

Introduction

Heavy-water reactor type nuclear power plants use heavy water for coolants and moderators. As a result, plenty of tritiums are produced by neutron activation process during nuclear fission reaction. Tritiums come from this process, exist as vapor and are exposed to personnels in controlled area and radiation workers by inhalations or skin absorption.

Also, some abnormal situations are happened such as massive heavy-water leakage and high density tritium leakage in reactor system, will take many human resources and time due to a lack of tritium respirators in abnormal situation dealing process for high level radiation at work area. Therefore, researches which combine the self-contained breathing apparatus (SCBA) with the plastic respirator are carried out to improve the dealing ability and working efficiency in abnormal situations.

Body

Abnormal radiation level is the case that field radiation level increases rapidly compare to the normal value. And abnormal situation is the case when the densities of noble gases and tritium in the air go up to 100 times for normal condition. However, the increase of radiation level due to radiation work plans is excluded.

In case of Wolsung unit 2 in 2004, the density of tritium due to a leakage of heavy water was 33~88 DAC in main access area and 591 DAC in leakage concerned work area at maximum.

Abnormal situation due to high tritium density, the workers can use plastic respirators and SCBA according to the Table 1. But when workers enter to the inside of nuclear reactor building, they cannot use plastic respirators since the tritium density of whole reactor building increases. Therefore they only can use SCBA. SCBA has a time limitation because the volume of air tank is limited and SCBA is furnished small amounts for emergency because it cannot be used in normal situation. So when workers are dealing with abnormal situations, there exist some

problems of SCBA use such as shortage of SCBA or air tank recharging.

Table 1. Standard of Tritium Protection Respirator Usage

Classification	Wearing Range	Operating Radius
Tritium Respirator	1 ~ 10 DAC	Wide Area
Air-line Respirator	Over 10 DAC	Narrow Area
SCBA	Over 50 DAC	Wide Area
Plastic Respirator	Over 50 DAC	Narrow Area

Result & Discussion

Former plastic respirators can be used without time limit in high tritium density because breathing air system is connected directly. But the connection is too short to access the work area, they are not used in abnormal situations. This connector development gives a mobility to those plastic respirators by linkages like Figure 1 and enables plastic respirator use in abnormal situations. Also this development combines plastic respirators with SCBA like Figure 2 so the plastic respirators get mobility in access to abnormal condition area. At work site, it is set to connect plastic respirators with breathing air system.



Figure 1. Picture of Connector



Figure 2. Picture of Connector Worn

This development installs button type valve to control the amount of supplied air for using time extension. Table 2 and 3 show the effect of the valve installation in moving time and working time at abnormal condition area.

As a result, possible working time in abnormal situation increases at least 3 times and dealing time with abnormal situation is shortened.

Table 2. Comparison of using time before and after the connector application

Classification	Before Application	After Application
Moving Time	About 20 minutes	About 20 minutes
Working Time	About 20 minutes	No limitation

note) Based on SCA 680

Table 3. Comparison of using time before and after the valve attachment

Classification	No Valve Attached	Valve Attached
50 Bar Reach	4 minutes	18~30 minutes
0 Bar Reach	4 min 30 seconds	24~35 minutes

note) Initial pressure 280 Bar

The working environment gets better since plastic respirators can be used in abnormal situation by development of connector. Also it is expected that radioactive wastes will be cut off because the less amount of disposable radiation protection equipments will be used.

Therefore, this development is expected to improve the working environment, reduce the unnecessary exposures and contribute to safe nuclear power plant operating by prompt deal with abnormal condition.