The Multi-Dimensional Analysis Method Development for Pool of KALIMER-600 using MARS-LMR CODE

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KAIST

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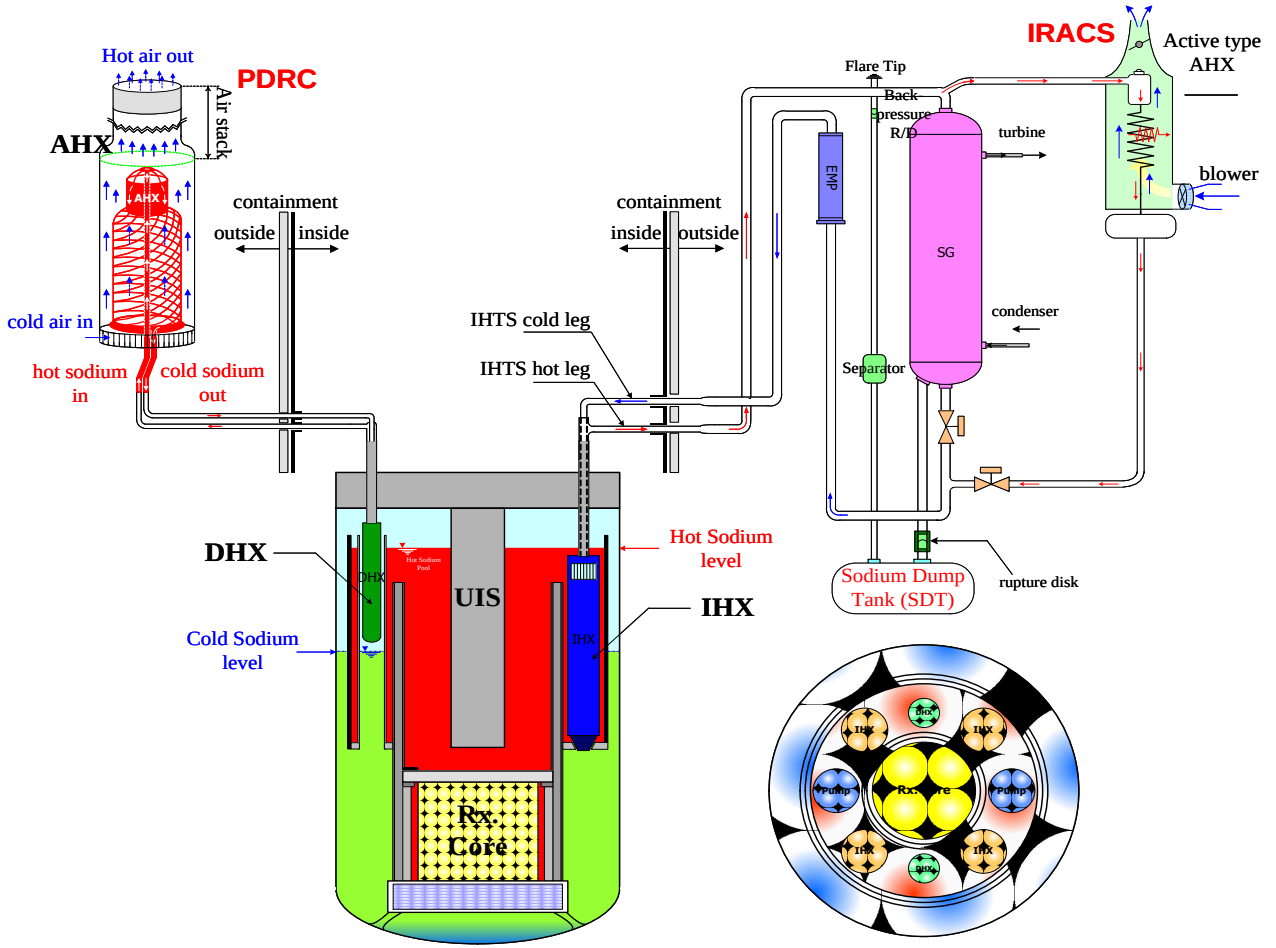
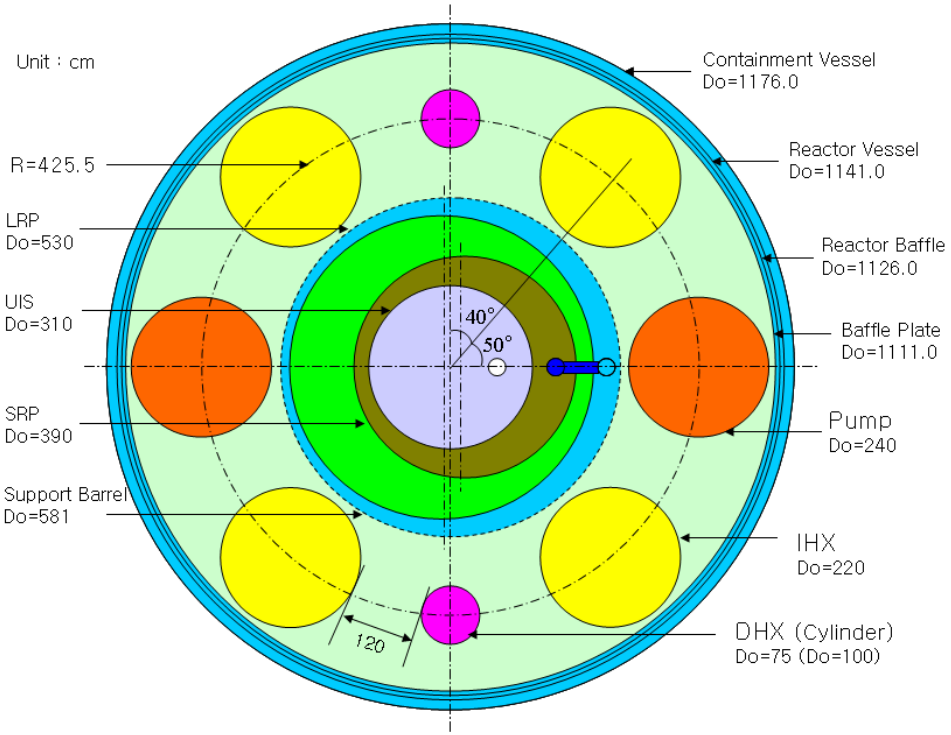
SFR



SFR ***KALIMER-600**

KAIST

SFR



		SFR (KALIMER-600)
Power[th]		1523.4MWt
Power[e]		637.5MWe
Net Eff.		39.4%
Pressure		about 1 atm
IHX Temp.	Inlet	544.8
	Outlet	385.9
IHX		4
PUMP		2
DHX		2

MARS CODE

CODE Structure

- Fortran 90 Modular Type Routine

Analysis Scope

- 1D & Multi-D System Analysis Capability
- COBRA-TF Sub channel analysis Capability

Coupling with other functional code(DLL)

- 3D Kinetics Code : MASTER and COREDAX
- Containment Code : CONTAIN & CONTEMP
- Severe Accident Code : MIDAS

Graphical User Interface

Support New models

- GEN-IV

MARS CODE

$$\frac{\partial}{\partial t}(\alpha_v \rho_v) + \frac{\partial}{\partial z}(\alpha_v \rho_v v_v) = \Gamma_{iv}$$

$$\frac{\partial}{\partial t}(\alpha_l \rho_l) + \frac{\partial}{\partial z}(\alpha_l \rho_l v_l) = \Gamma_{il}$$

$$\Gamma_{iv} = -\Gamma_{il}$$

$$F_{iv} = -F_{il}$$

$$Q_{iv} = -Q_{il}$$

$$\alpha_v \rho_v \frac{\partial v_v}{\partial t} + \alpha_v \rho_v v_v \frac{\partial v_v}{\partial z} = -\alpha_v \frac{\partial P}{\partial z} + \alpha_v \rho_v B_z - F_{VM} - F_{iv} - F_{Wv} + \Gamma_{iv} v_v$$

$$\alpha_v \rho_l \frac{\partial v_l}{\partial t} + \alpha_l \rho_l v_l \frac{\partial v_l}{\partial z} = -\alpha_l \frac{\partial P}{\partial z} + \alpha_l \rho_l B_z + F_{VM} - F_{il} - F_{Wl} + \Gamma_{il} v_l$$

