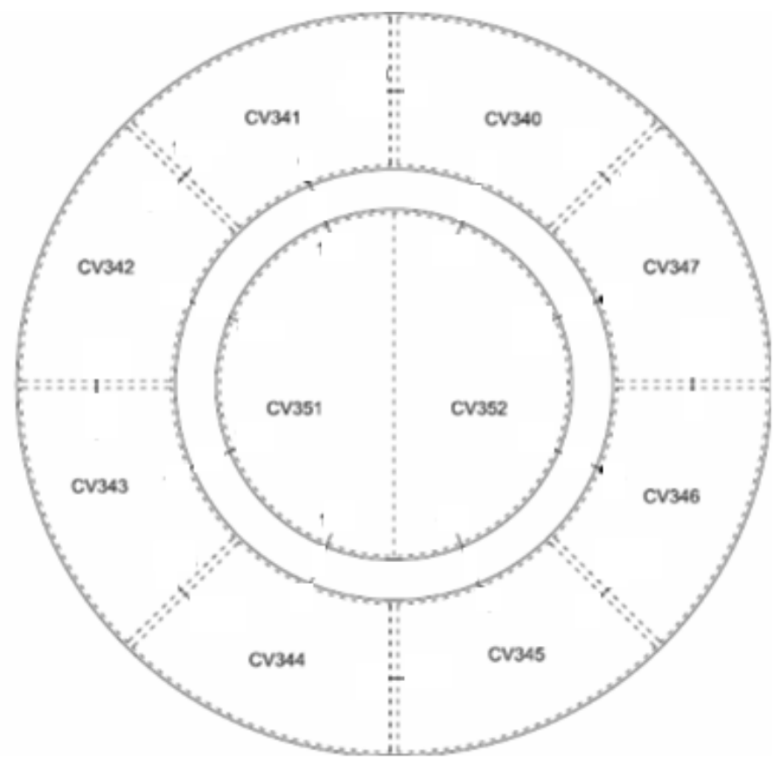


COR: 4 x 13

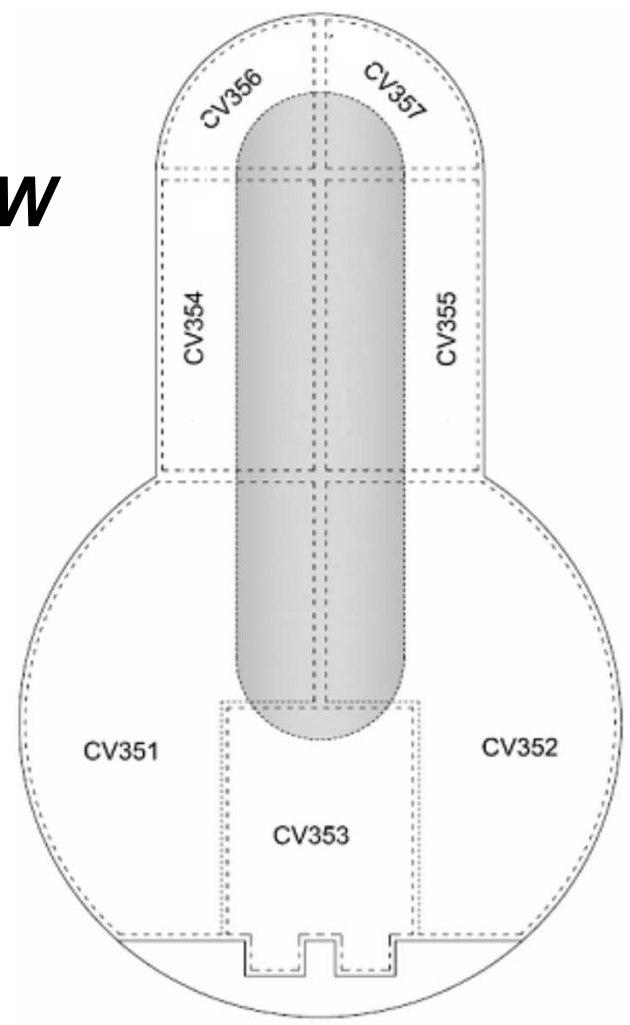


# 2. BWR: CSN, BSAF Project

**WW**

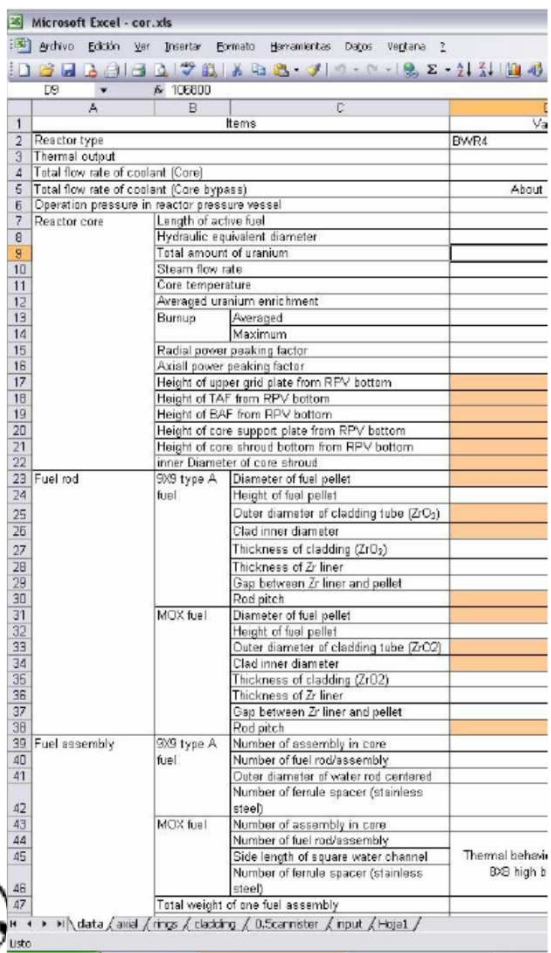


**DW**

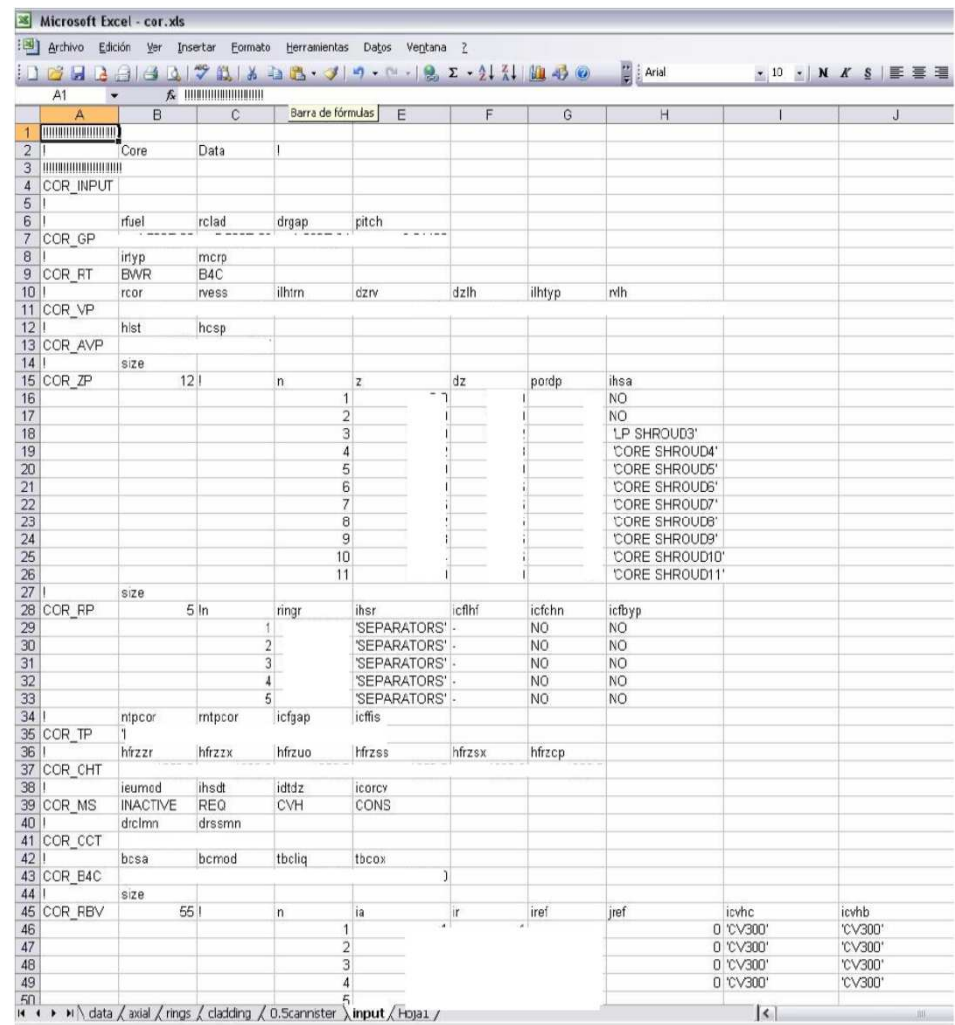


# 2. BWR: CSN, BSAF Project

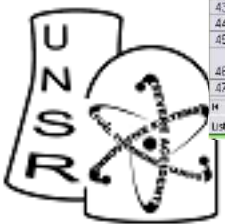
Input development of the 3 NPP → Excel worksheet



Item	Value
Reactor type	BWR4
Thermal output	
Total flow rate of coolant (Core)	
Total flow rate of coolant (Core bypass)	About
Operation pressure in reactor pressure vessel	
Reactor core	
Length of active fuel	
Hydraulic equivalent diameter	
Total amount of uranium	
Steam flow rate	
Core temperature	
Averaged uranium enrichment	
Burnup	Averaged Maximum
Radial power peaking factor	
Axial power peaking factor	
Height of upper grid plate from RPV bottom	
Height of TAF from RPV bottom	
Height of BAF from RPV bottom	
Height of core support plate from RPV bottom	
Height of core shroud bottom from RPV bottom	
Inner diameter of core shroud	
