Determination of an Optimal Radiation Scintillator for Verification Equipment of Spent Nuclear Fuel of Heavy Water Reactor

May 13, 2021

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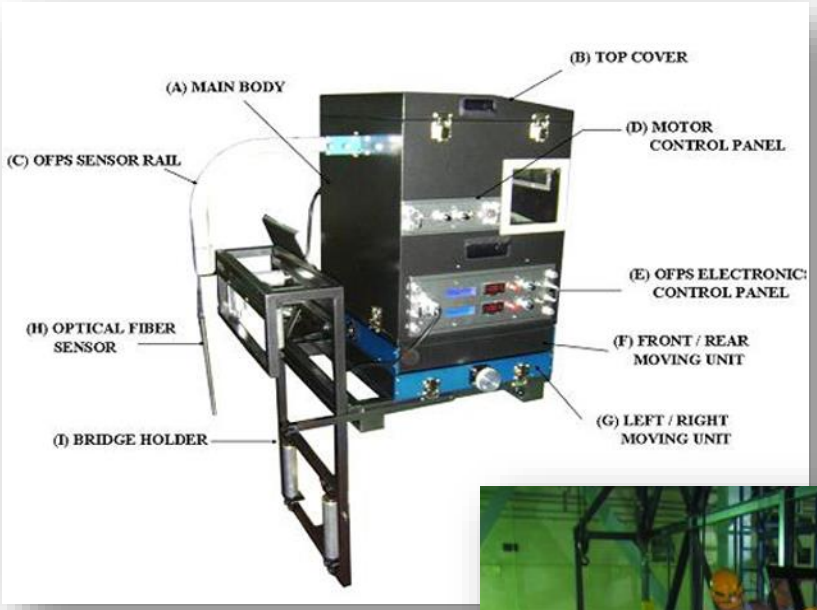
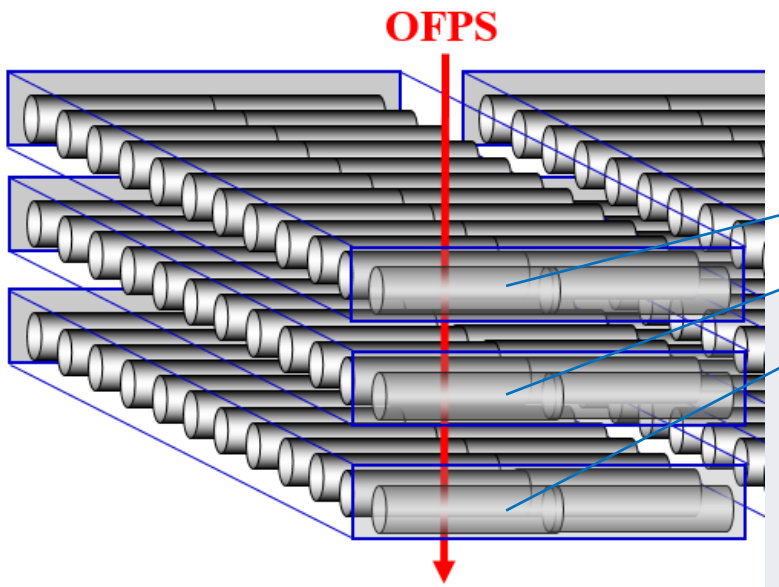
OFPS(Optical Fiber radiation Probe System)

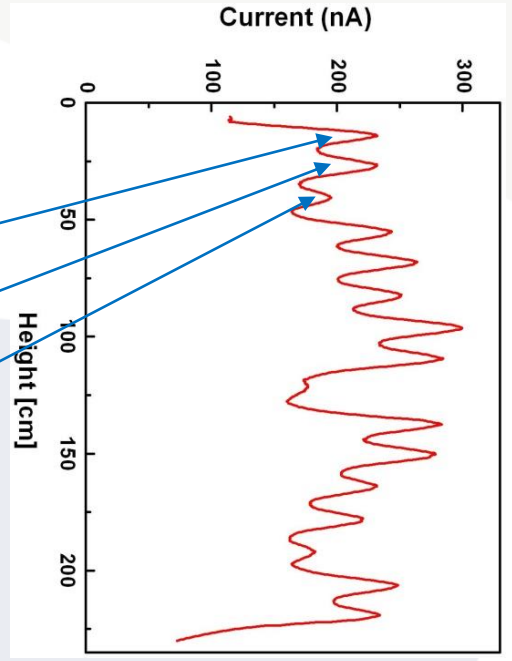


OFPS

➢ to confirm presence of irradiated bundles along the selected columns (method 'K')



