ANS Best Estimate Plus Uncertainty International Conference (BEPU 2018) BEPU2018-323
Real Collegio, Lucca, Italy, May 13-19, 2018

EXPERIMENTAL CHARACTERIZATION OF A THERMOCOAX WATER LEVEL DETECTOR FOR IN-CORE MEASUREMENTS

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ABSTRACT

In-core instrumentation reliability in NPP's is a fundamental issue that requires a wide phase of research and development including experimental characterization and ultimate verification at normal and abnormal conditions.
In two Pressurized Water Reactors (PWR) of Generation-3 under construction in China, a reactor pressure vessel level detector developed by Thermocoax will be installed as a part of monitoring system in case of accident or post-accident conditions.
The instrument detects the water level variation that occurs for instance in case of loss of coolant accident (LOCA).
SIET has conducted an experimental campaign for the verification of the detector performances at various combinations of pressure, temperature and level reflecting the normal and abnormal conditions of a PWR. A high pressure loop has been designed and built to host the level detector and provide the specified test conditions. The loop has been equipped with a set of instruments including pressure, differential pressure, temperature and mass flow meters to record the system conditions and to control the plant.
The operating principle of the sensor is based on the response to level variations of heated thermocouples compared to unheated ones. The heated thermocouples and the related electrical heaters are placed inside a metal shell hosting the unheated thermocouples as well.
The manufacturing process developed by Thermocoax allows to fit a significant number of temperature sensors in a reduced space for a rapid and reliable measurement of the level.
The water level reference measurements for the detector characterization are provided by a series of differential pressure sensors and fluid thermocouples located on the experimental vessel hosting the probe.
Emptying and refilling tests have been performed at different level variation rates, different pressure and temperature conditions. Moreover sensitivity tests have been performed to investigate the effect on the level signal of possible points of contact between detector shell and hosting tube.
Experimental results confirmed the level detector expected performances.