SSF
Test of Pressure Loss Characteristics of the SSF Fuel Assembly

,　　,　　,　　,

150

SSF

55-　　SSF　　　　　　　　　　　　　　　　　　　　　　　　　　　.

.　　　　　　　　　　　　　　　　　　　　　　　　　　　　.

180~38,000　　　,

500~32,200　　　　　　　　　　　　　　　0~7%,　　　　　　0~51%　　.

SSF　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　.

4

.

.

Abstract

A series of tests were conducted on 55-rods SSF fuel assembly to investigate the pressure loss characteristics of an assembly of SSF fuel rods. The tests were conducted on the bundle pressure loss and the assembly inlet orifice pressure loss respectively. For the rod bundle, single- and two-phase pressure loss measurements were performed. The single-phase tests were performed varying Reynolds number from 180 to 38,000, and the two phase tests were performed from 500 to 32,200 while air quality is to 7% and air void fraction to 51%. The single phase rod bundle friction factor and the two phase rod bundle friction multiplier were evaluated. For the assembly inlet orifice, pressure loss tests were also performed varying 4 different disk plates. The pressure loss coefficients of the assembly inlet orifice were evaluated as a function of flow blockage ratios.

1.

SMART-P   .

,

.

.

.

.

SSF(Self-sustained Square Finned)   .   SSF

,

.   SSF

.   SSF

.

SSF

55-   SSF

.

55-   SSF

,   SSF

.

.   4

(0,   24,   28,   32mm;   0,   6.9,   24.3,

46.3%)   ,

.

2.

