#### 2002

### PLUS7

An Experimental Study on the PLUS7 Fuel Assembly Vibration



#### Abstract

The PLUS7 fuel assembly for the Korea Standard Nuclear Power (KSNP) plants has been developed to obtain safety margin increase and economic benefits with thermal margin increase, higher burnup achievement, seismic strength increase, elimination of debris-induced failure and grid-to-rod fretting failure as compared to a current fuel assembly. In particular, PLUS7 fuel assembly has adopted mixing vanes on the mid grids to enhance coolant flow mixing around fuel rods, which will improve thermal margin compared to current fuel assembly. Since the higher flow mixing may increase a driving force to fuel assembly vibration and then make a negative effect on fuel integrity, it is prerequisite to evaluate the impact of vibration on fuel integrity. The vibration test of the PLUS7 fuel assembly has been performed using a Westinghouse hydraulic test facility to evaluate such vibration impact. This vibration test has confirmed that the PLUS7 fuel will not generate any resonance at the KSNP plant operating conditions through inductive displacement transducers installed at the assembly grid position of flow housing to measure grid amplitudes. In addition, the frequency and mode shapes of the PLUS7 fuel assembly obtained during the hydraulic tests at 250 °F as well as the mechanical tests in air at room temperature can be used to verify fuel models for Seismic and LOCA analyses. Vibration amplitudes of the PLUS7 fuel assembly during hydraulic tests can be used as a basic data to analyze grid-to-rod wear analysis.

1.

. PLUS7 1

2 PLUS7 , 가 . PLUS7

, 가 가

2. 2.1

Fuel Assembly Compatibility Test System (FACTS) 가 . 3

. PLUS7 250 °F, 225 psig . 4

> 5 . 6







# 3.1

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FACTS				250 °F	800
GPM		Pl	_US7	2440 GPM	
Sweep			2440 GPM	800 GPM	Sweep
		PLUS7	'가		
	2026 GPM	120%	가		
		. Sweep		800 GPM	50 GPM
가	Dwell				
8	가	S	SPS390	가	

## 3.2

PLUS7		Shaker	2 Hz	50
100 Hz	Sweep		Sweep	
	Dwell			

## 4.

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9

				가
	5	0°	270°	

,

2200 GPM	Grid 9	Orbit Plot	AC	DC level
	•			

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4 mil .

 ?}
 250 °F
 800 GPM
 2440 GPM

 6
 sweep
 .
 10
 PLUS7
 V5H
 3

 Waterfall Plot
 , PLUS7
 (a)
 (a)
 3

, (b) V5H 가

Sweep 800 GPM 50 GPM 가 2440 GPM Dwell . 11

PLUS7 V5H 1 가 1100 GPM 2 가 2200 GPM 2400 GPM 1 가 . 12

. 250 °F 20 ~ 25% .

5.

FACTS PLUS7

1) PLUS7 1 mil RMS 2 2) 1100 GPM 가 9 1 가 가 1 mil RMS , • 3) 250 °F 가 20 ~ 25% , 가 가 가 • 4) 가

,

•

가

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1. PLUS7











(a) KSNP

(b) PLUS7

2. KSNP PLUS7



3. FACTS





1<sup>st</sup> Grid (

)



6.



7. FACTS





9. Orbit Plot (



10.

Sweep

9)







(a)







12. ( PLUS7 )