8. Scaling of IET(Integral Effect Test)

: Semiscale, LOBI, SPES, BETHY, LSTF.

- full height
- maximum power : volume scaled reduction.
- decay power = 10%
  ∴ prevent correctly scaled temperatures and flow rates is nominal conditions.
- preserve T_{H} during steady state operation and T [illegible]
- higher pressure than the reference nominal value.
- less maximum allowable flow rate of RCP
- $L/\sqrt{D}$ scaling by Zuber for HL and CL piping in SPES, BETHSY and LSTF volume scaling.

Quantity	Semiscale Mod 2A	Lobi Mod 2	Spes	PKL	Bethsy	LSTF	Doel
1 Reference reactor	W PWR	KWU PWR	W PWR	KWU PWR	FRA PWR	W PWR	W PWR
and power [MW]	3411	3830	2775	3900	2700	3423	1187
2 Maximum power [MW] % of nominal power	2.0 10.0	5.4 10.0	9.0 13.8	2.5 10	3.0 10	10.0 14	11.873 10.0
3 Reported K_{v} [illegible]	1/1705	1/712	1/427	1/124	1/100	1/48	1/1
4 Number of rods	25	64	97	340	428	1064	21300
5 Maximum pressure of primary loop $[MP_{a}]$	15.5	15.5	20.0	4.0	17.2	16.00	15.5
6 Maximum pressure of secondary loop $[MP_{a}]$	6.9	10.0	10.0	5.6	8.0	7.3	5.88
7 Primary loop volume $[m^{3}]$	0.162	0.6	0.522	2.4	2.88	8.3	168.5
8 Number of U tubes for steam generators	2/6	8/24	12/13/13	30/30/30	34/34/34	141/141	3260/3260
9 Internal diameter of U tube [mm]	19.7	19.6	15.4	19.0	19.7	19.6	19.6
10 L/D ratio of Hot Leg[e]	117/249	73.1/119.1	37.2	n.a	38	17.8	10.64
11 Total length "a" in fig. 1[a] [m]	1.58 1.53	16.73 16.47	16.08 15.91	n.a	18.31 16.87	18.4 16.9	14.7^{d}
12 Linear rod power at 5% overall power[b] [kW/m]	1.00	1.08	1.27^{d}	1.00	0.96	0.91	1.12
13 Actual K_{v}[c]	1/2045	1/827	1/630	1/172	1/141	1/48	1/1.5

a Maximum and minimum value.

b The 5% value is the power related to the reported Kv.

c To compensate heat losses.

e Mean value

Table 1 Relevant characteristics of PWR simulators considered

- The slight difference in the elevation of 2 hot legs due to different diameters affect the time of appearance of voids
  - ∴ differences in the behavior of loops especially in the two phase national circulation period.
- experimental results　　　　Figure 8
- code simulation by RELAP　　Figures 10 - 13
- scaling analysis

  From a simplified scaling law,

$$Q_{LO} = \left[\frac{g\beta}{\rho_{LO} C_P} \frac{W_{CO}}{N}(L_{th} + L_{UT}/2) \Big/ \left[\sum_i \frac{f_i}{A_i}\frac{L_i}{D_i} + \sum_i \frac{K_i}{A_i^2}\right]\right]^{1/3}$$

  where W: power , CO : core , LO : loop , UT : u tube

  For $L/\sqrt{D}$ scaling or volume scaling in hot leg,

  i) hot leg volume scaling

$$Q_{LO} = \left[\frac{C_1 C_2 W_{REF} K_v^2 / N}{\frac{C_3}{A^2_{HL,REF}}\frac{L}{D} + C_7\frac{C_5}{A^2_{ST,REF}} + \frac{C_4}{A^2_{CO,REF}} + C_6}\right]^{1/3} \quad (7.34)$$

  ii) hot leg $L/\sqrt{D}$ scaling

$$Q_{LO} = \left[\frac{C_1 C_2 K_v^2 W_{REF} / N}{\frac{C_3 K_v^{0.5}}{A^2_{HL,REF}}\frac{L}{D} + C_7\frac{C_5}{A^2_{ST,REF}} + \frac{C_4}{A^2_{CO,REF}} + C_6}\right]^{1/3} \quad (7.35)$$

- Obtain "ideal or extrapolated value with tubing the LSTF valances as a reference Eqs. (7.34) and (7.35) and compare with experimental and code calculated values.

  ⟶　　그림

- For two phase national circulation, take the available experimental data base as a reference .
- Extrapolation of the reference trend.

  ⟶　　Fig. 27

  Dashed area constitutes the envelope of the curves obtained by the following methods.

  1 By multiplying the LSTF related curries by the volume scaling factor

  2 By considering the reduction of the peak flow rate when in creasing the dimensions

  3 By considering the uncertainty which comes from the different L/D is LSTF and real plant

  4 By considering the effect of reduced core height.

  ⟶　obtained from the evaluation of the effects of relevant parameters on G.