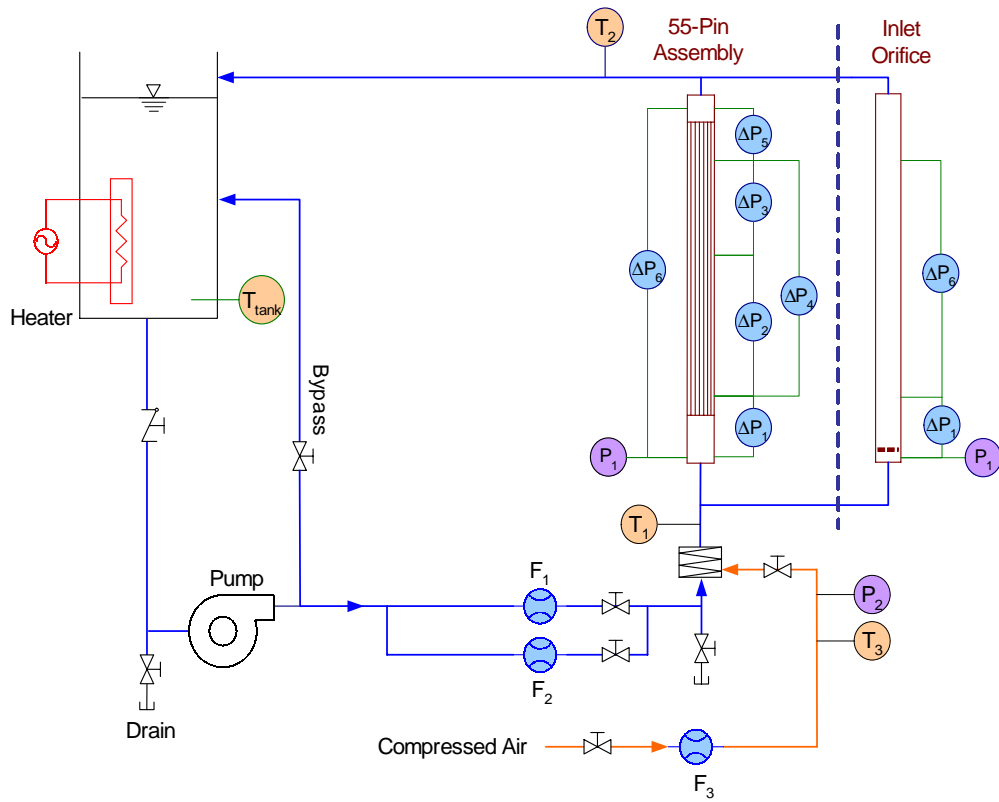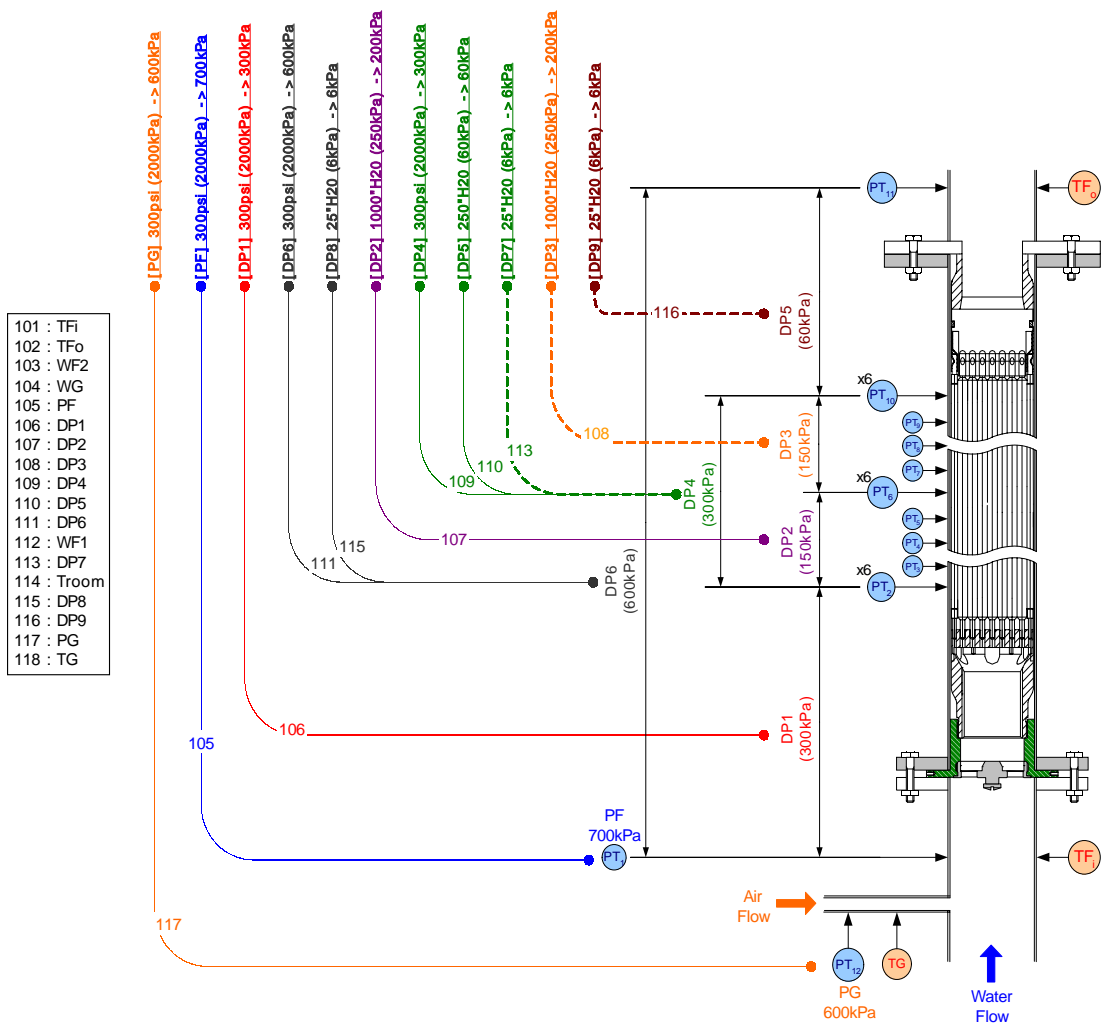SSF   55-

,   55-   ,

.   20~40   -

.

COLD-II   .

　　　　　　　　　　1   .

1.

　　　55-   60 mm

　　　　　　　　　　.　　　　　　,

　　　　,   .

　　　　　　　　　　　　　　.   2

　　.

　　　　　　.   ,   0.05~10.6 kg/s (

180~38,000,   46~8,700 kg/m²s)   .   ,   0.2~8.3

kg/s (500~32,200,   150~6,800 kg/m²s)

18.6 g/s (2,700,   0~15.0 kg/m²s)   .