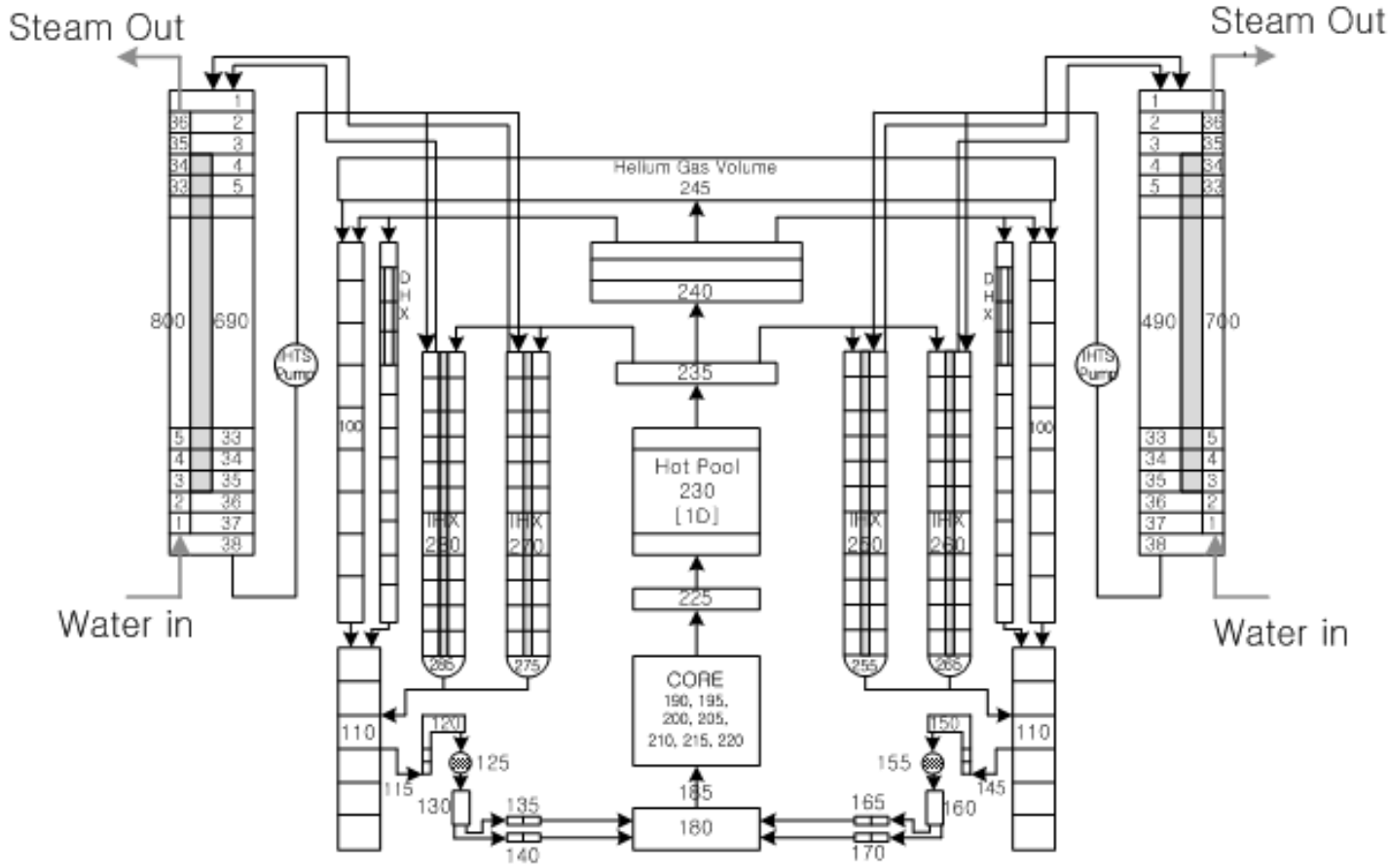
$$\frac{\partial}{\partial t}(\alpha_v \rho_v U_v) + \frac{\partial}{\partial z}(\alpha_v \rho_v U_v v_v) = -P \frac{\partial \alpha_v}{\partial t} - P \frac{\partial}{\partial z}(\alpha_v v_v) + q_{Wv} + Q_{iv} + DISS_v$$

$$\frac{\partial}{\partial t}(\alpha_l \rho_l U_l) + \frac{\partial}{\partial z}(\alpha_l \rho_l U_l v_l) = -P \frac{\partial \alpha_l}{\partial t} - P \frac{\partial}{\partial z}(\alpha_l v_l) + q_{Wl} + Q_{il} + DISS_l$$

$$\frac{\partial}{\partial t}(\alpha_v \rho_v X_n) + \frac{\partial}{\partial z}(\alpha_v \rho_v X_n v_v) = 0$$

$$\frac{\partial \rho_B}{\partial t} + \frac{\partial}{\partial z}(\rho_B v_l) = 0$$