Fuel rod	
BWS type A fuel	Diameter of fuel pellet Height of fuel pellet Outer diameter of cladding tube (ZrO <sub>2</sub> ) Clad inner diameter Thickness of cladding (ZrO <sub>2</sub> ) Thickness of Zr liner Gap between Zr liner and pellet Rod pitch
MOX fuel	Diameter of fuel pellet Height of fuel pellet Outer diameter of cladding tube (ZrO <sub>2</sub> ) Clad inner diameter Thickness of cladding (ZrO <sub>2</sub> ) Thickness of Zr liner Gap between Zr liner and pellet Rod pitch
Fuel assembly	
BWS type A fuel	Number of assembly in core Number of fuel rod/assembly Outer diameter of water rod contained Number of ferrule spacer (stainless steel)
MOX fuel	Number of assembly in core Number of fuel rod/assembly Side length of square water channel Number of ferrule spacer (stainless steel)
Total weight of one fuel assembly	Thermal behavior BWS high b

Item	Value							
Core Data								
CCR_INPUT								
rfuel	rcklad	drgap	pitch					
CCR_GP								
lrytp	mcrp							
CCR_RT	BWR	B4C						
rcor	rves	ilhm	dzrv	dzlh	ilhtyp	rlh		
CCR_VP								
hist	hcsp							
CCR_AVP								
size								
CCR_ZP	12	n	z	dz	porp	ihsa		
1						NO		
2						NO		
3						'LP SHROUD3'		
4						'CORE SHROUD4'		
5						'CORE SHROUD5'		
6						'CORE SHROUD6'		
7						'CORE SHROUD7'		
8						'CORE SHROUD8'		
9						'CORE SHROUD9'		
10						'CORE SHROUD10'		
11						'CORE SHROUD11'		
size								
CCR_FP	5	ln	ringr	ihsr	icfthf	icfchn	icfbyp	
1				'SEPARATORS'		NO	NO	
2				'SEPARATORS'		NO	NO	
3				'SEPARATORS'		NO	NO	
4				'SEPARATORS'		NO	NO	
5				'SEPARATORS'		NO	NO	
ntrpcor	rntpcor	icfgap	icffis					
CCR_TP	1							
hfrzr	hfrzx	hfrzuo	hfrzss	hfrzsx	hfrzcp			
CCR_CHT								
ieumed	ihstdt	idtdz	icorcv					
CCR_MS	INACTIVE	REQ	CVH	CONS				
drlmn	drssmn							
CCR_CCT								
bcsa	bcmod	tblq	tbcx					
CCR_B4C								
size								
CCR_REV	55	n	ia	ir	iref	ref	icvhc	icvhb
1							0 'CV300'	'CV300'
2							0 'CV300'	'CV300'
3							0 'CV300'	'CV300'
4							0 'CV300'	'CV300'
5							0 'CV300'	'CV300'