F1   ,   F2   ,

.   (DP1),   (DP2,

DP3,   DP4),   (DP5)

(DP6)   .   1

.

2.

1

Note	Ref	Wf	Gf	jf	Reg	Wg	Gg	jg	x	α	N
	-	kg/s	kg/m²s	m/s	-	g/s	kg/m²s	m/s	%	%	-
1	2,060~38,000	0.6~10.6	500~8,700								96
2	1,600~5,000	0.6~2.0	525~1,640								15
3	1,740~25,000	0.7~10.3	555~8,400								50
4	500~8,000	0.2~3.0	160~2,500								42
5	500~4,500	0.2~1.6	160~1,300								57
6	180~27,000	0.07~10.1	60~8,240								146
7	190~33,700	0.06~10.1	50~8,240								167
1	4,300~5,400	1.5~1.9	,200~1,500	1.2~1.5	~500	~3.4	~2.8	~1.4	~0.2	~21	17
2	4,000~9,000	1.3~3.1	,000~2,500	1.1~2.6	~2,500	~16.8	~13.7	~3.4	~1.2	~44	43
3	8,000~13,000	2.5~4.3	,000~3,500	2.1~3.5	~1,600	~11.1	~9.1	~2.6	~0.4	~34	26
4	6,300~13,000	2.0~4.3	,600~3,500	1.6~3.5	~2,700	~18.3	~15.0	~3.3	~0.9	~41	17
5	9,000~17,000	2.7~5.2	,200~4,300	2.2~4.3	~2,600	~17.6	~14.4	~3.0	~0.6	~37	24
6	6,300~26,000	4.5~7.2	,700~6,000	3.7~6.0	~2,200	~15.0	~12.3	~2.2	~0.3	~28	18
7	2,500~32,000	5.8~8.3	,800~6,800	4.8~6.8	~1,900	~12.8	~10.5	~1.7	~0.2	~23	18
8	1,900~2,200	0.6~0.7	500~600	0.5~0.6	~900	~6.1	~5.0	~2.5	~0.9	~33	22
9	3,300~7,600	1.1~2.5	900~2,000	0.9~2.0	~2,400	~16.1	~13.2	~3.5	~1.5	~45	23
10	5,500~11,700	1.8~3.7	,500~3,000	1.5~3.1	~2,300	~15.8	~12.9	~3.3	~0.9	~41	21
11	7,000~15,000	2.3~4.8	,900~4,000	1.9~4.0	~2,700	~18.6	~15.3	~3.3	~0.8	~40	25
12	4,000~5,000	1.4~1.8	,100~1,500	1.1~1.5	~2,600	~17.6	~14.5	~3.4	~1.3	~44	23
13	2,700~3,500	0.9~1.2	700~1,000	0.7~1.0	~2,600	~17.7	~14.5	~3.6	~1.9	~47	24
14	1,900~2,500	0.6~0.8	500~700	0.5~0.7	~2,400	~16.1	~13.2	~3.6	~2.5	~48	24
15	1,100~1,400	0.4~0.5	300~400	0.3~0.4	~2,600	~17.8	~14.6	~3.7	~4.2	~50	25
16	500~700	0.2~0.2	150~200	0.1~0.2	~2,600	~17.8	~14.6	~3.7	~7.3	~51	14
17	2,000~18,500	3.9~6.2	,200~5,100	3.2~5.1	~2,000	~13.9	~11.4	~2.4	~0.4	~30	18
0 mm	400~31,500	0.1~10.1	100~8,300								46
0 mm	630~37,000	0.2~11.3	200~9,300								54
0 mm	2,800~66,000	0.8~19.0	660~15,500								39
0 mm	5,000~38,000	1.3~11.0	,000~9,000								15
24 mm	1,200~41,000	0.3~11.6	300~9,500								32
24 mm	2,500~33,500	0.8~10.6	650~8,700								28
32 mm	1,300~20,000	0.4~6.1	300~5,000								25
28 mm	1,300~31,500	0.4~9.0	300~7,400								26

3.

55-   0.05~10.6 kg/s,

180~38,000   .

3   .