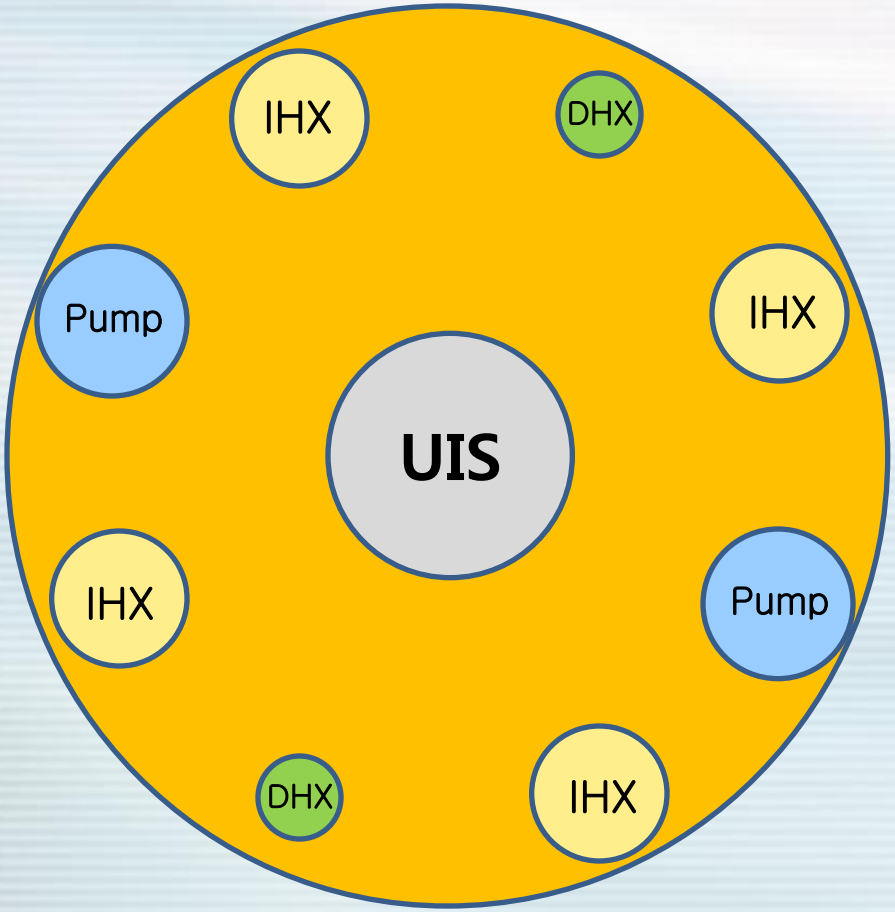
Multi-D Modeling

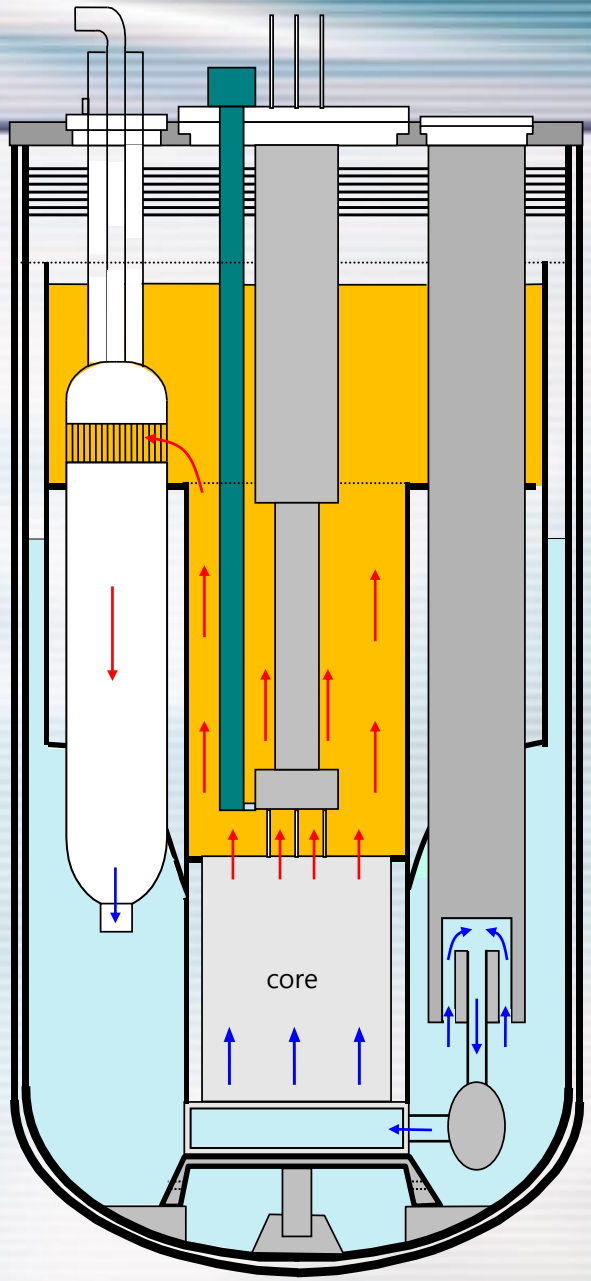


Multi-D Modeling

- **Development of Multi-Dimensional Analysis**
- **Evaluation of whole SFR System with MARS**
- **Hot Pool Coolant Temp. Distribution**
- **Pressure, Velocity & Flow direction**
- **More Accurate Evaluation of Safety**

Multi-D Modeling





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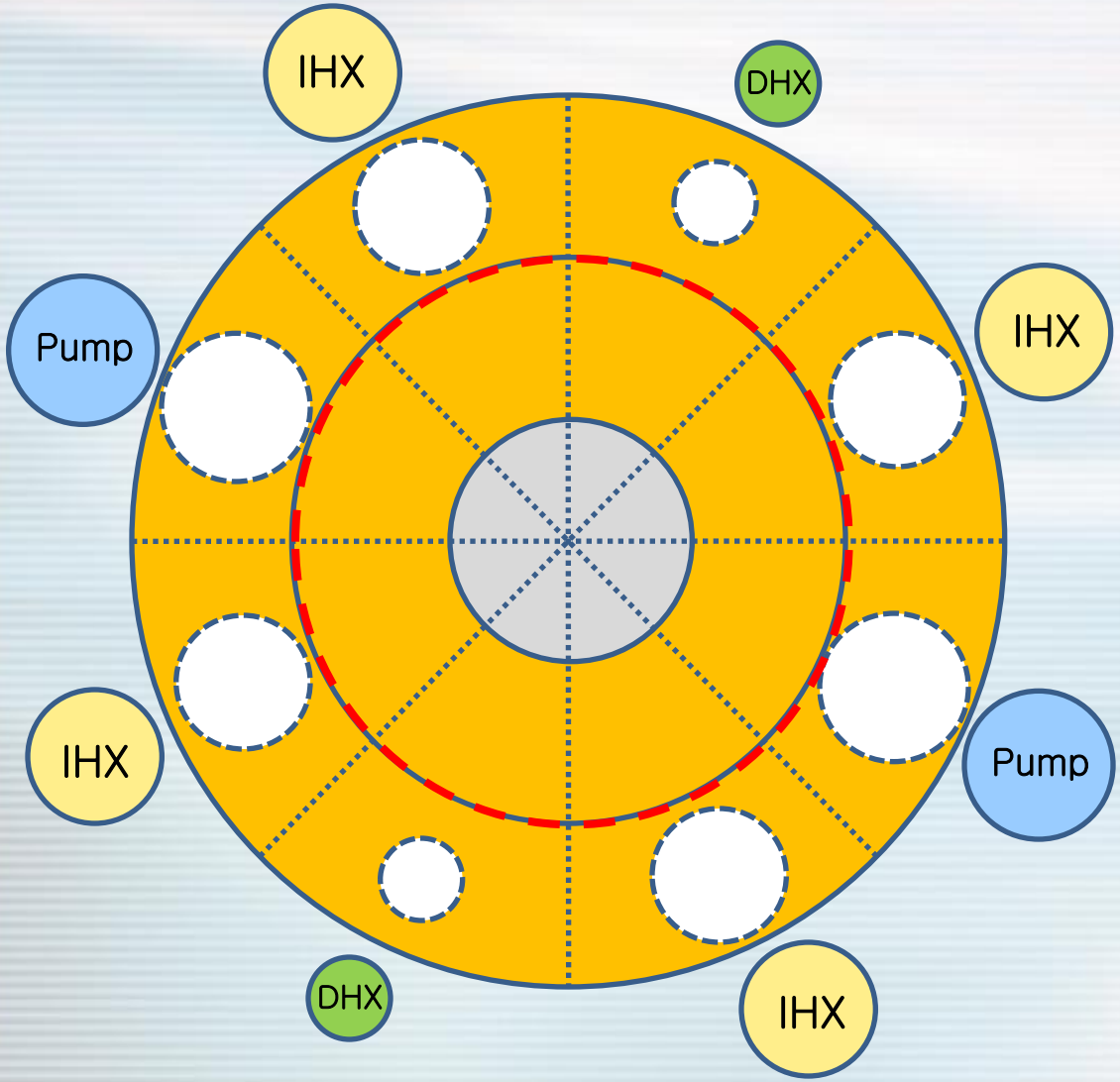

