An Analysis of Characteristics of Radioactive Aerosol by Cutting Methods Available for Decommissioning of Nuclear Power Plants

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1. Introduction

Most of the studies on radioactive aerosol have been focused on critical accidents. Radioactive aerosol is also the biggest factor that affects the internal explosion to radiation of the workers during the decommission process. Therefore, it is required to analyze the characteristics of radioactive aerosol generated before starting decommissioning of nuclear power plants. The sources of radioactive aerosol during decommissioning of nuclear power plants include the situations, such as cutting, dissolution, generation of dust and incineration. This study provides scope of cutting for decommissioning of nuclear power plants, cutting time per cutting method, and the size of radioactive aerosol generated.

2. Application of cutting technology for decommissioning of nuclear power plant

The cutting process during decommissioning of nuclear power plant applies to Secondary System tube, Concrete Iron plate, facility, Primary Cooling pipe, Concrete Bioshield, and Concrete wall.

3. Generation of radioactive aerosol

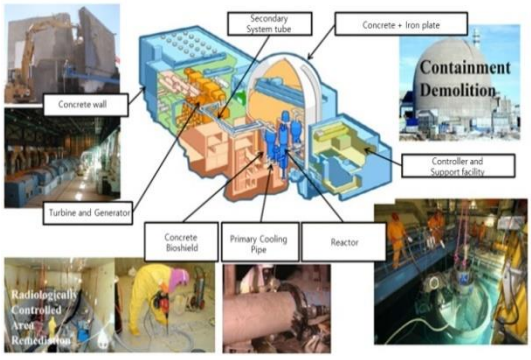

Fig. 1. Cutting range when decommissioning nuclear power plant.

3.1 Critical accident

In accidents of nuclear power plant, aerosol is generated mainly due to nucleation of supersaturated steam. Radioactive steam evaporated from hot core remains spreads from the core remains. The radioactive steam gets supersaturated due to low temperature, and the supersaturated steam molecules agglomerate with each other or with other heterogeneous particles, generating aerosol particles.

3.2 Decommissioning of nuclear power plant

During decommissioning of a power plant, nuclear aerosol is generated due to cutting or melting the pipes and concrete in the primary system.

4. Cutting methods and characteristics

In order to understand the speed of cutting process and the size of aerosol by cutting methods, we have analyzed the BR-3 pipe cutting case in Belgium. In analysis of cutting speed by thickness, Plasma cutting and Flame cutting are found to be superior to other technologies. For the influence of pipe thickness on the aerosol particle, it was found that Flame cutting and Arc saw method generate relatively large radioactive aerosol particles. Most of the radioactive aerosol particles of 5~10 μm are filtered by nose hair or mouth. Those of 1~5 μm are adsorbed in bronchial tubes and lungs. However, the radioactive aerosol particles of 0.1~1 μm move to and adsorbed in alveoli. The alveolus is the organ where oxygen in blood is exchanged. Radioactive aerosol particles adsorbed in alveoli causes exposure of the whole body to radiation.

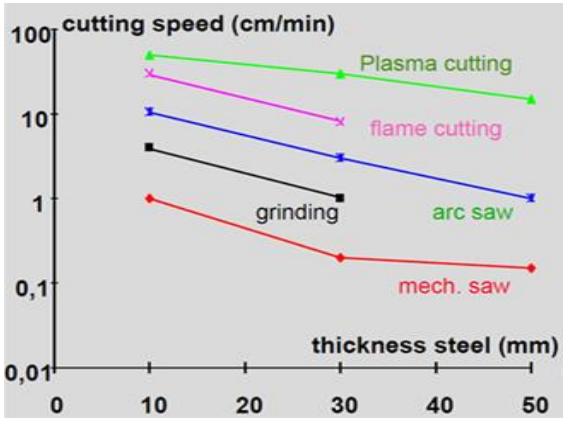

Fig. 2. Cutting speed by cutting method.

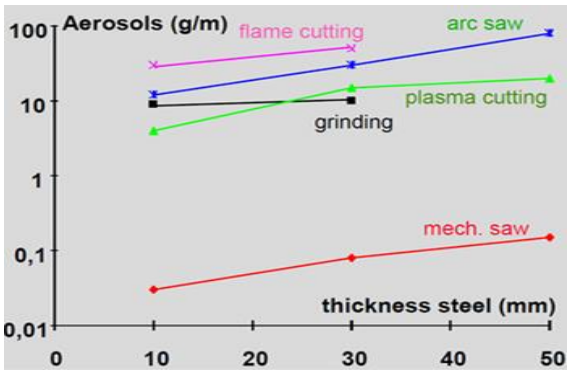

Fig. 3. Size of aerosol particles by cutting method.

5. Conclusion

During decommissioning of nuclear power plants, Plasma cutting and Flame cutting are most appropriate as they require short process time and generate relatively large radioactive aerosol particles. The best way of the cutting process for decommissioning of nuclear power plants is to calculate the volume of radiation to be exposed by the workers, and to estimate the optimum work time. In preliminary estimation of the volume of radiation exposed, it is difficult to measure in some pipes and facilities due to complex structure of nuclear power plants. It is possible to establish the radiation exposure scenario through the computer codes based on the experiment result, and to utilize the data for future decommissioning of nuclear power plants.

REFERENCES

[1] S.G Park, H.R Kim, D.G Lee, U.S Jung and K.J Jung “A State of the Art on The Dismantling Techniques for the KRR-1 & 2 Decommissioning”, KAERI/AR(2001).