PAPER 34.2

Velocities Measurements for Pressurized Water Reactor Research using PIV-CFD

J. Stefanini*, G. Mignot**, V. Saldo**, G. Baroi***, T. Conte***
(*)TSI France Inc., Marseille, France
(**) CEA Cadarache, France
(***) Framatome, Paris, France

ABSTRACT

Since several years, a R&D action, based on numerical simulation and experiments of flow into PWR vessels was initiated at Framatome and CEA. The aim is to reach a better understanding of the thermal hydraulic phenomena and their consequence into the whole nuclear vessel. This paper presents a comparison between numerical simulation and experimental data obtained using PIV technique. Measurements have been performed into the hot legs of a 1300 MW PWR mock-up.

The experiment was carried out on a scaled down PWR model. The facility represents the upper plenum of such reactor with its internal components (control rods guides, support columns, …) and its hot legs. The 450 l/s nominal flow rate is symmetrically distributed on 4 hot legs through regulation gates.

One TSI PIV system including 200 mJ laser and high-resolution cross correlation camera (1K x 1K pixels) was used to describe the flow behavior. For practical reasons and to avoid image distortion due to circular optical access, the camera is located at the end of the hot leg, which is equipped with a flat glass window.

Measurements were carried out in one hot leg and we will present in this paper data obtained in three different cross section planes (perpendicular to the main flow direction).

The numerical simulation has been done using a standard CFD code that allows computing thermohydraulics phenomena into complex geometrical situation. It is solving 3D Navier Stokes equations using finite volume method and allows computing steady and unsteady conditions.

In order to make a realistic comparison between experimental results and numerical simulation, we averaged the PIV data over 100 instantaneous velocities fields.

The results show a good agreement between experimental data and CFD regarding the velocity spatial distribution and general flow behavior. However it is necessary to investigate with more detail in order to have a good agreement not only when comparing the general flow behavior but also comparing numerical data (velocity magnitude).