1. INTRODUCTION

Due to reaching limitation of on-site storable capacity of spent fuel from the nuclear power plant and delay on the governmental construction plan of independent spent fuel storage installation, the spent fuel transported to the nuclear power plant which was improved the compact storage rack. So this study shows that this transportation work applied an ALARA point of view, reduced the radiation exposure.

2. BODY

2.1 Legal Regulation, Features and Specification of KN-12

2.1.1Regulation relating to transportation reporting and transportation inspection

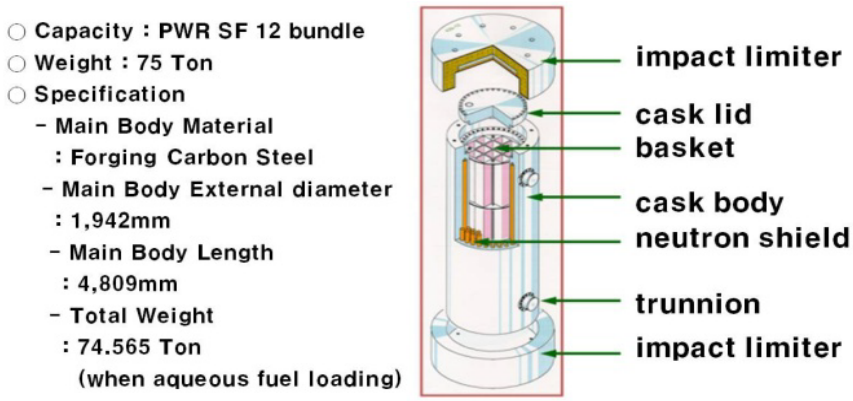
- Nuclear Safety Act Article 71 (Reporting on Transportation)
- Enforcement Decree Article 108 (Submit a reporting document until 5 days before the every transportation day)
- Notification No.2013-27
- Nuclear Safety Act Article 75(Inspection of Package and Transportation)
- Act on Prevention of Radiation Disasters Article 12. (Inspections, etc.)
- Enforcement Decree of Act on Prevention of Radiation Disasters Article 18, clause 3. (Inspections of Transportation)

2.1.2 Licensing Process Relating to Transportation

Licensing of transportation cask and equipment → Inspection of transportation route and vehicle → Advance notification of nuclear materials transportation → Transportation reporting and inspection application → simulation transporting → Fuel loading and cask storage → Notification of radioactive material transportation → Transportation Inspection → Fuel Transportation

2.1.3 Transportation Cask (KN-12) Features

- Transportation Capacity : 12 Bundles (PWR)
- Transportation Method : Wet Process (Filling inside with water)
- Transportation Type : Type B(U) Fissile Package (B(U)F)



2.2 Radiation Safety Management

2.2.1 Basic Policy

- Observance of the NUCLEAR SAFETY ACT
- Observance of the spent fuel on-site transport /storage procedure
- Observance of the manual and procedure of radiation emergency at nuclear power plant
- Observance of the radiation management operation procedure
- Application of ALARA and prevention of radioactive contamination diffusion

* Calculation of goal radiation dose appropriate ?
* Selection of radiation protective equipment appropriate?

* Working place and related system equipment?
* Need to shielding?
* Need to simulation training?
- Minimization of radioactive waste production
- Inspection of the stability of transport equipment (transportation cask, vehicle and etc.)
- Inspection of radioactive contaminant leak at the transfer canal after transportation

2.2.2 As Low As Reasonably Achievable(ALARA)

- During work at the top of KN-12 spent fuel, it used to use a shielding ring, but the work was changed as drainage of the top after finishing work. It made the reduction
- Execution of a simulation transporting and training
- Experts and experienced workers input and work management with separating main workers and assistance workers
- Application of workspace considering a shielding wall
- Prevention of rework by work planning in advance and scrutiny
- Restriction of unnecessary workers and establishment of the low-dose stand-by area
- Prevention of the internal exposure during watering decontamination and exhaustion work for cask (Wearing respiratory equipment and measuring air contamination level)

