# Mock-up Training Effects for Steam Generator Lancing & FOSAR

Byeong-Mok Park*, Kyung-Wook Shin, Cheol-Wan Park, Ah-Ran Cha, Dong-Hyun Yoo, Min-Gyu Kim, and Do-Yeong Jung
SAE-AN ENGNIEERING.CO., 481-10 Gasan-dong, Geumcheon-gu, Seoul, Republic of Korea
*pbm@sae-an.co.kr

## 1. Introduction

The sludge lancing and foreign object search and retrieval (FOSAR) work on the secondary side of steam generator in nuclear power plant aims to improve the thermal efficiency and to preserve the tube integrity of the steam generator.
It is generally performed during planned outage overhaul.

Nuclear power plants (NPP's) are subject to the constraints of the working environment, unlike the general industry. Typical examples are radiation working environment involving radiation exposure, working environment contaminated by radioactive materials, low illumination environment and different types of steam generator structures for NPP's.

As a means to overcome the limitation of such a working environment, The Mock-up system can provide the useful utility. Before the sludge lancing & FOSAR work of the steam generator, mock-up is exercised before actual work is put in order to overcome the working environment of the nuclear power plant and to perform the work smoothly.

In this study, we analyze the work environment of sludge lancing & FOSAR and establish the mock-up system to reduce the work time.

## 2. Mock-up training

### *2.1 Mock-up training definition*

The police dictionary defines the definition of mock-up training as follows;

Mock-up training is training for trainees to achieve the set objectives or to perform a specific plan in a given situation. In other words, it is a training method that assumes the situation that the trainee will encounter during the work and allows the trainee to cope in that situation. Especially, the advantage of mock-up training is to reduce the gap between theory and reality, and emphasizing the teamwork and communication, and to improve the applicability and analysis to the real situation.

### *2.2 Work environment around steam generator*

The steam generator sludge lancing & FOSAR work in the reactor building is performed by a regular radiation work permit (RRWP) or a specific radiation work permit (SRWP). Especially lancing & FOSAR work, It is performed SRWP due to the large amount of radiation exposure.

According to the recent collective dose case, it can be seen that set up and dissolve of the lancing & FOSAR equipment of the It's occupied 22.3% of total exposure dose. The collective dose for each work is specified in Table. 1.

Table 1. Collective Dose Case

| Work | | Collective dose (Man-mSv) | Percentage |
|---|---|---|---|
| Lancing | Equipment Set up | 10.78 | 16.7% |
| | Equipment Dissolve | 3.59 | 5.6% |
| | Lancing | 21.70 | 33.7% |
| | Sum | 36.07 | 56.1% |
| FOSAR | | 28.23 | 43.9% |

The radiation controlled area of NPP's have various levels of radioactive contamination. In the case of lancing & FOSAR, it is grouped work the secondary side of the steam generator, but the work site may be contaminated with the high contamination level to the reactor building steam generator hand hole area. Because of the presence of body and equipment contamination, decontamination of the body and equipment can cause problems such as radioactive waste generation, internal exposure, and inhibit the integrity of equipment. Be careful of contamination when equipment transporting, set up and dissolve.

NPP's have high ceilings and are divided into

many compartments compared to other general industries, so installation and replacement of lighting equipment may not be smooth. Therefore, if necessary, a separate lighting fixture is installed to improve the low illumination working environment. However, the lighting of the overall working environment is in the dark, and the ability to perform work at low illumination is required.

The lancing & FOSAR equipment according to NPP's type may be the same or may be different. The power plant planned for lancing & FOSAR notify the purchase bid. As a qualified supplier make a successful bid, and the probability of the same company continuing to perform the same power plant is low. Therefore, It is necessary to check the equipment of the power plant where the work is to be performed, need to mastery, and to check that the equipment is in normal operation because there is an unused time for equipment that has been checked after use.

*2.3 Mock-up training*

The mock-up training system in the general work environment will reduce the time and safety accidents through mastery of work considering the following points.

- Theory of equipment training
- Actual equipment operation training
- Repeat training of equipment operation
- Carry out the actual work

The radiation working environment is a poor working environment such as contamination by radioactive material and relatively low illumination compared to general working environment. Mock-up training in the radiation working environment should have the following effects in addition to the general working environment to reduce radiation exposure and prevent the diffusion of contamination by radioactive material.

- Theory of equipment for prevent of foreign object inflow and occurrence of equipment contamination
- Actual equipment operation and inspection training
- Repeat training of equipment operation
- Repetitive training in consideration of radiation exposure reduction and time reduction in the radiation working environment

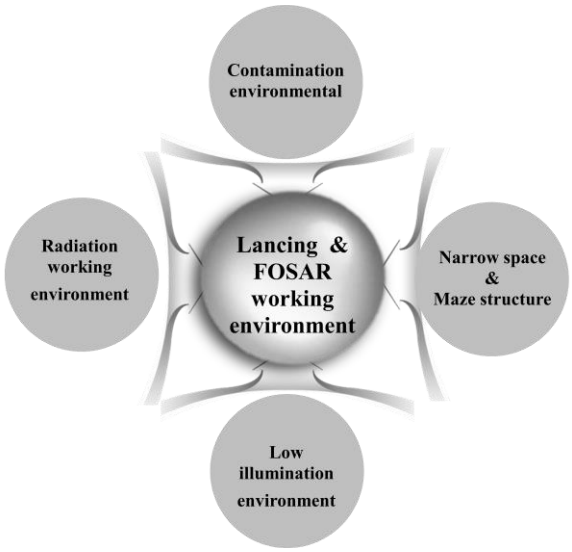


Fig.1. Lancing & FOSAR Work Environment.

## 3. Conclusion

Unlike general mock-up training, there are several constraints of working environment for mock-up training of steam generator lancing & FOSAR in NPP. In order to obtain optimal operation efficiency, Mock-up training suitable to the working environment in NPP should be established and implemented. In terms of the number of mock-up exercise, the mock-up training cannot be performed many times because of the time limitation before the field work. Also, a fewer times of the mock-up exercise can be problem. The number of times of mock-up exercise could contribute to the reduction of radiation exposure by shortening the time of lancing & FOSAR work.

Therefore, it is necessary to study the optimal number of times of mock-up by analyzing the characteristics of equipment and work environment in the steam generator lancing & FOSAR.

## REFERENCES

[1] Developed a cartridge filter cutting device after removing sludge on secondary side of steam generator of nuclear power plant, 2013. 10. 17 Korea radioactive waste society fall conference.
[2] Police Dictionary.
[3] Regulation about the industry safety and health Standard, Ministry of employment and labor No 160. 2016. 7. 11.