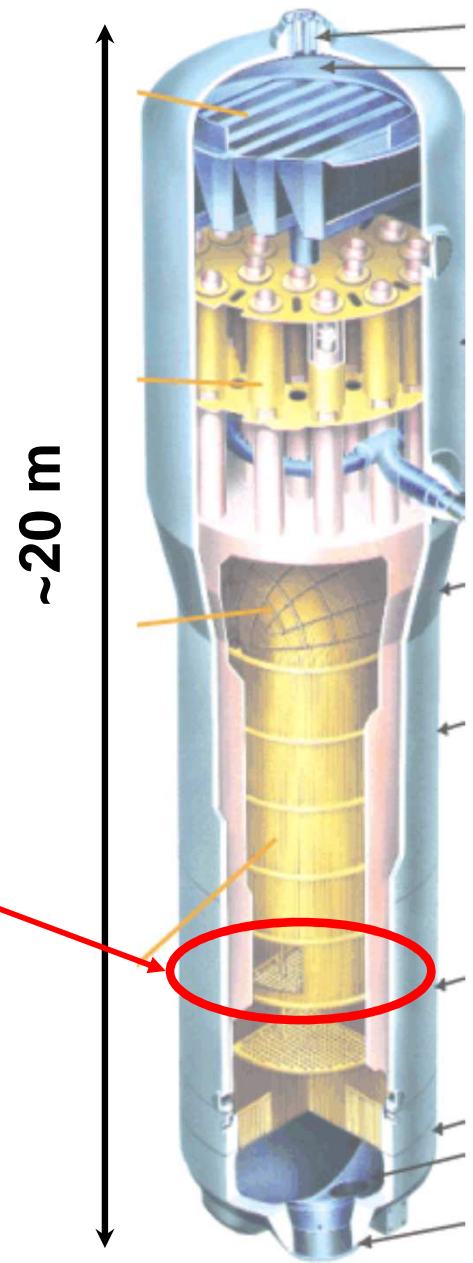
# 3. PWR: ARTIST-Ext Project

**Objective:** Aerosol retention in the Secondary Side of a Steam Generator.

**Focus:** Implementation of the ARI3SG correlation in MELCOR 2.1:

$$\eta_{TB} = 0.47 \cdot \exp \left[ -0.009 \cdot \left( \frac{Re_p^2}{Stk} \right)^{\frac{1}{2}} \right] \cdot Stk^{\frac{1}{4}}$$

- Scope:**
- "Near field" deposition (break stage)
  - "Dry conditions" (no pool scrubbing)