.   SMART-P

15kPa

.

ΔP

3. 55-

4
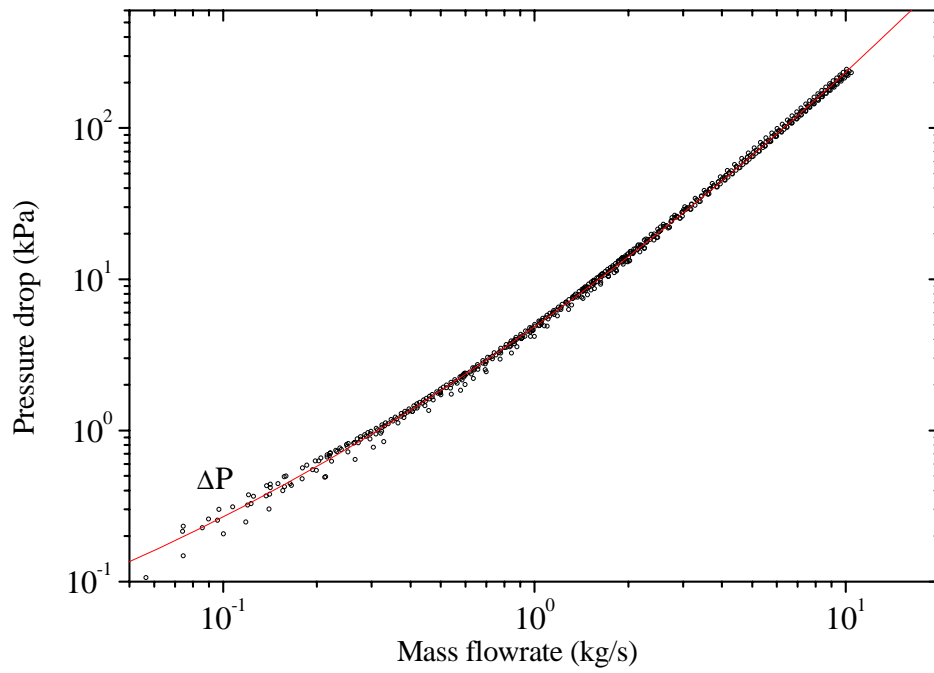
SMART-P   29,000~ 33,000

.

. SSF

.   KMR

wire-wrapped   .   SSF

            wire-wrapped   Cheng and Todreas[1]

        4   .

