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## Performance Analysis and Test on the KAERI Designed Spacer Grids for the PWR

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**Key Words:** Fuel Assembly( ), Spacer Grid Spring( ), Fuel Rod( ), Spacer Grid( ), Characteristic Curve( )

### Abstract

KAERI has contrived 16 kinds of spacer grid shapes of its own since 1997 and applied for domestic and foreign patents. To date, KAERI has obtained US and ROK patents for 11 kinds of spacer grid shapes among them and the others are under review in USA, EC, China, and ROK. In this study, detailed performance analysis and test on two spacer grid shapes that are assumed to be the most effective candidates for the spacer grid of the next generation nuclear fuel in Korea was carried out. The result has shown that the performances of the candidates are better or not worse than those of the current spacer grid.

1. 80 % 가 (PWR) 가

40 %

Fig. 1 가 , 가  
200 mm 가 4000 mm  
Fig. 1  
가 1 , 8 , 24  
1

(UO<sub>2</sub>) ( 8 mm, 10 mm  
0.6 mm  
)가

3 5  
(cell)  
( 3mm)

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1  
2 2  
2 가



2001

가

3.

(Doublet)  
H (Opt. H)  
2가

Fig. 5

2

가<sup>2)</sup>

. Fig. 5

가

(conformal contact shape)  
(Opt. H )

가

가

(

2000/2001

Opt. H 2003

2.

.) Fig. 5

Doublet

2000

2003

.)  
(self-recovery)

( ) ( )

가

/  
1  
가



Fig. 4 Mixing Vane.

UO<sub>2</sub> 가

1

Fig. 4

(mixing vane)

가



Fig. 5 Test Specimen of KAERI Designed Springs(left: Opt. H; right: Doublet).

4.

Fig. 6 5 5x5

가

shaker 가

KAERI

( H

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가

가

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(

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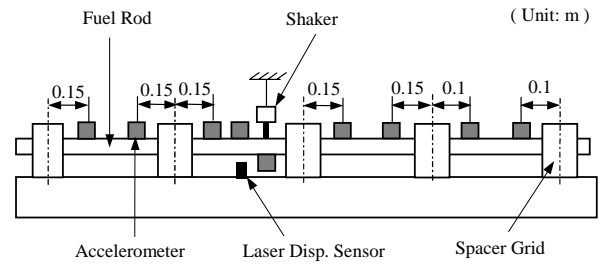


Fig. 6 Fuel Rod Vibration Test Set-up.

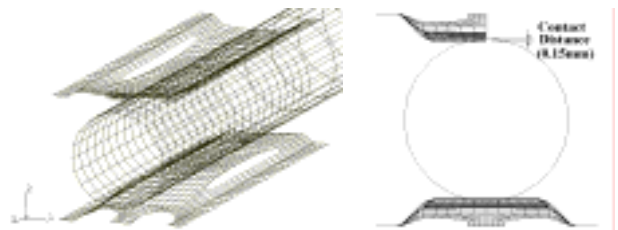


Fig. 7 FEM model of Fuel Rod Vibration Considering Contact Analysis.

Table 2 Comparisons of Fuel Assembly Vibration Test and Analysis.

	Previous Model (Hz)	Modified Model (Hz)	Test Result (Hz)
1	2.6	4.3	6.4
2	4.2	4.3	
3	8.8	10.4	15.2
4	10.3	10.4	
5	18.7	19.2	24.0
6	19.3	19.2	

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ABAQUS

Table 1

Table 1

Table 2 5x5

5

Table 1 Comparisons of Fuel Rod Vibration Test and Analysis.

	Test (Hz)	Pre. Model (Hz)	Diff. (%)	Mod. Model (Hz)	Diff. (%)
1	43.4	28.8	33.6	43.6	-0.6
2	55.9	32.9	41.2	55.5	0.79
3	58.2	36.3	37.6	57.2	1.58
4	59.9	41.6	30.1	59.2	0.38
5	62.1	47.9	22.8	62.3	-0.38

\* Diff.(%): (Test-Analysis)/Test \* 100

5.

16x16 Doublet

Fig. 8

Fig. 9

750 mm/s

18.9 kN

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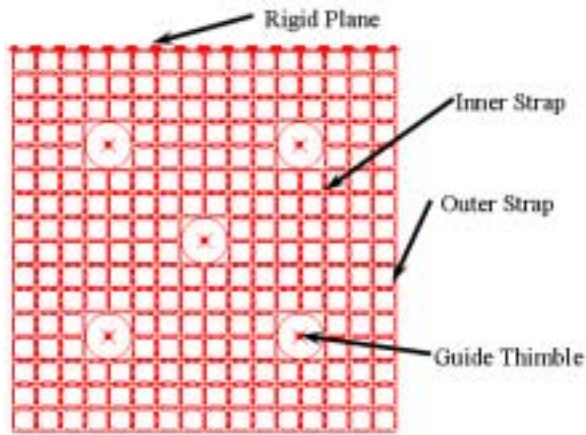


Fig. 8 FE Model of the 16x16-type Doublet Spacer Grid.