**ARI3SG**

# 3. PWR: ARTIST-Ext Project

**Spanish PWR: 2614 MWth**  
**3 loops**

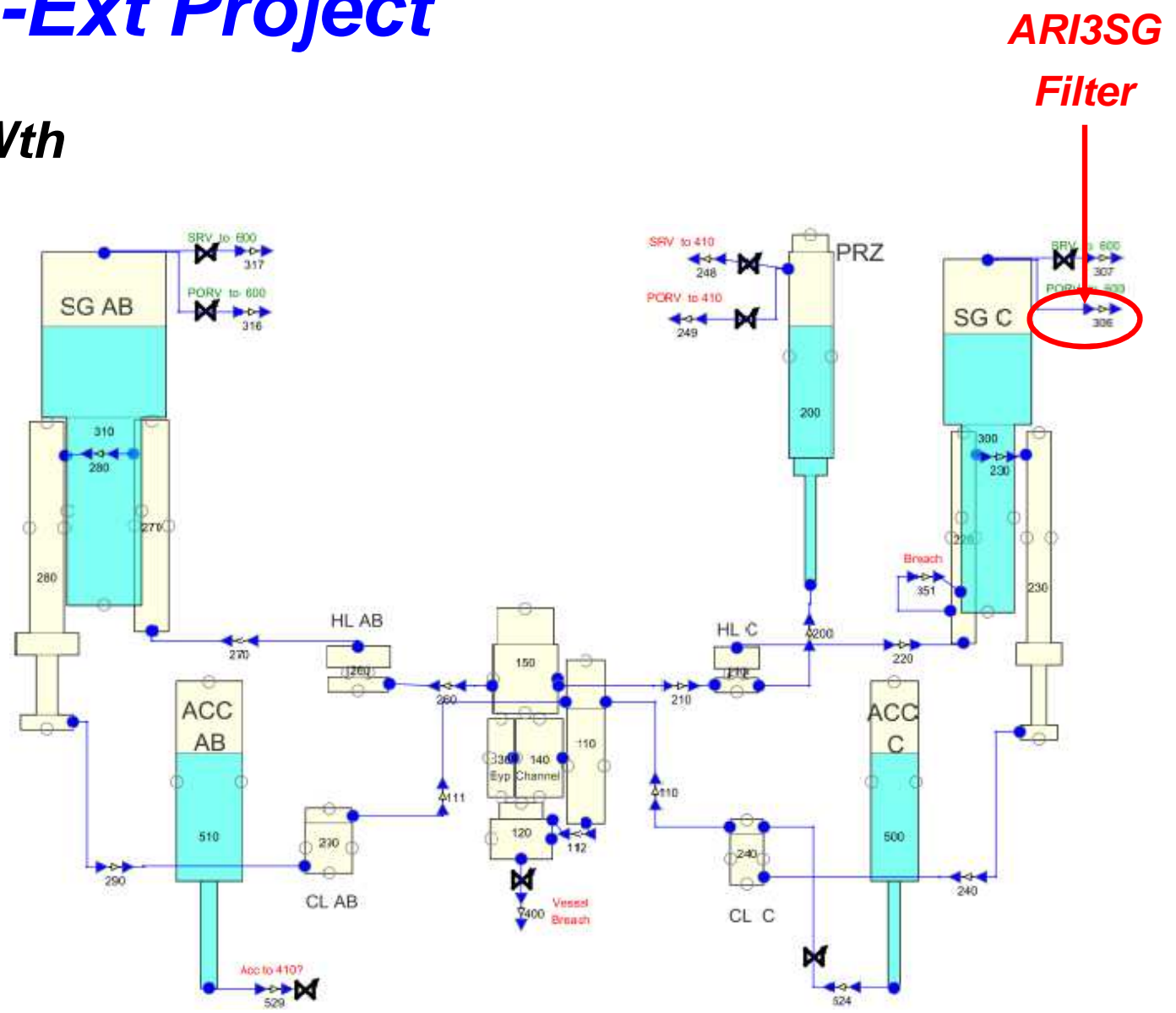
## Scenario:

### SGTR:

- Double-ended rupture SG.
- SG PORV failed Open.
- Bypass sequence.

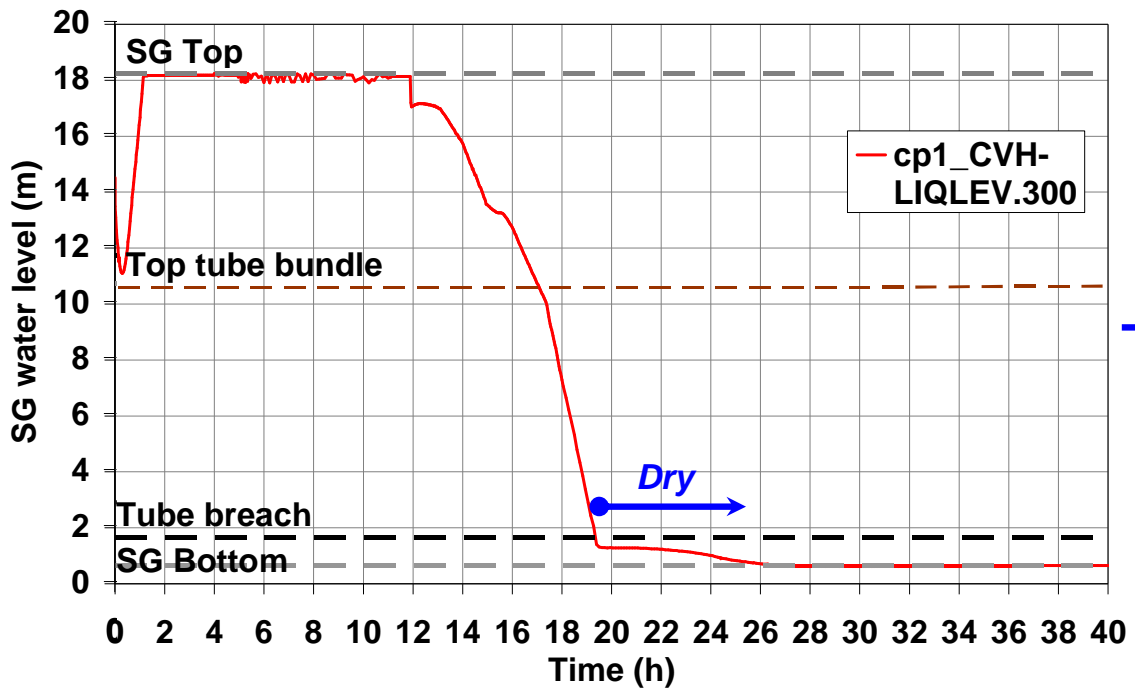
## Approach:

- Filter implementation by Control Function





# 3. PWR: ARTIST-Ext Project



**ONGOING ANALYSES**

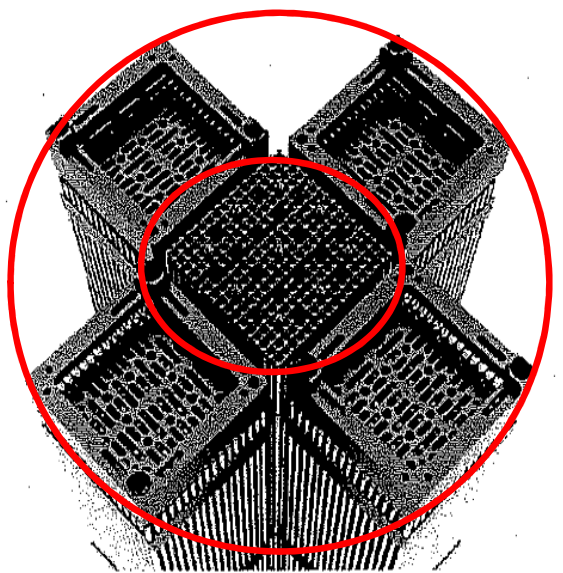


# 4. SFP: OECD-SFP Project

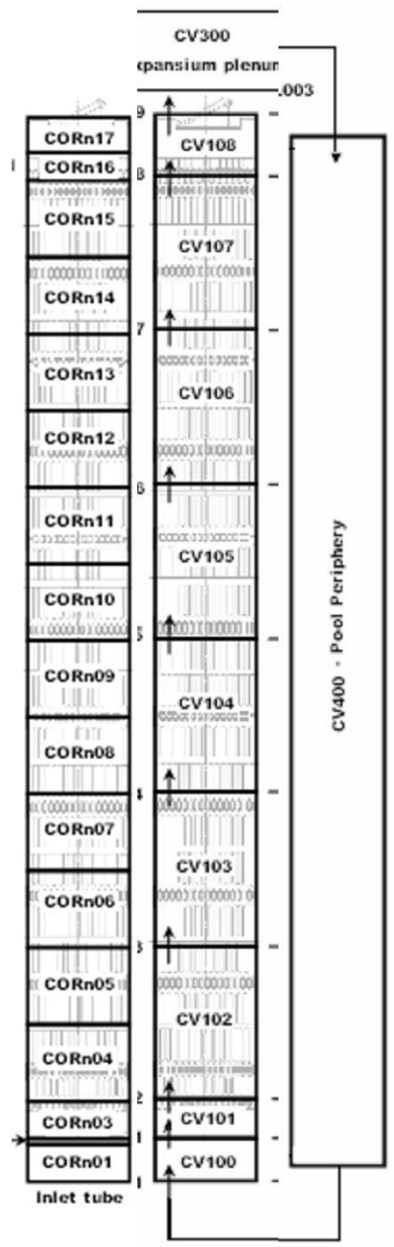
## SFP tests:

