

## Development of Spent Fuel Rod Cutting Device

150

pellet , debris , tube cutter , tube

/ 가

### Abstract

The spent fuel rod cutting technology that is a prior process of the LWR spent fuel decladding in the spent fuel reusing process is described in this paper. For this, the characteristics of the spent fuel rod and several cutting methods are analyzed, and the basic experiments for diamond wheel cutting method and tube cutting method are carried out. The tube cutting method, which has advantages in durability, maintainability of tube circle, debris generation and risk of fire, is selected as a spent fuel rod cutting method. The detailed design of the spent fuel rod cutting device by this method is performed. This device is automatized and modularized to make the remote operation and maintenance easy.

1.

,  
 .  
 , 가 / .  
 / , , wire  
 EDM(Electron discharge machining cutting) 4가  
 . 4가 ,  
 , , 1 / diamond  
 tube cutter blade  
 . diamond tube cutter  
 , diamond  
 , 가 tube cutter ,  
 , , tube cutter  
 , 가 ,  
 .  
 , pressing  
 . ,  
 가 ,  
 diamond , 가 ,  
 2 tube cutter ,  
 debris (2.7 g / 1 ), ( )  
 3 Ass'y) ( 90 %)

가

가

2.

pellet tube .

, tube pellet ,  
1 3 .

1.

				340	
	40	(N/mm <sup>2</sup> )	450	220	45.87 Kg/mm <sup>2</sup>
	91.92				
	6.80 (g/cm <sup>3</sup> )				
(862 )	(HCC)	(N/mm <sup>2</sup> )	320	125 175	32.6 Kg/mm <sup>2</sup>
	(BCC)				
	1852	(%)	20	25	
	3580				
	0.18 barn				

2. Tube Pellet

Tube			Pellet		
	O.D	I.D	T	O.D	Lenght
14 x 14 (mm)	10.75	10.1	0.65	8.05	10
17 x 17 (mm)	9.5	8.93	0.57	8.05	10

3.

Clad material	$\alpha^*$ (Kg/mm <sup>2</sup> )	Integral neutron dose** (n/cm <sup>2</sup> )	$\alpha'^*$ (Kg/mm <sup>2</sup> )
Aluminum	2.77	$2.6 \times 10^{21}$	3.04
Stainless steel	24.2	$3.9 \times 10^{20}$	38.72
Zircaloy-2, 4	29.4	$1.4 \times 10^{21}$	36.75
Inconel-702	56.7	$1.4 \times 10^{21}$	102.06

가 , , 가 가

4

#### 4. Zircaloy

	Sn		Fe		Ni		Cr		Zr
Zircaloy - 1	2.5		-		-		-		
Zircaloy - 2	1.2	1.7	0.07	0.20	0.03	0.80	0.05	0.13	"
Zircaloy - 3	0.25	0.50	Feaks Ni 0.25 0.40		-		-		"
Zircaloy - 4	1.45		0.15		-		0.1		"

\*  $\sigma_a, \sigma_a'$  = Yield stress before and after irradiation, respectively.

\*\* Integral neutron dose causing maximum mechanical strength changes.

### 3.

#### 3.1.

/ , , Wire EDM

4 가

. 4 가

/ (saw/abrade cutting)

( $1\mu\text{m}$  )

가 ,

가 /

, (

) , 가

가 ,

가 . Wire EDM

, (wire

wheeler) 가 가

wire

가 . 가

shear cutting

tube cutter

tube cutting . shear cutting 가

(hammering pressing )

tube cutting , 가 , 2

diamond

tube cutter blade

### 3.2. Diamond cutter Tube cutter

diamond cutter tube cutter

1 diamond cutter

diamond cutter

tube cutter

tube cutter

2



Diamond cutter



Tube cutter

1. Diamond cutter Tube cutter .



Diamond cutter



Tube cutter

2.

3.3. Diamond cutter Tube cutter /

diamond cutter tube cutter 4  
 , , , , debris, , ,  
 / . diamond  
 , 가 ,  
 , tube cutter  
 가 ,  
 /  
 tube cutter .

