Dynamic Buckling Test of Cell Setting Spacer Grid and Normal Spacer Grid

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1. Introduction

As the capacity of spent nuclear fuel storage pool at reactor sites becomes saturates in few years, long term dry storage has been recently discussed as an alternative option in Korea. The Korea Atomic Energy Research Institute have been evaluated the integrity and retrievability of fuel for transportation and long-term dry storage of spent nuclear fuel. Spacer grid is one of the structural parts of the fuel assembly. The studies were focused on buckling behavior of a normal spacer grid and cell setting spacer grid.

2. Method and Results

2.1 Specimen

A test specimen was 14OFA spacer grid fabricated with Zircaloy-4 material as shown in Fig. 1(a). The fuel rods were inserted into every fuel rod slots at a space grid as shown in Fig. 2(b). The fuel rod cell size was expand due to the irradiation effect for operation period. The simulated cell size was increased by 0.07 mm than normal space grid cell size, but all cell size was not uniformly expand.

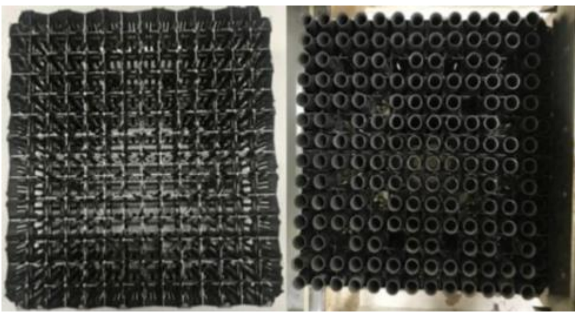

Fig. 1. Photograph of a 14OFA Space Grid (a) and space grid with Fuel Rods (b).

2.2. Pendulum Type Impact Tester and Test Conditions

Fig. 2 shows the schematic drawing of the pendulum type impact tester. The impact hammer was fixed and rotated by the motor. The specimen was fixed with a force of 15.7 kgf using air pressure. Impact energies transmitted to the plate and rod could be controlled. The length of the arm is about 0.88 m and the mass of the hammer is about 38 kg.

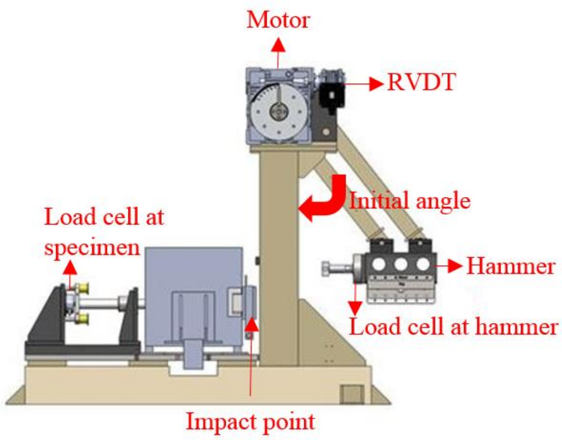

Fig. 2. Pendulum type impact tester.

Pendulum type impact test of the normal and cell setting spacer grid was executed room temperature condition. The initial impact angle was started from 25 degrees. It was increased by 2° until buckling. The number of specimens was three.

2.3 Test Results

The impact test results of normal and cell setting spacer grid specimen were summarized in Table 1 and 2.

Table 1. Impact test results of cell setting spacer grid

	SG no.1		SG no.2		SG no.3	
	H/S	S/S	H/S	S/S	H/S	S/S
25	32,846	36,120	29,460	35,312	32,370	35,604
26	33,826	36,946	32,256	37,007	33,832	37,158
27	34,821	38,150	32,033	36,062	33,482	37,897
28	35,134	39,513	30,802	34,814	35,283	38,594
29	33,240	41,158	22,779	29,216	36,219	38,707
30	31,968	37,292	29,460	35,312	34,888	40,326

Table 2. Impact test results of normal Spacer grid

	SG no.1		SG no.2		SG no.3	
	H/S	S/S	H/S	S/S	H/S	S/S
25	31,908	35,103				
26	33,751	36,375				
27	34,958	37,042	34,600	37,470	32,637	36,412
28	35,751	37,885	36,244	37,875	35,462	38,036
29	37,089	37,844	35,139	38,827	37,011	38,899
30	37,658	38,893	37,056	38,524	38,627	40,131
31	33,866	38,955	37,909	40,316	39,497	40,826
32	28,022	34,636	26,342	34,829	40,468	41,790
33					40,006	42,440
34					28,356	33,755

The average buckling strength and standard deviation of normal spacer grid at the hammer side were 38,478 N and 1,285 N, and average buckling strength and standard deviation of cell setting spacer grid at the hammer side were 34,360 N and 1637 N, respectively. Therefore, the critical buckling strength of the cell setting spacer grid was about 10% smaller than those of the normal spacer grid.

3. Conclusion

The test was carried out to confirm the buckling strength of normal spacer grid and cell setting spacer grid. The simulated spacer grid cell size was increased by 0.05 mm than normal spacer grid cell size, these gaps between the fuel rods and the grid supports eventually caused a reduction in the dynamic impact strength of the spacer grid itself. The critical buckling strength of the cell setting spacer grid was smaller than those of the normal spacer grids. Future works will attempt to identify the effects of hydrogen and use it in the assessment of SNF evaluate the integrity.

ACKNOWLEDGEMENTS

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