- Complete LOCA in SFPools
- BWR/PWR fuel assemblies
- Zr air oxidation leading to cladding ignition

## 2 Scenarios modeled:



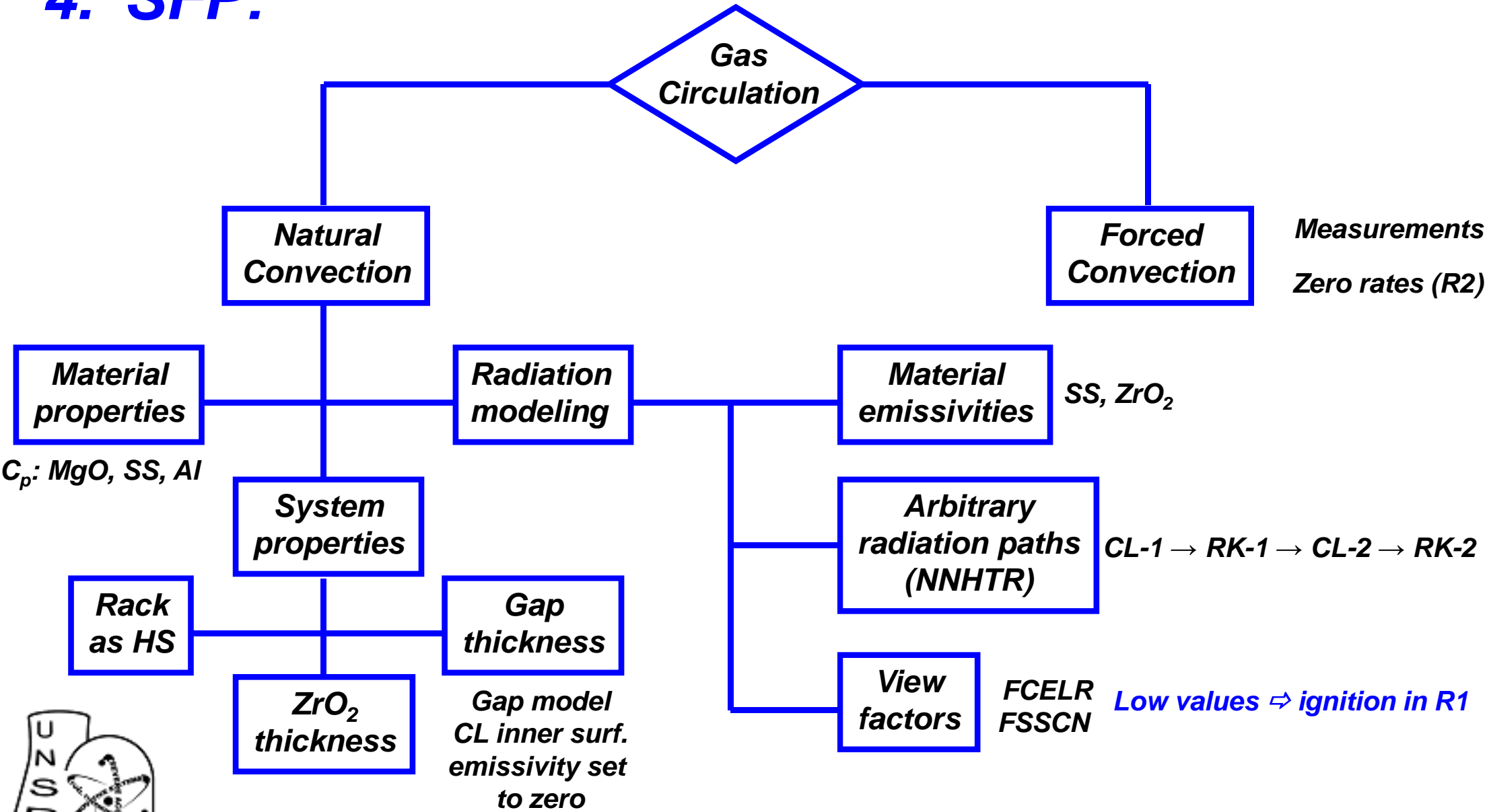
- 1x1
- 1x4



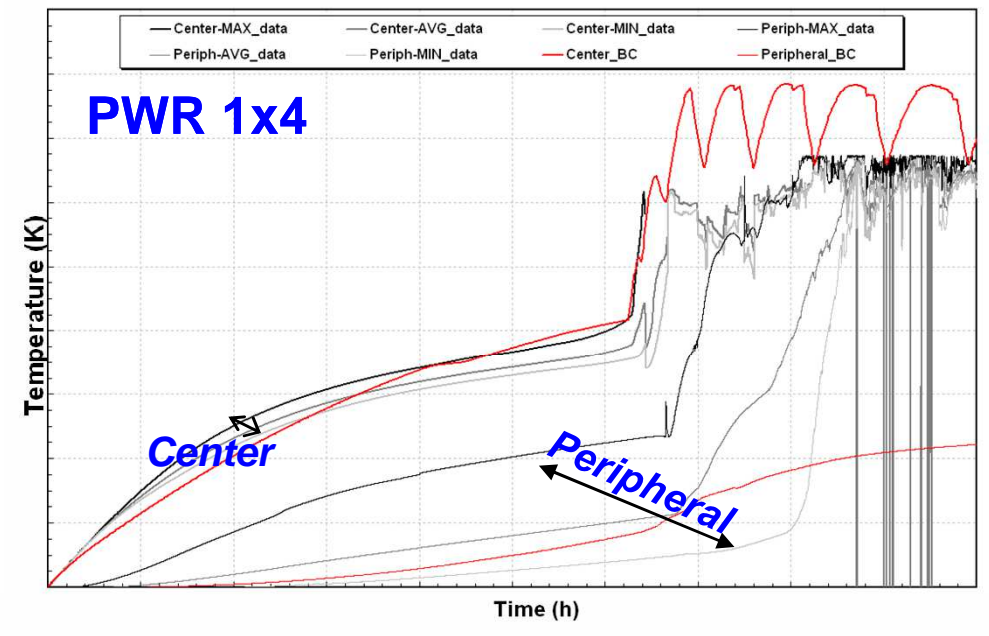