4. Diamond cutter Tube cutter

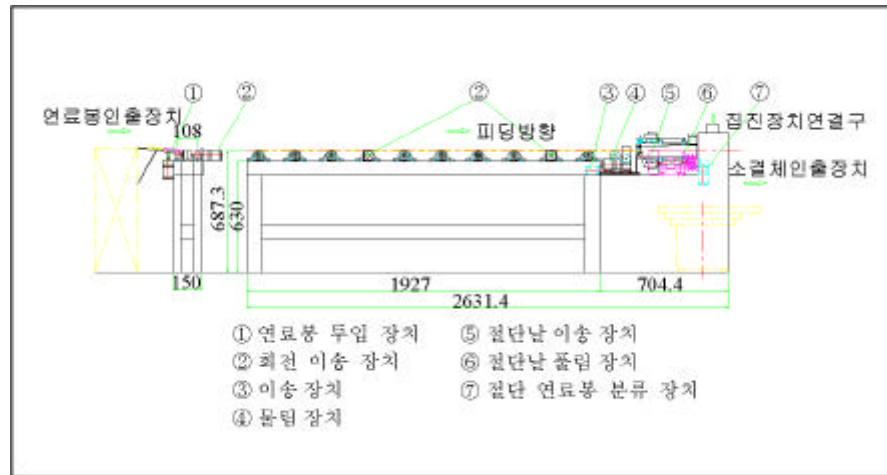
	Diamond cutter	Tube cutter
	· Diamond 가 가	· Stainless steel cutter
/	· , / · Cutter	· , / · Cutter
	·	·
Debris	· 1.995 g/	· ( )
	· , Hot cell 가	·
	· 97 %	· 97 %
	· 3	· 5

4. Tube cutter

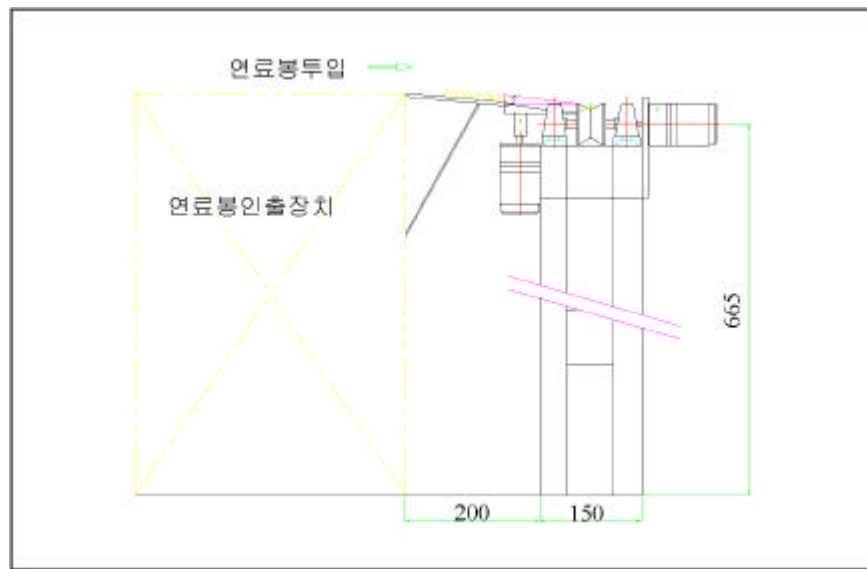
tube  
 cutter  
 , , , , ,  
 , , , , ,  
 . roller  
 2 m .  
 ,  
 . tube cutter ,