2.2.3 Radiation Safety Management on work (Loading and unloading)

a) Loading

- Preparatory work for fuel loading
* Radiation detection of the workspace, decontamination pit and L/P after water filling
- Fuel loading work and radiation detection
* In case of fuel loading and unloading, after close the cover
* L/P after water drainage
- Loaded cask transfer and decontamination work
* Decontamination with high-pressure water before the transfer and measurement of the air concentration
- Preparatory work for carrying out of the transportation cask
* Leaking test and radiation (radioactivity) measurement of the cask
* Contamination measurement after secondary decontamination of the cask, preparation for carrying out
- Checking taking over of transfer to out of site

b) Unloading

- Preparatory work for fuel storage
* Radiation measurement of workspace, decontamination crew and after removing bolts, before and after water filling
- Fuel storage
* Radiation measurement after removing covers, storing fuel and draining
- Decontamination work of the transportation cask
* Radiation measurement after the decontamination
* Sampling and Nuclide analysis of the cask inside
- Preparatory work for transfer of the empty cask
- Checking taking over of transfer to out of site

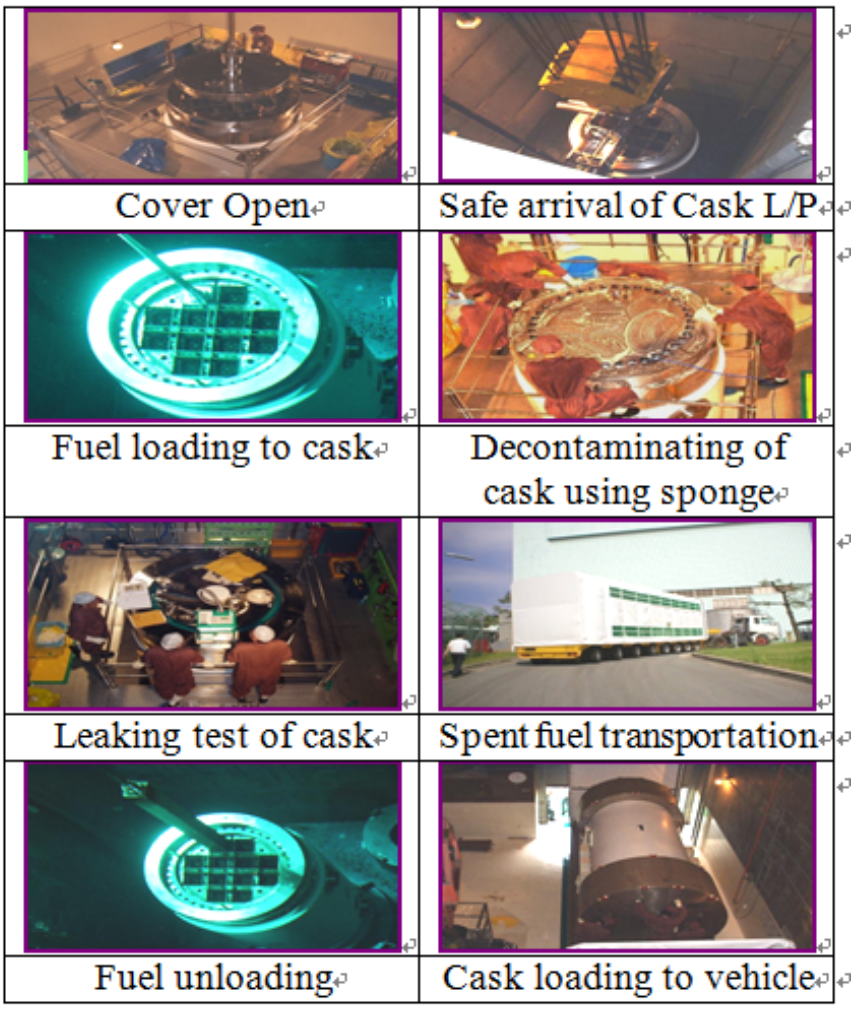
2.2.4 Standard of Radiation Dose rate and Surface Fouling Level(Nuclear Safery Act)