  Wire-wrapped   SSF
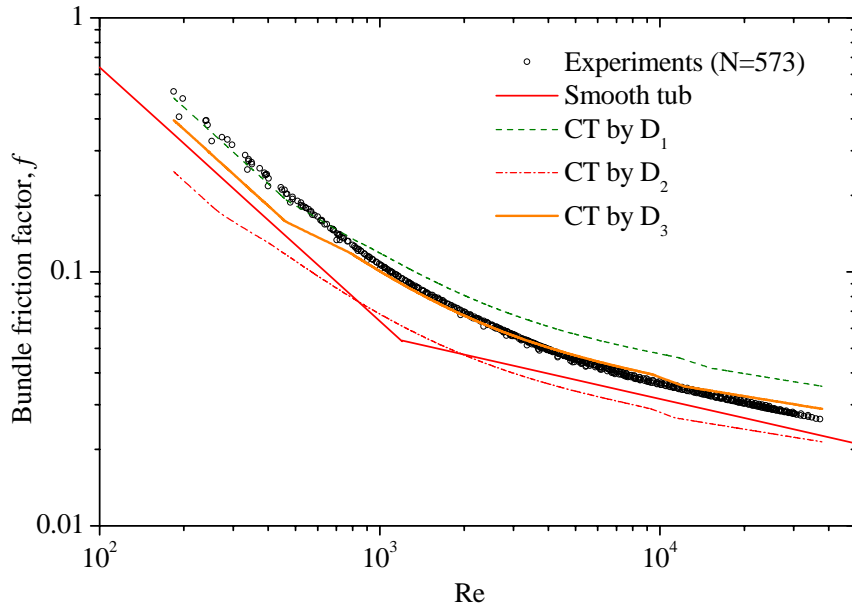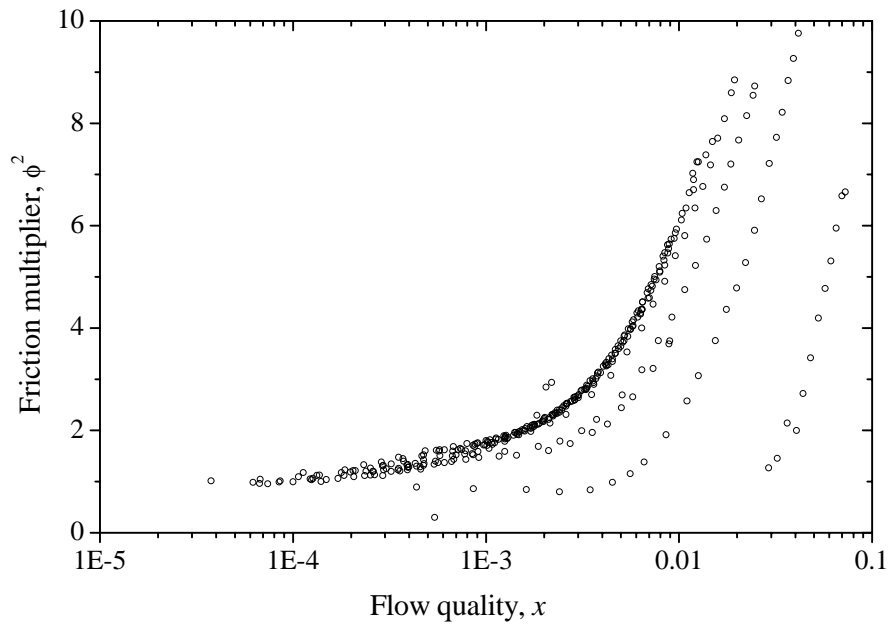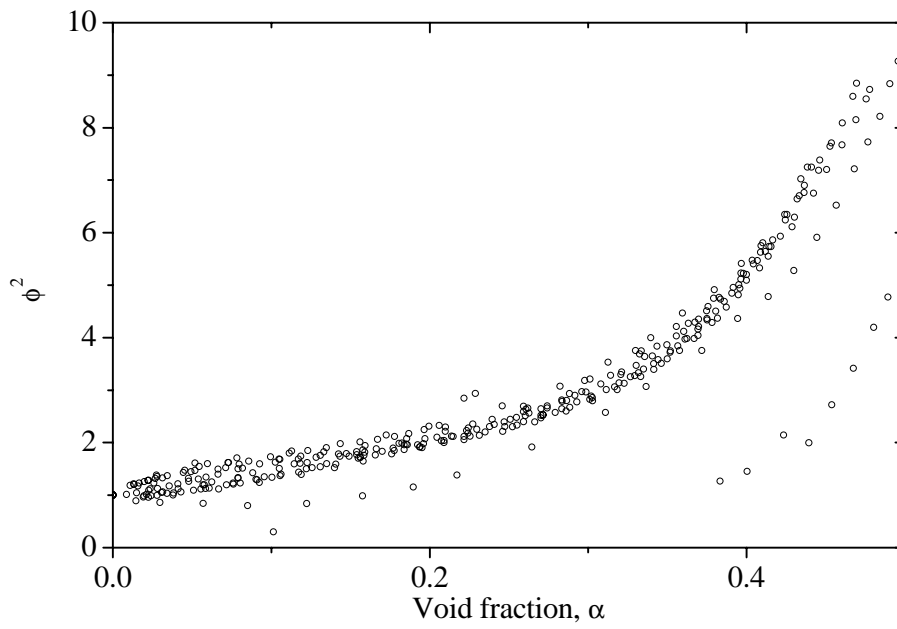(H/D)   (P/D)   , SSF

            D   .

    4   D_1

                        , D_2

                                                    , D_3 D_1 D_2 .

                SSF   e-wrapped

Figure caption: 4.　55-

55-　　　　　　　　　　　　　　　　　　　　　　　　　0.2~8.3　kg/s　(

　　　　　　　500~32,200),　　　　　　　0~18.6　g/s　(

2,700)　　.　　　　　　　　0~7%,　　　　　0~51%　　　.