Measurement of spent fuel using the OFPS



Signal of 16 spent fuel bundles

Problems and Objectives

1. Problems

   - Low sensitivity of a scintillation detector

   - Large and heavy equipment

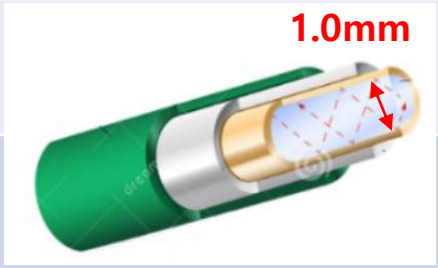
2. Objectives

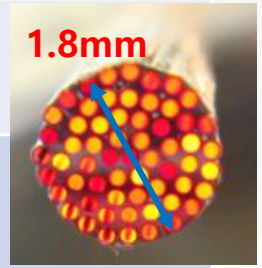
   - To improve sensitivity of a scintillation detector

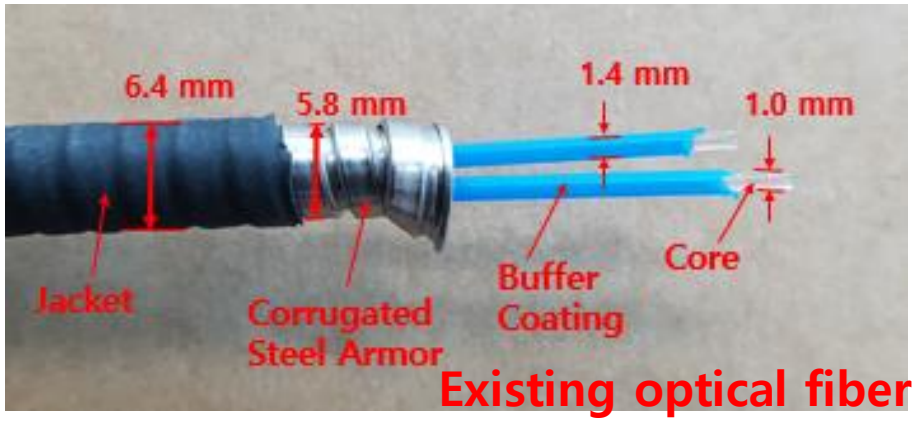
   - To develop small and light OFPS

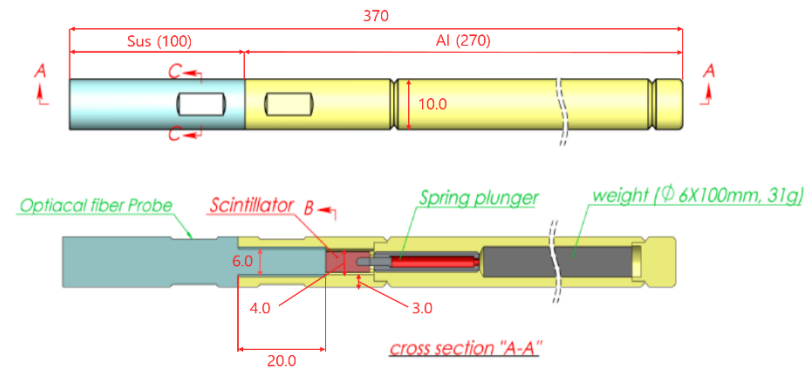
Comparison of Existing and New Scintillation Detectors

	Existing Detector	New Detector
Scintillator	Ce activated Li glass scintillator, 1.0 mm (diameter) x 5.0 mm(length)	P-Terphenyl organic scintillator, 4.0 mm x 4.0 mm x 10.0mm
Core diameter of optical fiber	1.0 mm	1.8 mm(200μm x 64 ea)
Optical fiber type	Mono-core	Bundle Type
Use of a secondary fiber	Yes	No
Wall material of a detector	1.0 mm Stainless steel	3.0 mm Al