가

3 6

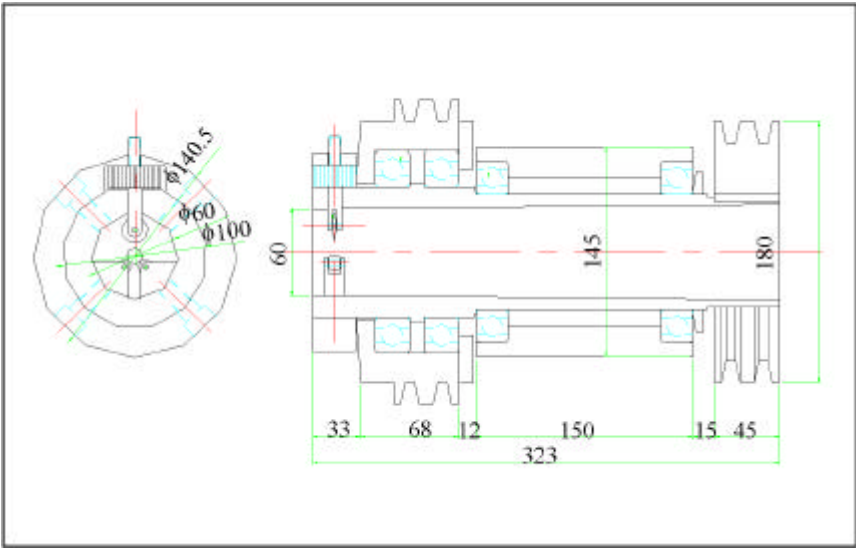


3. Tube cutter

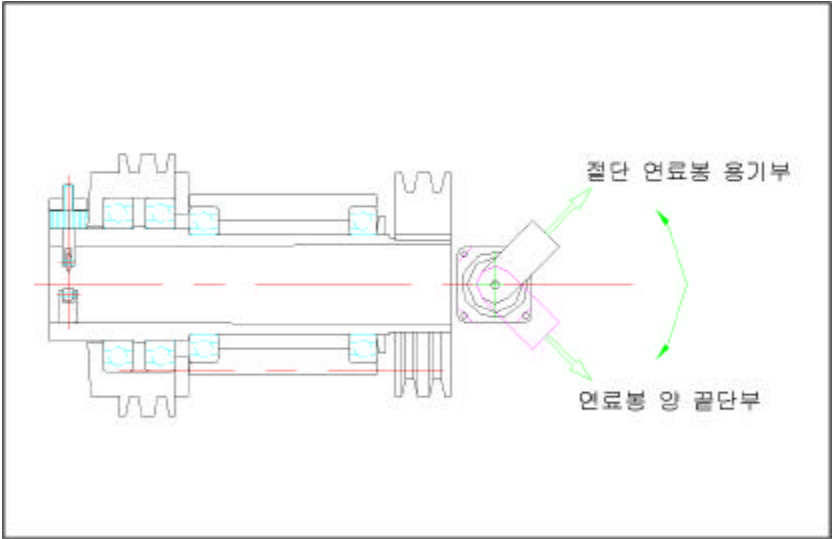


4.

Assembly.



5. Assembly.



6. Assembly.

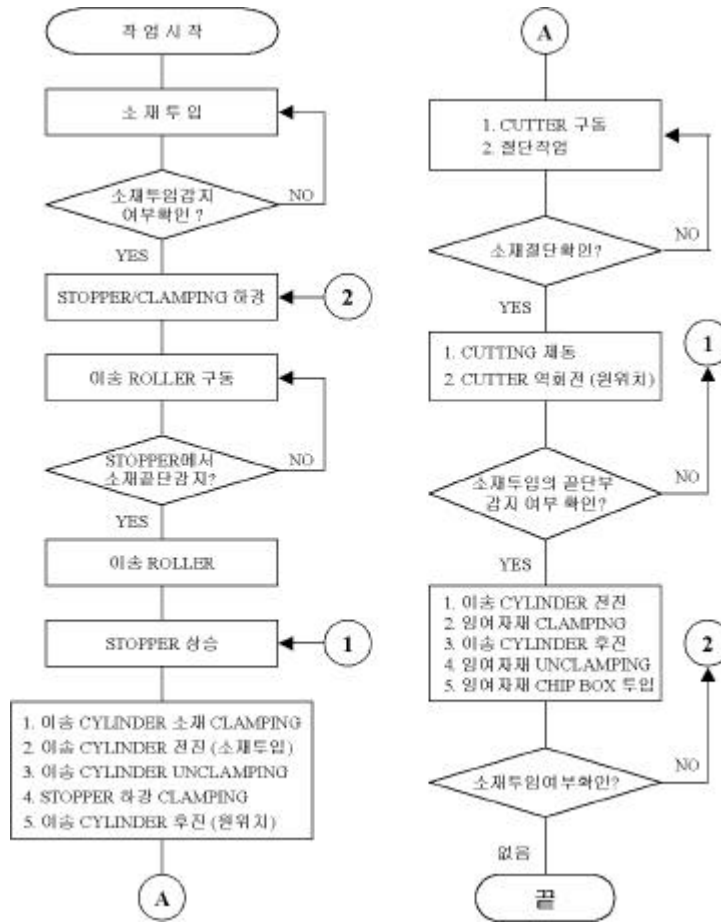
가  
 , tube cutter  
 , 가



5.

tube cutter  
roller

7



7.

6.

diamond cutter

tube cutter

가

가 debris

2

가 가 tube cutter

, / 가

1. U.S. DOE, "Fuel Rod Consolidation Project" Final Design Report Contract No. DE-ACO7-86ID 12651. DOE/ID/12651-2-Vol. 1 DE88 004219
2. , “ ”, KAERI/RR-1744/96, , (1986).
3. W. D. Bond and J. C. Mailen and G. E. Michaels, "Evaluation of Methods for Decladding LWR Fuel for a Pyroprocessing Based Reprocessing Plant", October (1992).
4. Westinghouse Proprietary Class 2, Chapter 2: Zircaloy-4, Rev. 6, Oct., (1993).
5. , “ ”, KAERI/TR-1084/98, , (1998).