.

,　　　　　　　　　　　　　　　　　,　　　-　,　　　-　,　　　　　,

hydrocarbon　　　　　　　　　　　　　　　　　　　　Chexal-Lellouche[2]

.

7%　　　　　　　　　　　　　　　　　51%　　　　.

.

6　　　　　.

(0.4%　　)　　　　　　　　　　　　　　　　　　　　　.

.

7　　　　　.　　　　　　　　　　　　　　　　　　　　.

5

6

(0, 24, 28,   32mm)

.   -

7   .

7

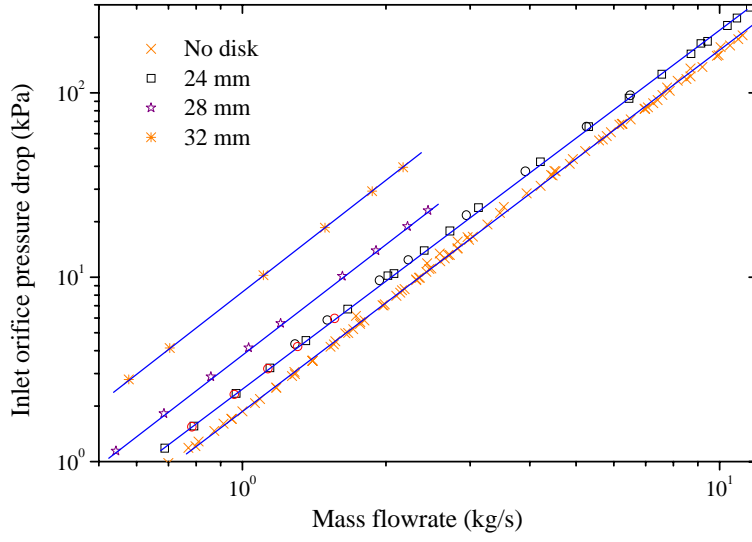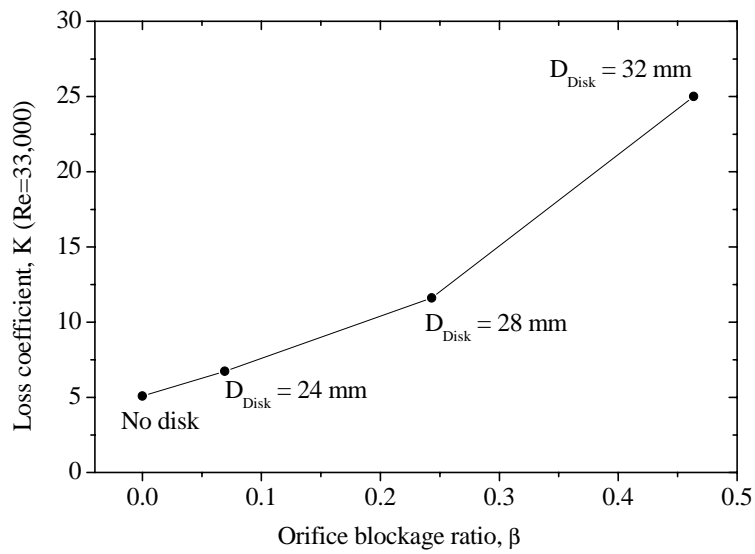7   8   SMART-P

33,000   .

SMART-P   6~20

.

8

4.

55-　　SSF

.　　　　　　　　　　　　　　　　　　　　　　　　　　　.

H/D　　P/D　　　　　　　　　　　, SSF

wire-wrapped　　　　　　　　　　　　　　　　　　　　,

D

.

.

4

.

.

.

1. S. K. Cheng and N. E. Todreas, "Hydraulic Models and Correlations for Bare and Wire-Wrapped Hexagonal Rod Bundles – Bundle Friction Factors, Subchannel Friction Factors and Mixing Paraemters," Nuclear Eng. and Des., vol.92, pp.227~251, 1986.

2. G. S. Lellouche and B. A. Zolator, "Mechanistic Model for Predicting Two-Phase Void Fraction for Water in Vertical Tubes, Channels and Rod Bundles," EPRI NP-2246-SR, pp.F-21~F-83, 1982.