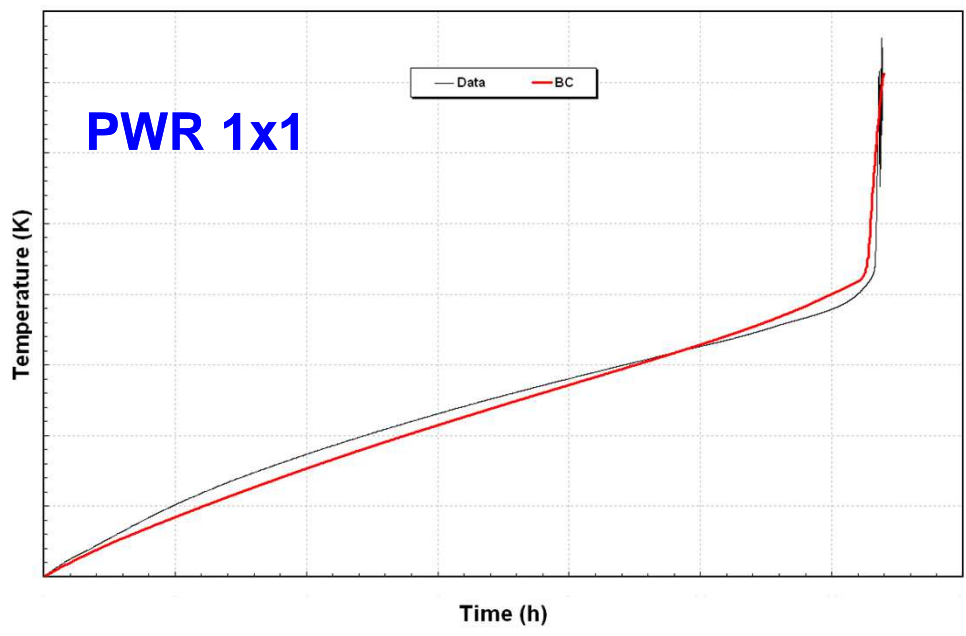
1x1:

# 4. SFP:

## SFP-PWR 1X4



# 4. SFP: OECD-SFP Project



- The ignition onset time well captured.
- Discrepancies on ignition onset location or propagation.