- Carrying material
* Below 10mSv/h(Only for transportation)
* α(0.4Bq/㎠), β-γ(0.4Bq/㎠)
- Transportation vehicle
* Surface of Vehicle/2m separation : 2/0.1mSv/h
* Driver's seat of vehicle : 0.02mSv/h

- Empty transportation cask

* The outside of Empty cask : α(0.4Bq/㎠), β-γ(0.4Bq/㎠)

* The inside of Empty cask : α(40Bq/㎠), β-γ(400Bq/㎠)



3. CONCLUSION

Domestic spent fuel transportation consequential exposure dose has declined compared to the beginning. The first reason is that H.P worker has executed the activity of occupational radiation exposure reduction (ALARA) with establishment of the basic policy about radiation safety management. The second is reduction of the work time by changing over to work process as 100% drainage of water in the cask not to install a shielding material to the top. This empirical case study will be helpful in performance of work relating to spent fuel transportation afterward.

3.1 Exposure Radiation Dose Assessment of Spent Fuel in Korea

Work Process In NPP	Exposure Radiation Dose(man-mSv)			Dose Total Per process (man-mSv)	Remark
	2009	2010	2011		
Preparation Work for Loading	0.03	0.00	0.02	**0.05**	
Spent Fuel Loading	0.00	0.00	0.00	**0.00**	
Preparation Work for Transportation (Decontamination and Locking)	4.01	2.46	2.03	**8.50**	
Leaking Test and Preparation of Cask Transfer	0.66	0.57	1.01	**2.24**	
Spent Fuel Transportation	0.96	0.48	0.76	**2.20**	
Simulated Transportation and Equipment Movement	0.06	0.00	0.00	**0.06**	
Sub Total(Loading)	**5.72**	**3.51**	**3.82**	**13.05**	
Spent Fuel Storage	0.23	0.18	0.18	**0.59**	
Preparation Work for Empty Cask Transportation	0.76	0.15	0.12	**1.03**	
Preparation Work for Empty Cask Transfer	0.29	0.11	0.20	**0.60**	
Empty Cask Transportation	0.96	0.85	0.77	**2.58**	
Simulated Transportation and Equipment Check-up	0.46	0.23	0.00	**0.69**	
Sub Total(Unloading)	**5.72**	**3.51**	**3.82**	**13.05**	
Total	**10.07**	**5.95**	**6.16**	**22.18**	

※ Exposure dose in 2013 is similar to 2011

3.2 Exposure Radiation Dose Assessment of Spent Fuel internationally

Loading

Nuclear Fuel and Transportation Cask Type	Total Exposure Dose (man-mrem)
75,000MWD/MTU, Cooling 5 Years / 125 tons HI-TRAC 125D Transportation Cask	2017.4
75,000MWD/MTU, Cooling 5 Years / 125 tons HI-TRAC 125 Transportation Cask	2063.1
60,000MWD/MTU, Cooling 3 Years / 100 tons HI-TRAC Transportation Cask	6628.4
HI-STAR 100 System Loading 40,000MWD / MTU, Cooling 5 Years	1365.9

Unloading

Nuclear Fuel and Transportation Cask Type	Total Exposure Dose (man-mrem)
75,000MWD/MTU, Cooling 5 Years / 125 tons HI-TRAC 125D Transportation Cask	787.5
75,000MWD/MTU, Cooling 5 Years / 125 tons HI-TRAC 125 Transportation Cask	924.4
60,000MWD/MTU, Cooling 3 Years / 100 tons HI-TRAC Transportation Cask	3275.0
HI-STAR 100 System Loading 40,000MWD / MTU, Cooling 5 Years	934.2

REFERENCE

- Nuclear Safety Act/Enforcement Decree/Enforcement Rule
- Transportation Procedure of On-site Spent Fuel (KHNP)
- Radiation Safety Management for Transportation of On-site Spent Fuel (KHNP)
- HOLTEC HI-STROM/HI-STAR Cask system safety evaluation report