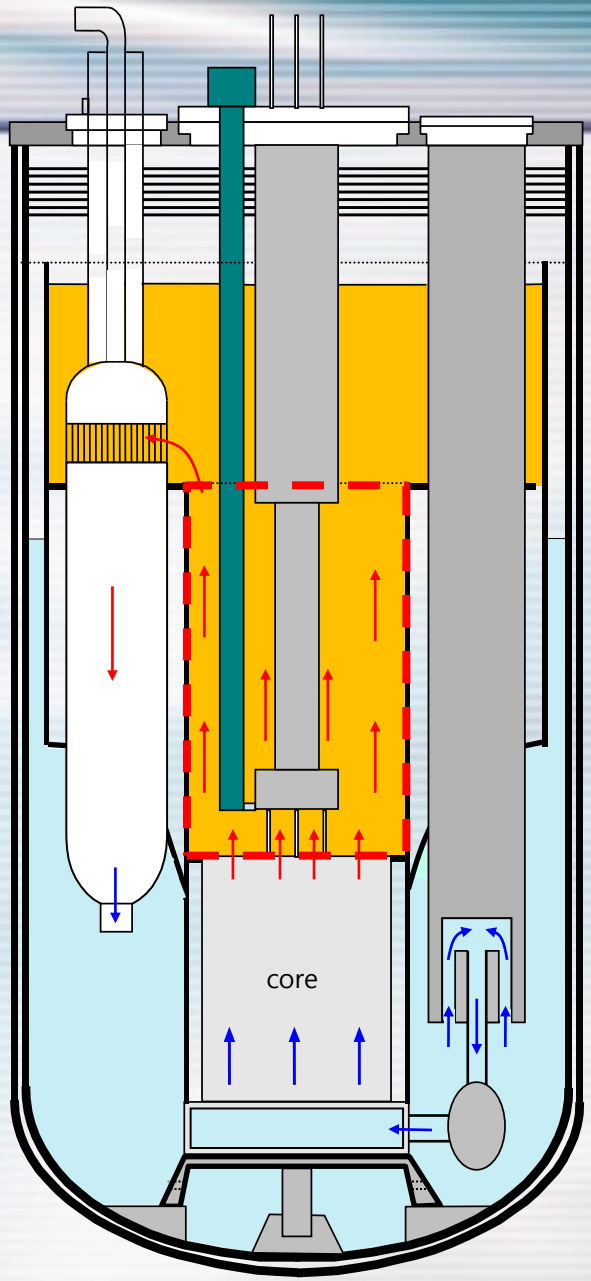

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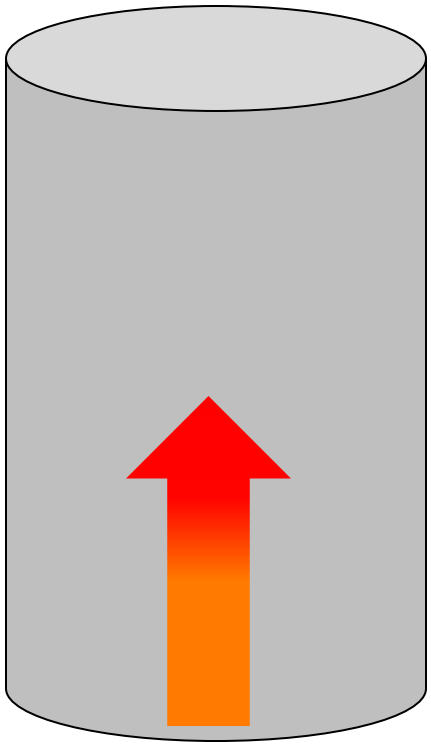
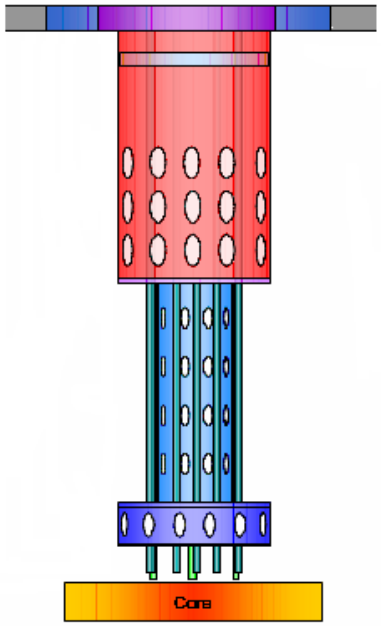
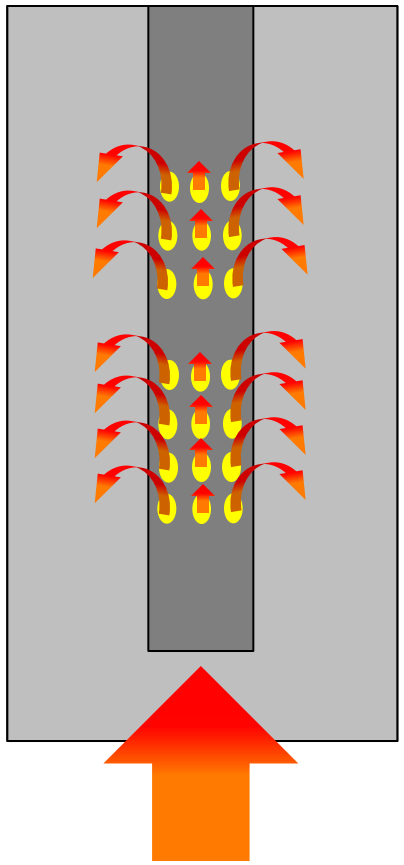






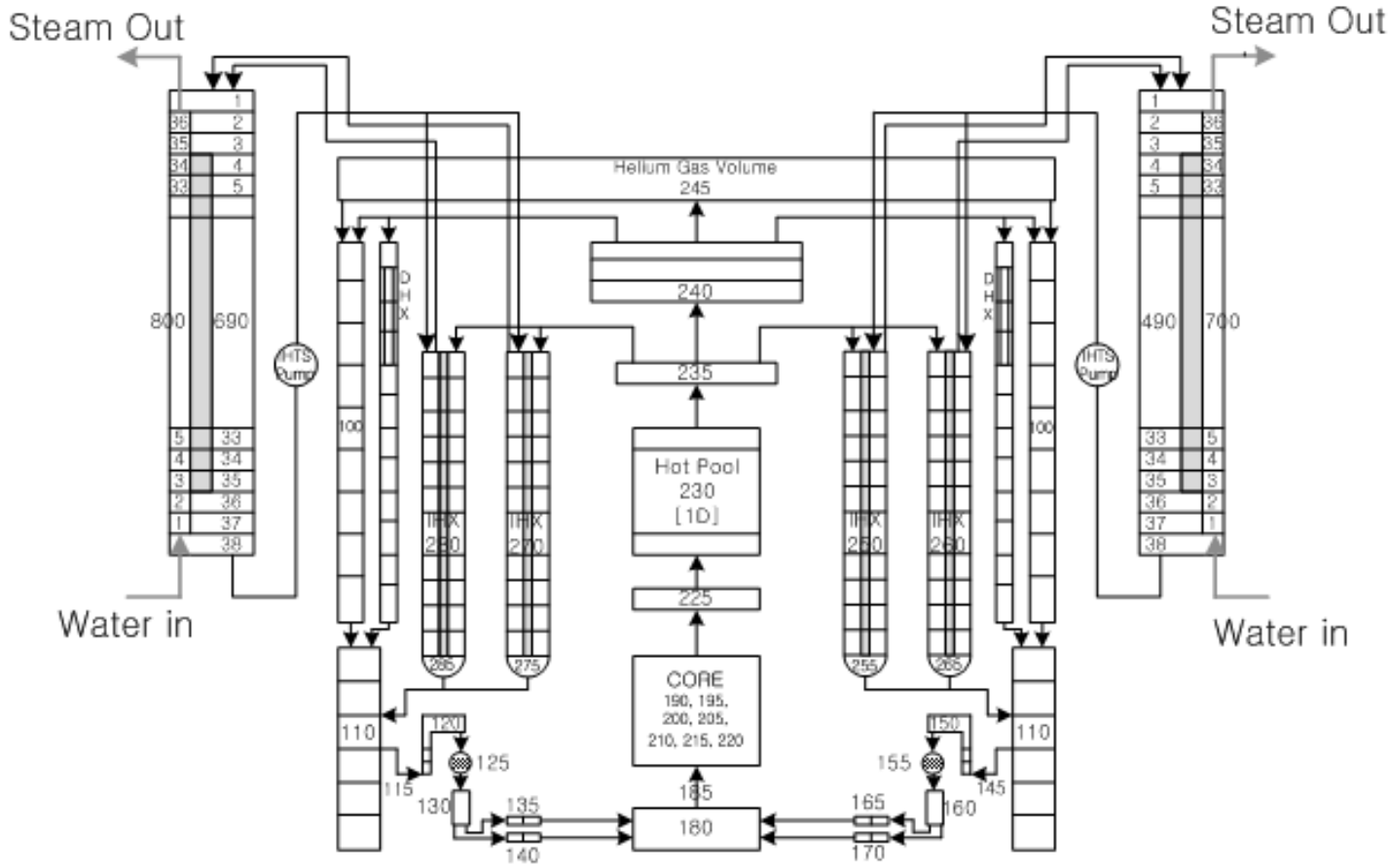
Multi-D Modeling

Angle	[°]
θ	45°

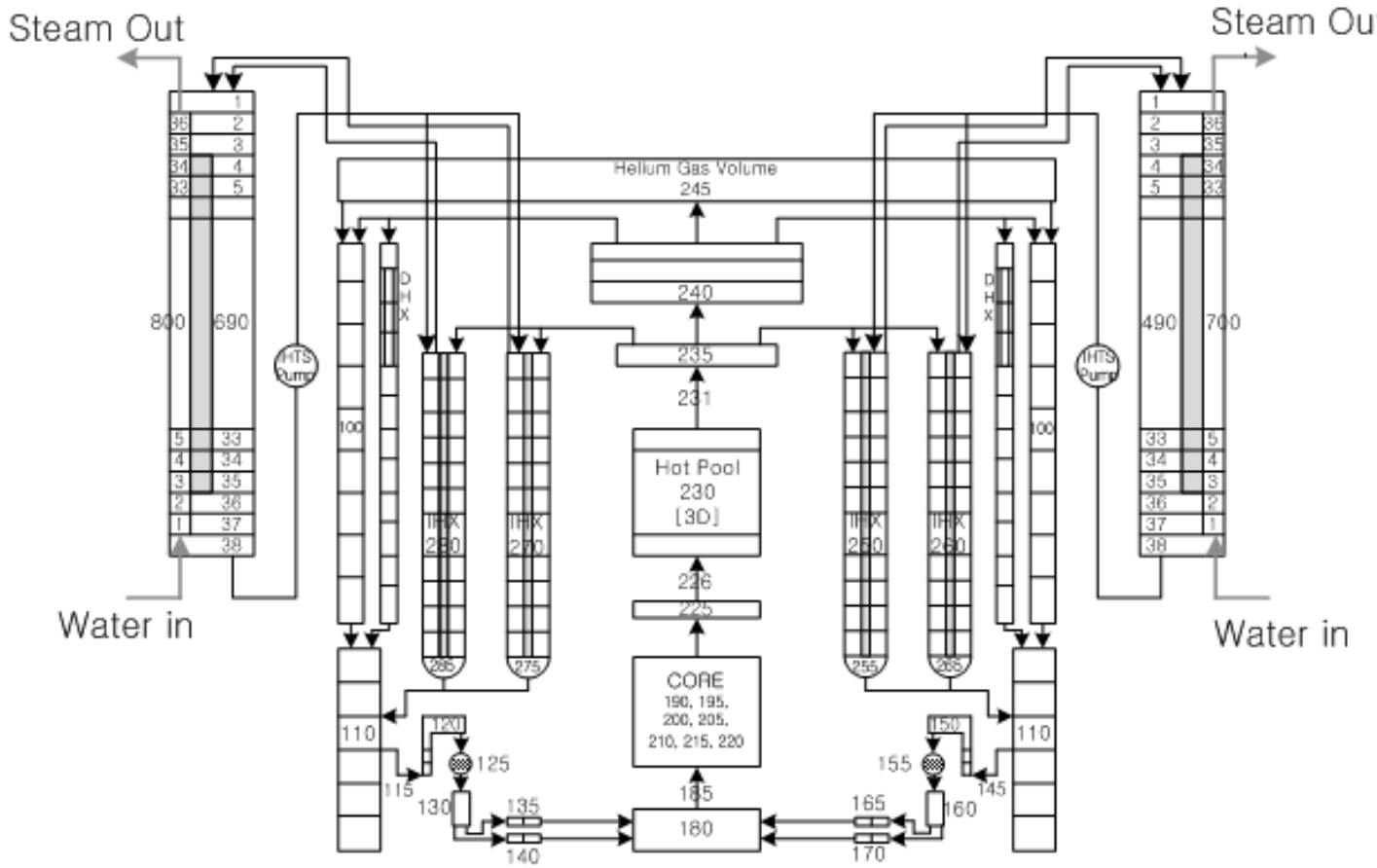
Height	[m]
Z_7	0.3
Z_6	0.67
Z_5	0.795985
Z_4	0.795985
Z_3	0.795985
Z_2	0.795985
Z_1	0.795985