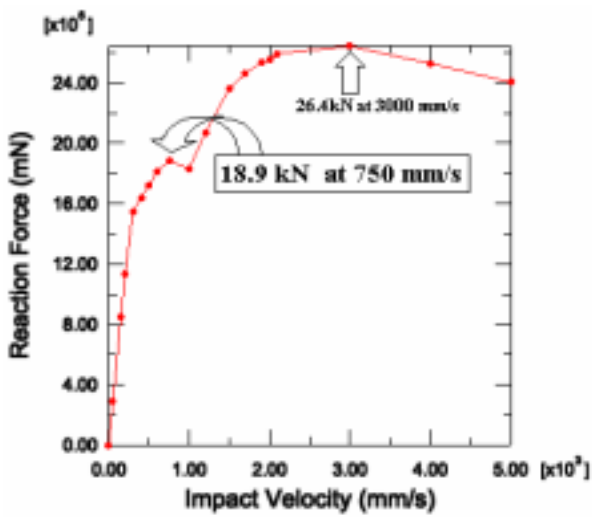


Fig. 9 Impact Analysis Result of the 16x16 Type Doublet Spacer Grid

Fig. 10  
 10 %  
 가  
 10 %  
 FOCUS PLUS7  
 5 %  
 PLUS7 가

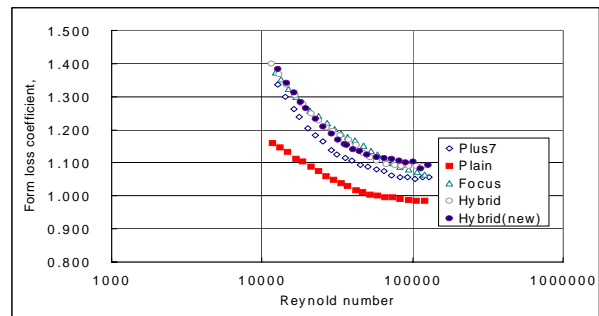


Fig. 10 Pressure Drop Test Result.

7.

6.

5x5

( 가  
 ), Siemens/KWU KNFC  
 FOCUS 가 PLUS7  
 (Hybrid) (Opt. H  
 )  
 Re 10<sup>4</sup> 10<sup>5</sup>

5x5  
 4  
 FOCUS , PLUS7,  
 z/D=50 Fig. 11  
 z/D=50 FOCUS Hybrid 가  
 , FOCUS 가  
 Hybrid  
 z/D=50  
 FOCUS

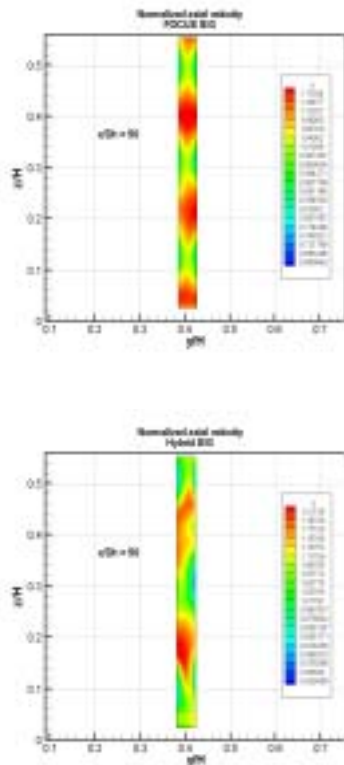


Fig. 11. Axial Velocity Distribution of FOCUS and Hybrid Spacer Grid at  $z/D=50$ .

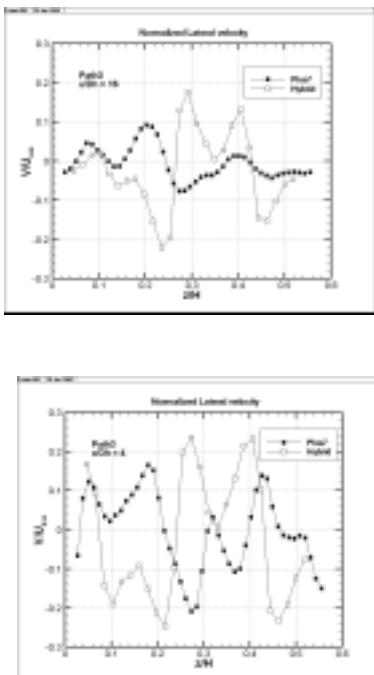


Fig. 12. Transverse Velocity Distribution of PLUS-7 and Hybrid Spacer Grid.

Fig. 12 PLUS7 Hybrid 가 z/D=4 가 z/D=16 Hybrid가 PLUS7 Hybrid

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(1) Kreyns P. H. and Burkart M. W., 1968, "Radiation-enhanced Relaxation in Zircaloy-4 and Zr/2.5 wt % Nb/0.5 wt % Cu Alloys," *J. of Nuclear Materials*, Vol.26, pp. 87 ~ 104.

(2) , , , 2003, " 가

/ , " pp.1297 1302.

(3) K. J Park *et al.* 2004, "Impact Analysis of a Full Model Doublet-Type Spacer Grid in the Fuel Assembly of a PWR," ICONE12-49292.