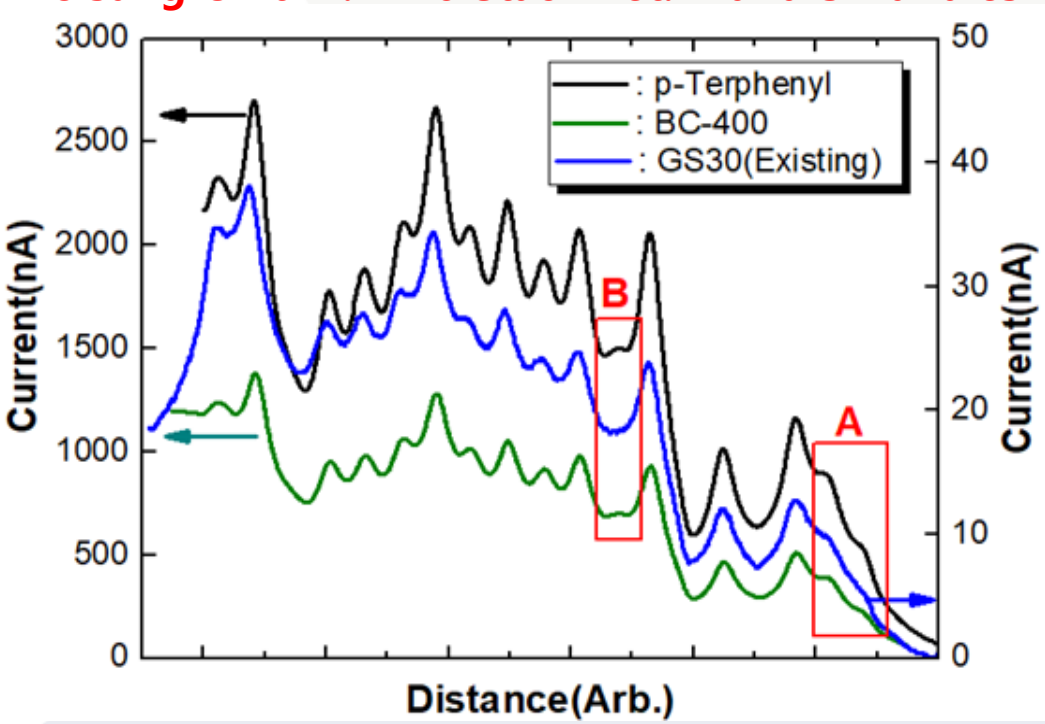




Field Test of an Optical Fiber-based Scintillation Detector

Fiber \ Properties		Core Dia.(μm)	Buffer coating	Jacket Dia.(mm)	Coating (mm)	Use of a secondary fiber	Wave Length(nm)	Flexibility	Detector container
Existing Fiber		1,000	1,400	6.4	-	Use	300 – 1,200	Hard	Existing container
UV-VIS Fiber	Mono-Core (A)	800	2,500	7.5	2,500	Use	190 – 1,200	Hard	New container
	Bundle Core (C)	1,800 (200μm/core)	2,500	6.0	2,500	No	190 – 1,200	Soft	
VIS-NIR fiber (B)		954	1,400	6.0	1,400	Use	400 – 2,500	Soft	

Wolsung Unit 1 : E-16 Stack Bet. 4 and 5 Bundles



- ✓ Signal amplitude of the new detector is about one hundred times higher than that of the present detector. More clear in 'A' region.
- ✓ A signal that isn't seen in the results of the present detector is observed in the new detector (in 'B' region).
- ✓ A good flexibility of a optical cable makes the inspection activity easy and convenient.

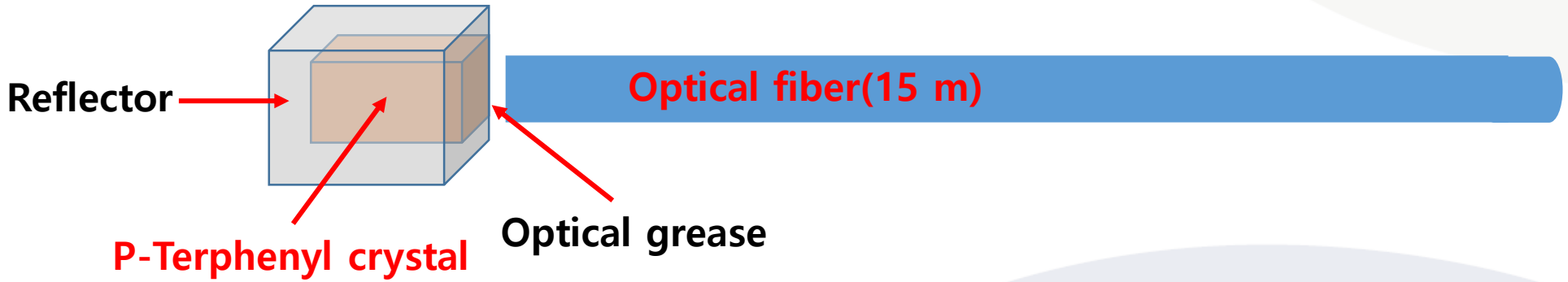
Field Test of OFPS

	Existing Equipment	New Equipment
Size(cm)	55 cm x 40 cm x 70 cm	53 cm x 22 cm x 51 cm
Weight(kg)	About 40 kg	About 25 kg
No. of a necessary operator	2 persons	1 person

- ✓ The new OFPS with small size and light weight was manufactured to handle easily and conveniently the equipment.
- ✓ The simplified operation S/W
- ✓ The radiation signal could not be obtained due to the problem of an baseline adjustment.

Nest Step

- ✓ Fabrication of an OFPS Prototype
- ✓ Fabrication of a final version, a scintillation detector based on light simulation



- ✓ Field Test with a new OFPS and a new scintillation detector

Thank you..

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