DEVELOPMENT AND QUALIFICATION OF AN AEROSOL GENERATOR FOR INVESTIGATIONS UNDER THERMAL-HYDRAULIC SEVERE ACCIDENT BOUNDARY CONDITIONS

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ABSTRACT

During a severe accident, the largest part of the radioactive inventory inside the containment consists of airborne particles of different species. They are generated in the reactor pressure vessel and then released into the containment. The major aim of this project is to investigate the behavior of aerosols under the thermal-hydraulic boundary conditions of severe accidents with a core melt-down. This paper deals mainly with the generation of representative non-soluble aerosols under those conditions as well as the design of a test facility.
The initial idea was to design a test facility in which thermal-hydraulic boundary conditions of temperatures up to 200°C, pressures up to eight bar gauge, relative humidity up to 100 % and condensation conditions are possible to be investigated. Furthermore, particles are limited to solids of tin dioxide and silver. For the test facility a particle concentration was defined from 0.1 g/m³ to 5 g/m³ with a specific size distribution (aerodynamic diameter) less than or equal to 10 µm.
These requirements were a main challenge for the aerosol generation units. Therefore, a suitable unit for each material was designed to generate reproducible particles constantly for more than eight hours. For the non-soluble particles, silver and tin dioxide, a mechanical dispersing unit was designed. In the design, the flow and the particle discharge were optimized to increase the efficiency of the generation unit.

KEYWORDS
aerosol behavior, aerosol generation, containment phenomena, severe accidents

1 INTRODUCTION AND MOTIVATION

During a severe accident, the largest part of the radioactive inventory inside the containment consists of airborne particles of different species. They are generated in the reactor pressure vessel and then released into the containment. Much research in recent years has focused on developing codes to simulate the behavior of the aerosols in the containment [1, 2]. The main problem is that for simulations of these phenomena, experiments with a sufficient measuring technique and a high resolution are needed. Therefore, the measurement and the characterization of aerosols is a challenging area, especially the measurement of the particle size distribution and the relative humidity. Normally commercial aerosol characterizing measurement devices measure ex situ and under environmental conditions. That is the reason why commercial devices are mostly designed for ambient pressures and temperatures. Therefore, the investigated atmosphere must be conditioned to lower pressures and temperatures. With a national funded project called IN-EX, the question of if it is possible to develop and qualify optical measurement