論 文 の 内 容 の 要 旨

論文題目　Numerical modelling of flooding in nuclear reactor building based on Lagrangian approach
（ラグランジュアプローチに基づいた原子炉建屋内の溢水の数値モデル）

氏　名　汪 子迪

The Fukushima nuclear accident raises the importance of flooding study in nuclear reactor buildings. The flooding can damage the safety-related structure, system and components. Moreover, during the floods, some floating bodies, such as broken doors, emergency power, or even parked vehicles, could cause severe damage to the plant safety.

The Explicit Moving Particle Simulation (EMPS) method, one type of the Moving Particle Simulation method, is applied to model flooding by its fully Lagrangian approach with high calculation efficiency. Applicability of the wall boundary model is firstly investigated and an improved polygon wall boundary model is proposed and tested for arbitrary geometries. The EMPS method with the improved polygon wall boundary in modelling flooding is then investigated by verification and validation. As a supplement to provide its applicability, the internal flooding process of a pressurized water reactor AP1000® is simulated based on a simplified model.

In addition, in order to study the floatable bodies transport during floods, the Discrete Element Method (DEM) is employed to model the solid-solid interaction. A coupled numerical scheme based on the EMPS and DEM is proposed and further validated by several experimental results. A sensitivity study of damping coefficient is preliminarily discussed for a 3D complex dam break flow. Finally, a more realistic internal flooding process in AP1000®, which is with multiple large floatable bodies, is demonstrated. The results achieved so far reveal that the coupled method is capable for application to flooding analysis with large bodies transport in the nuclear reactor buildings.