Radius	[m]
R_1	0.6→1.5
R_2	1.6→1.0
R_3	0.8→0.32

Multi-D Modeling

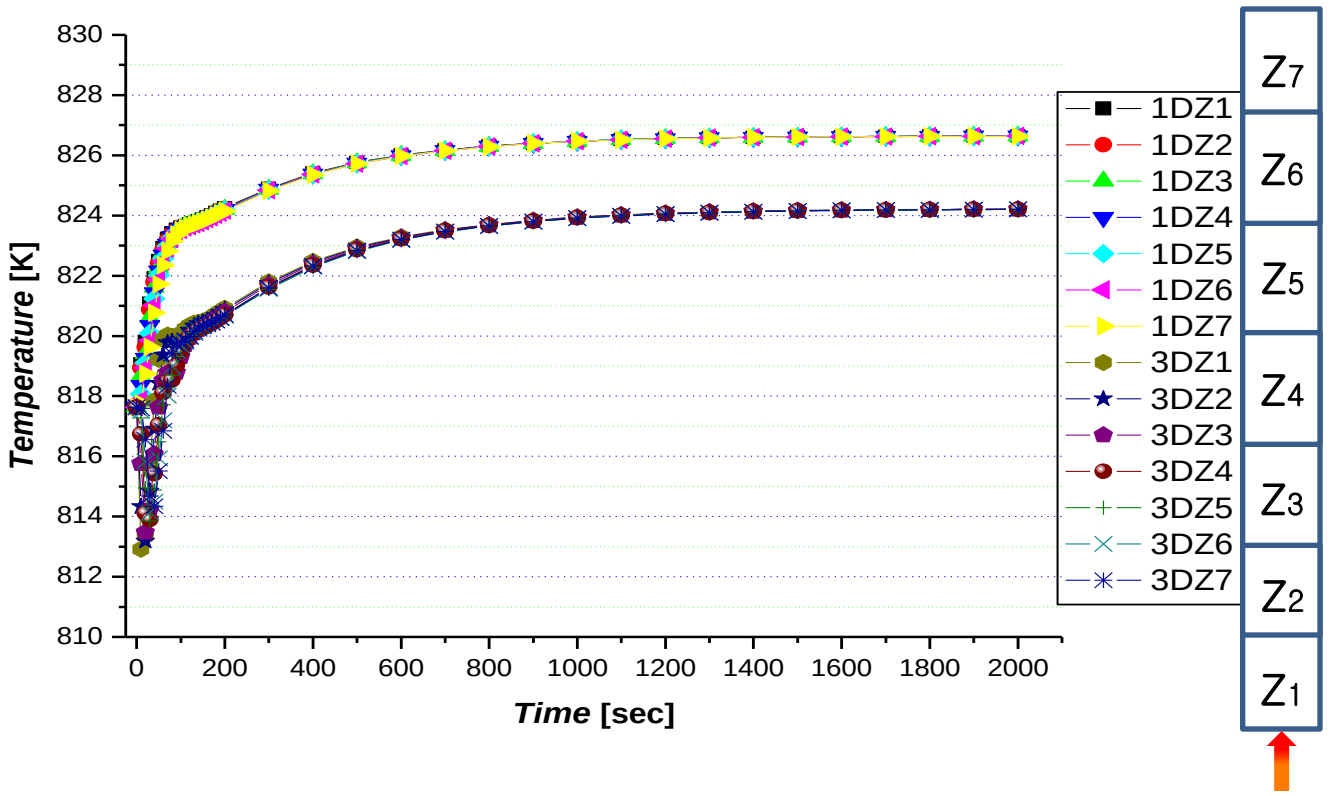


Multi-D Modeling



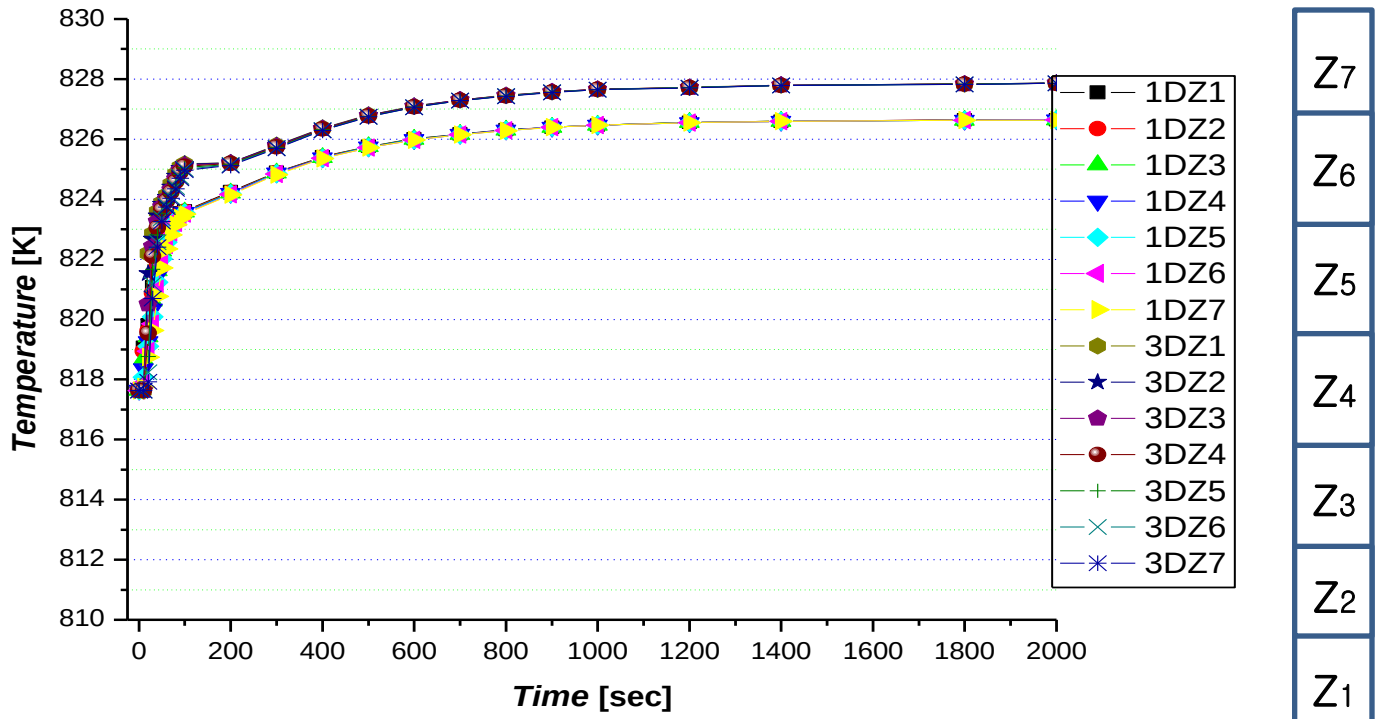
Result

Temp-Pre



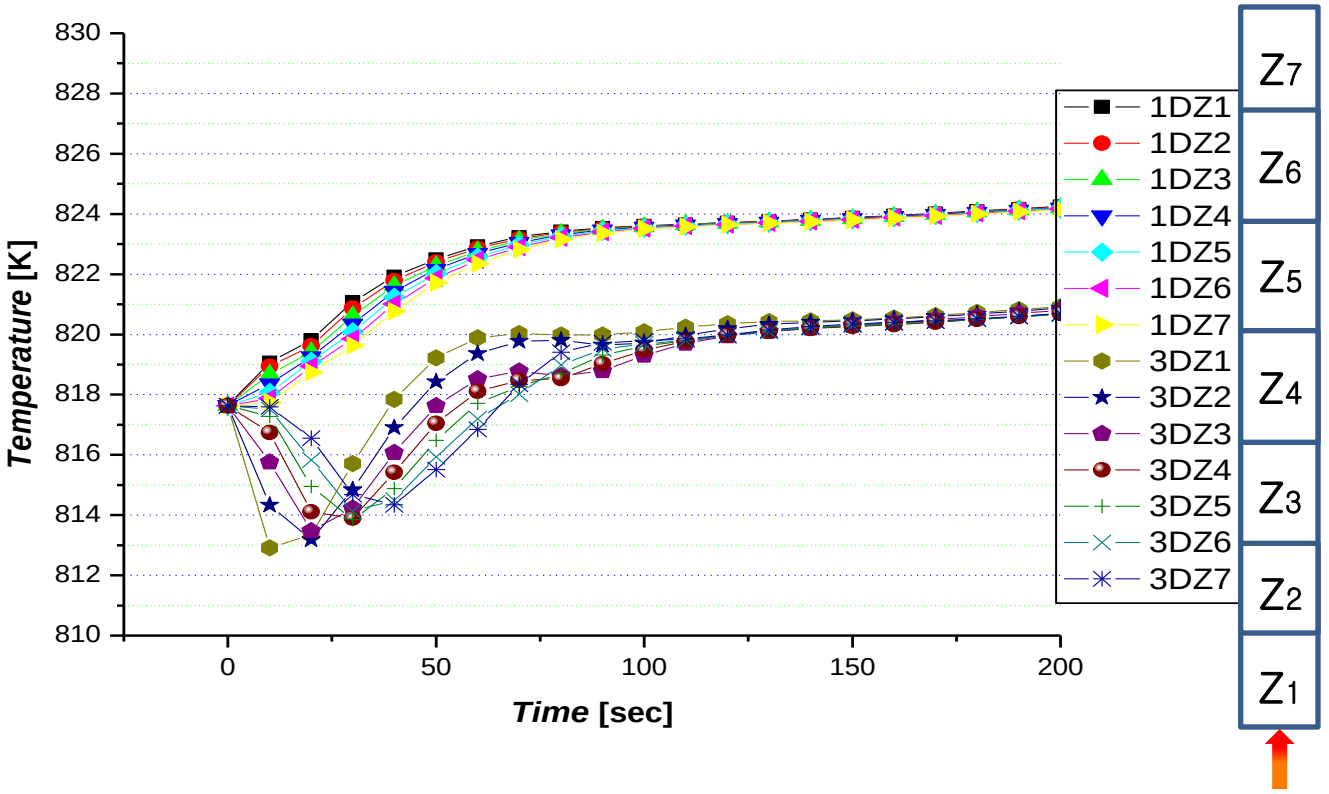
Result

Temperature



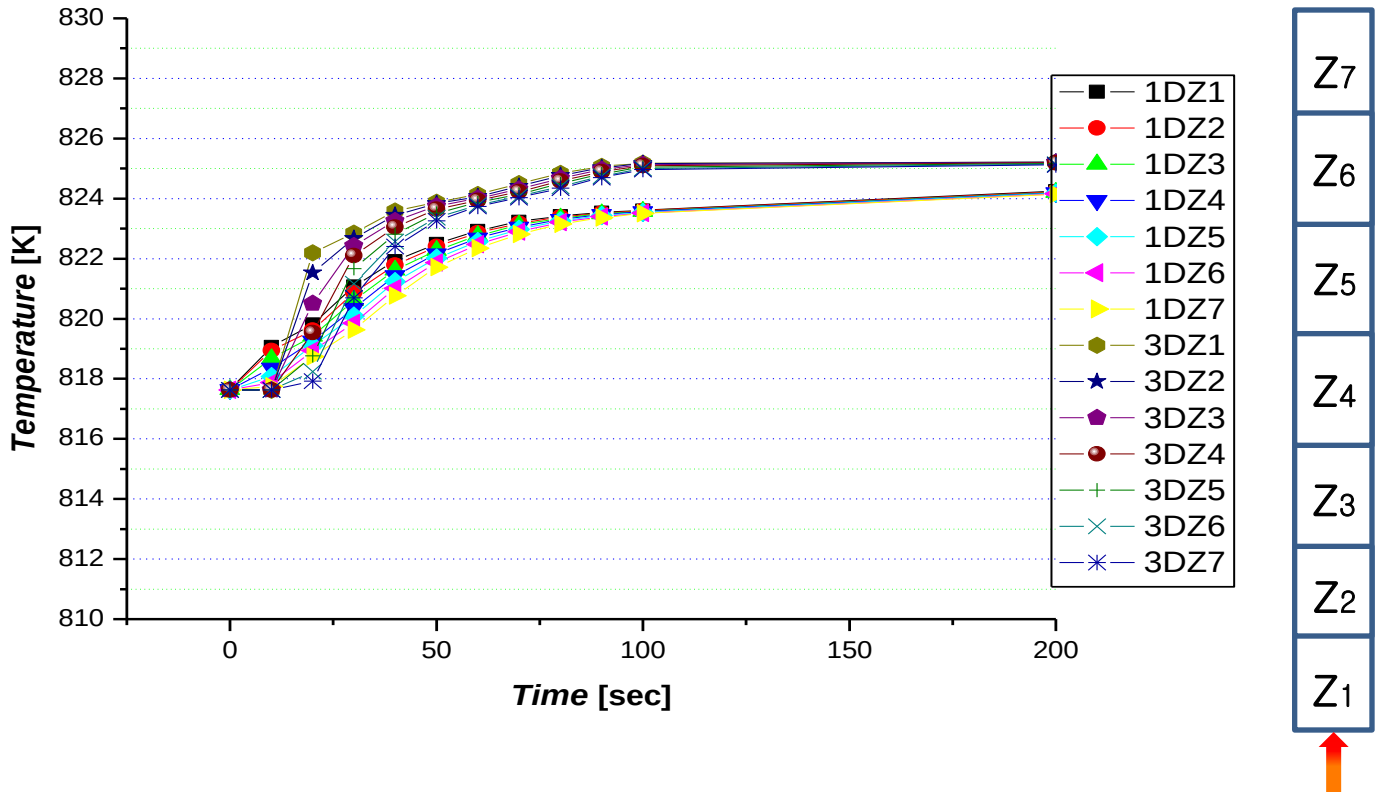
Result

Temp-Pre



