Cite abstract as Author(s) (2009), Title, European Aerosol Conference 2009, Karlsruhe, Abstract T123A01

Determination of loss factors of aerosol particles in the sampling systems of nuclear power plants

R.F.W.Jonas[1] and G.F.Lindenthal[2]

[1]TÜV Nord SysTec GmbH & Co. KG, Große Bahnstr. 31, D-22525 Hamburg , Germany,
[2]Ingenieurbüro für Partikeltechnologie und Umweltmesstechnik, Steinweg 8, D-34314 Espenau Germany

Aerosol measurement, particle deposition, radioactive particles, nuclear sampling systems

According to the German nuclear technical rule KTA 1503.1 the sampling system of a nuclear power plant must be able to collect aerosols with aerodynamic diameters between 0.1 µm and 20 µm with pipe retention factors below 3.

As with all measured quantities the stack emission of radioactive material of a nuclear power plant with exhaust air includes an uncertainty. This is caused by the statistical error and additionally by the non-representative sampling and the deposition of aerosols in the sampling systems. The non-representative sampling results from the insufficient mixing of the air (inhomogenous concentration) and from the non-isokinetic flow in reaching the inlet of the screen of the sampling system. The deposition depends on the particle diameter and is caused by molecular diffusion, impaction and sedimentation. The ratio of the mass concentrations in front of the screen and at the end of the sampling system is called the pipe retention factor.

Pipe retention factors and loss factors (without consideration of non representative sampling) are investigated for sampling systems of different nuclear power plants in Germany using three methods of determination:

1) Dispersing of test aerosols directly into probes of the screen of the sampling system and comparing the aerosol concentrations with those at the end of the sampling system
2) Generation of a defined quantity of aerosol particles at the bottom of the chimney and measuring the particle concentrations by using aerosol collectors or aerosol monitors at the end of the sampling system
3) Measuring the size distribution by number of the ambient aerosol in the chimney in front of the screen and at the end of the sampling system with optical particle counters.

The experimental results are in compliance with theoretical estimations. The measured loss factors and pipe retention factors lie below 3. The transfer properties of the sampling systems for larger particles (aerodynamic diameters up to 3 mm) also have been investigated. The results show that the sampling systems are suitable even in these cases.

The presentation gives a survey of the measured pipe retention factors. The results of the three methods of determination are compared indicating advantages and disadvantages based on our experiences.