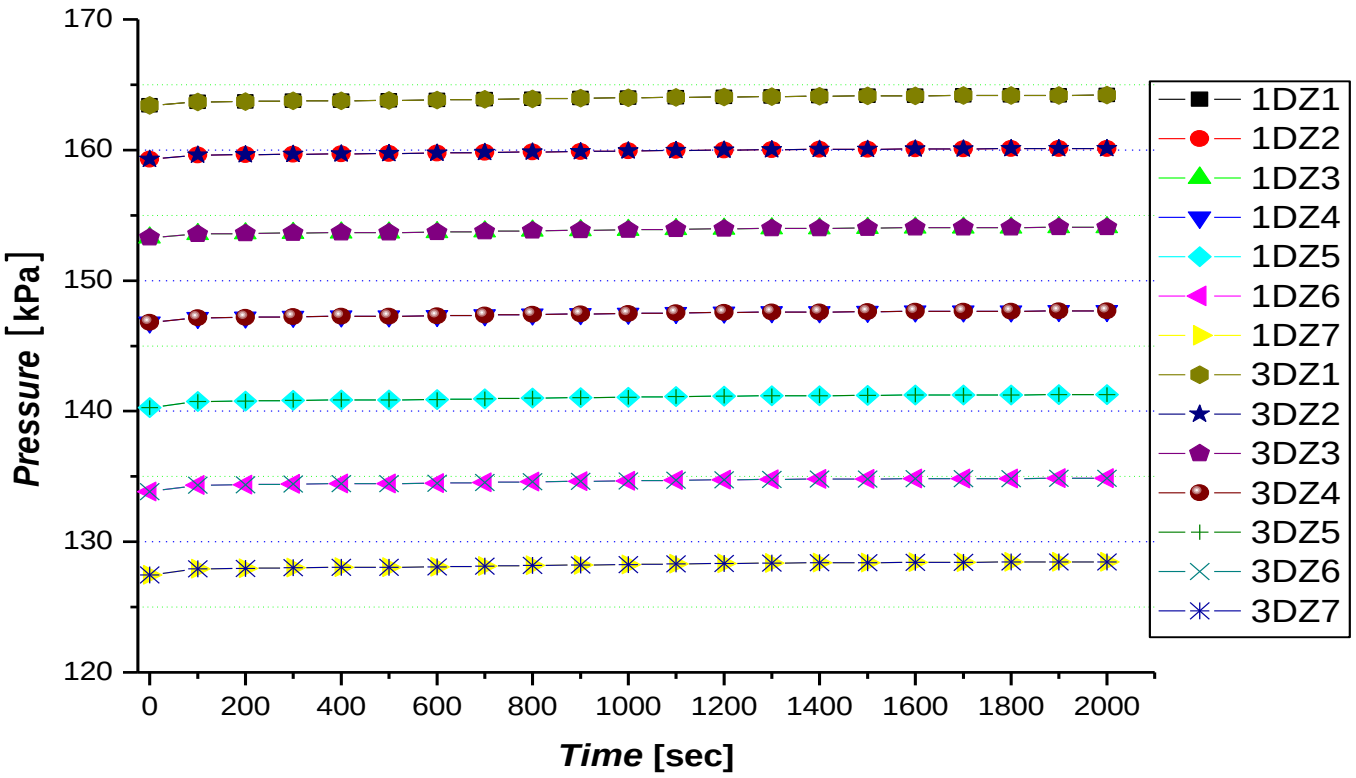
Result

Temperature



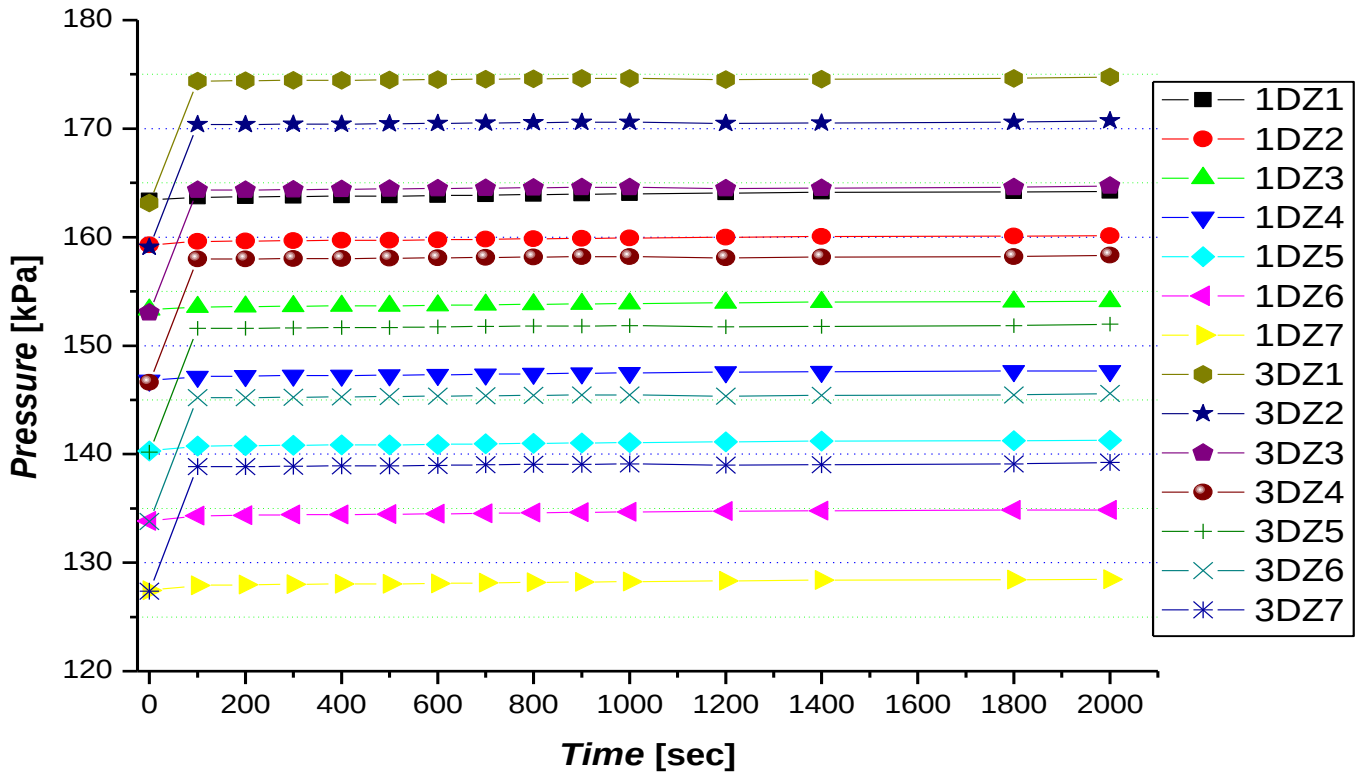
Result

Pres.-Pre



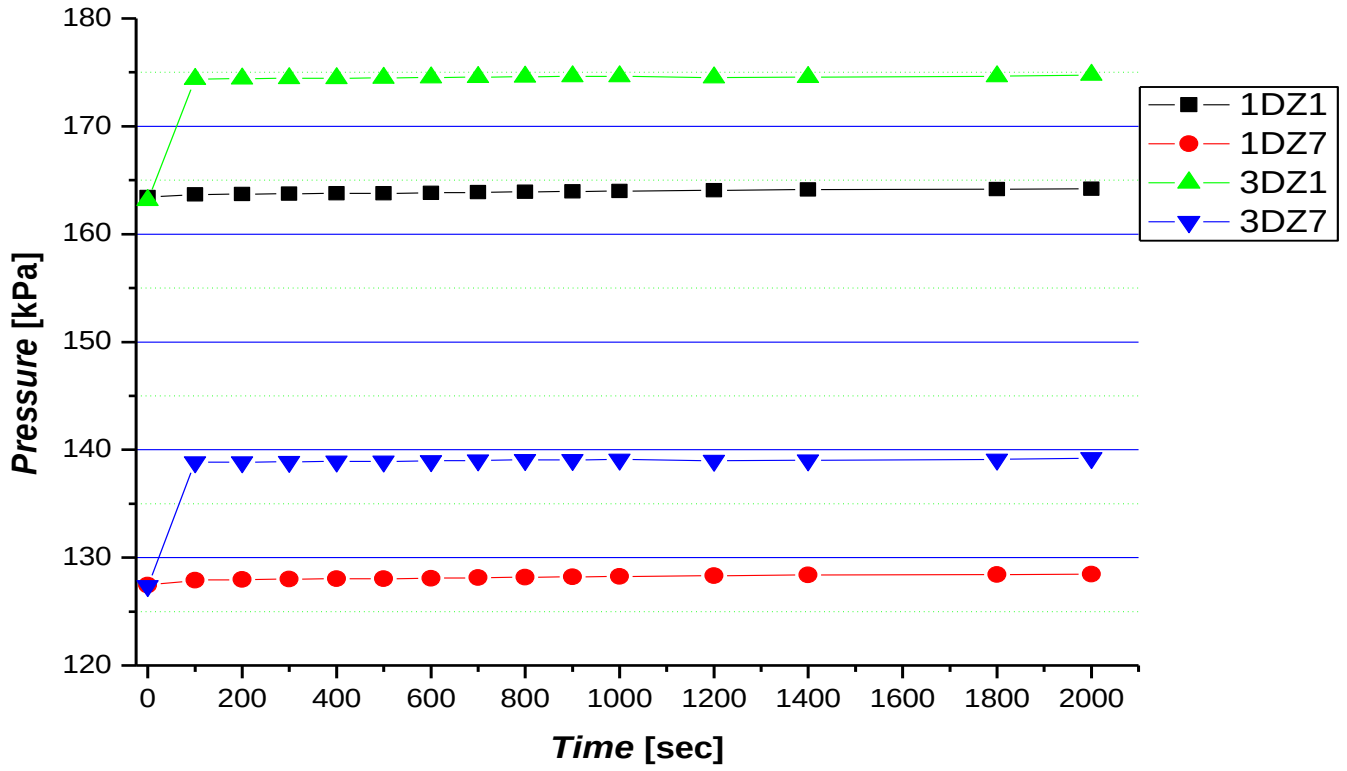
Result

Pressure



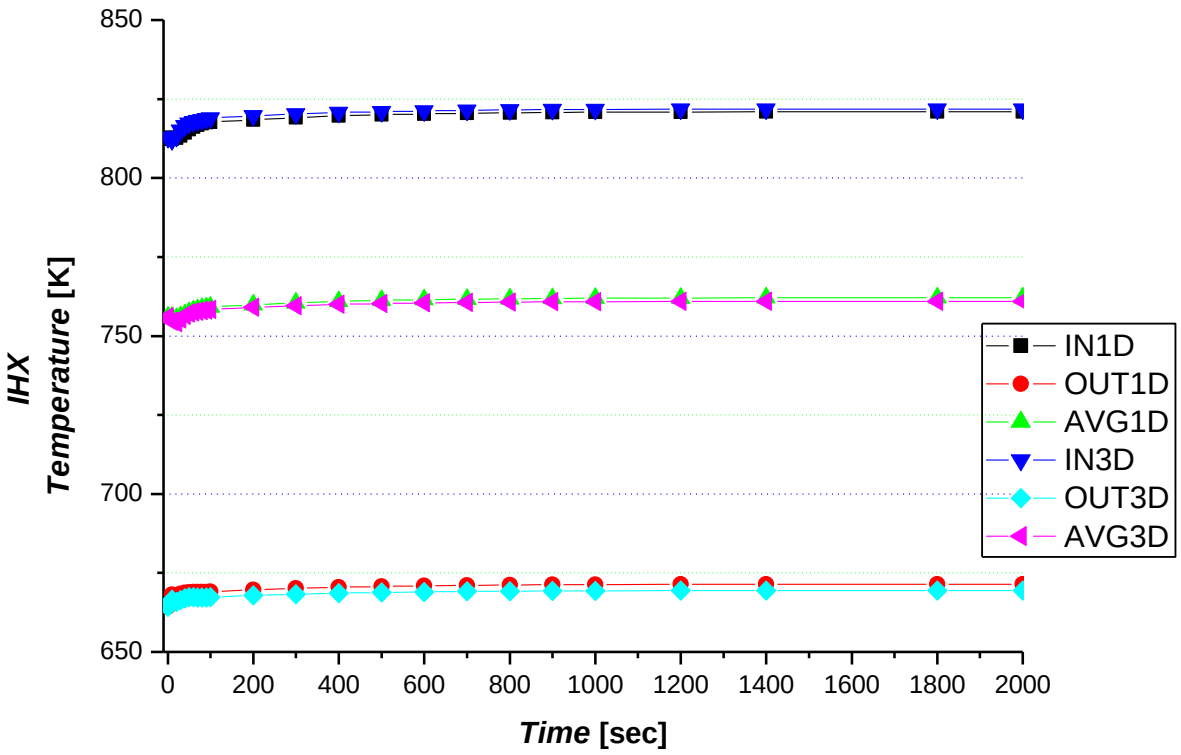
Result

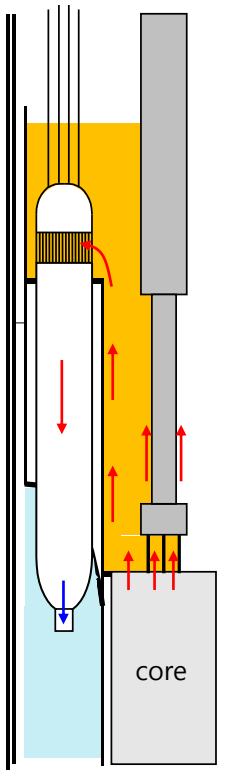
Pressure



Result

IHX


IHX
Temperature [K]
850
800
750
700
650
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Time [sec]
IN1D
OUT1D
AVG1D
IN3D
OUT3D
AVG3D


core

Discussion

- Replace to 3D Hot pool & Consideration of UIS
- Temperature, Pressure and flow distribution
- Study about Multi-D of MARS CODE

○ Modify to One Hot pool model

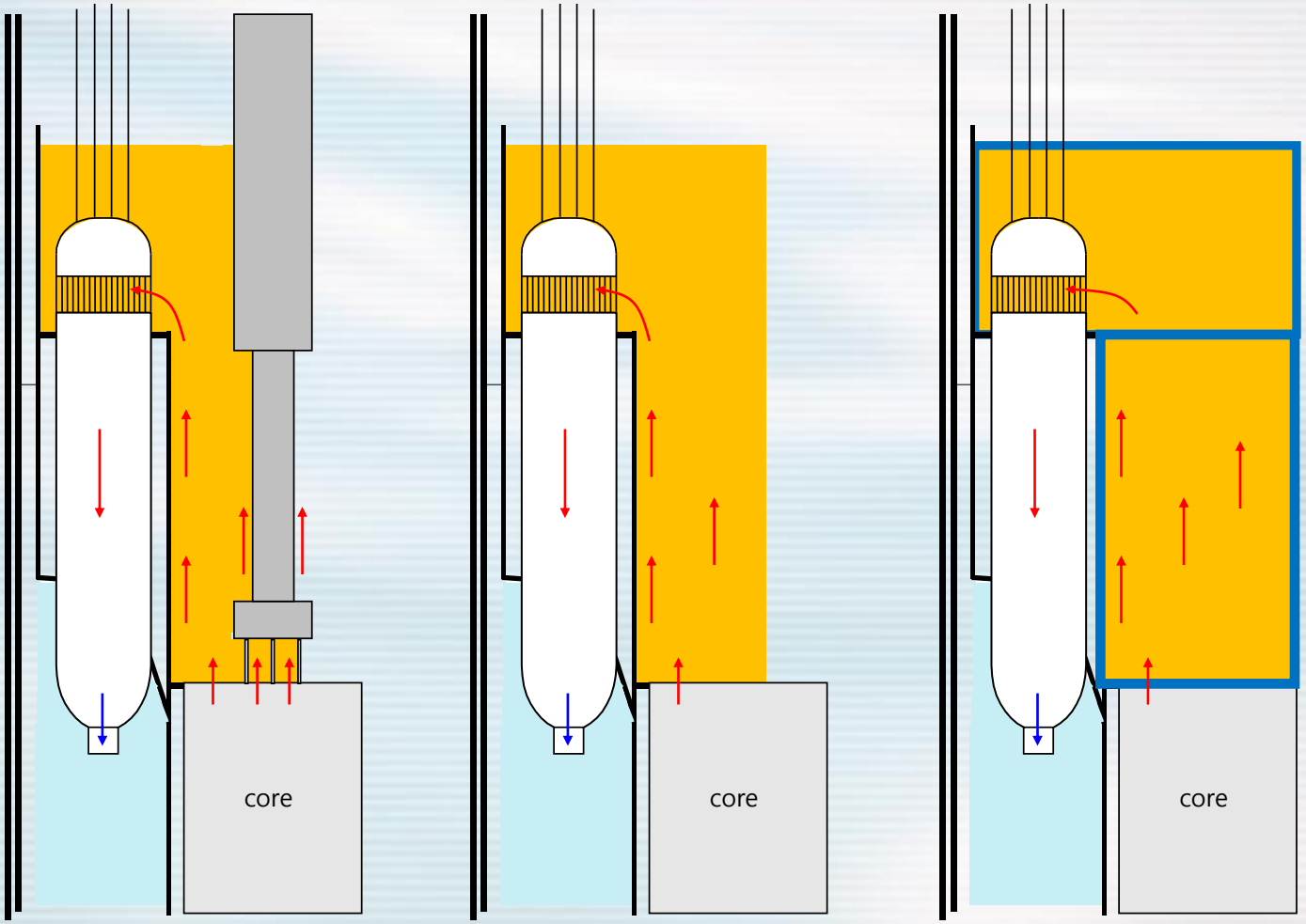
○ Analysis of Transient condition

→ UTOP (Unprotected Transient OverPower events)

→ ULOF (Unprotected Loss of Flow)

→ ULOHS (Unprotected Loss of Heat Sink events)
(Loss of the intermediate Loop)

Discussion



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Thank you for your attention