Contribution ID: **50** Type: **Oral Presentation**

#5-50 Experimental and numerical examination of different springs dimensions for non-destructive measurement of the internal pressure and composition of PWR fuel rods

Friday, June 13, 2025 10:40 AM (20 minutes)

During the irradiation process, fission gases, such as helium, xenon and krypton, are released and the pressure inside the fuel rods increases. The internal pressure as well as the composition of the fission gases present within the plenum of the fuel rod are of major interest to nuclear power plant operators as they can be accurate indicators of the fuel behavior and reflect the overall fuel performances in operation, during shipping and in long term storage. These parameters can be used, notably, for the definition of fuel burn up limits. The Acoustic team of the Institute of Electronics and Systems (Montpellier University & CNRS), in collaboration with EDF, are working on the implementation of a non-destructive acoustic method to perform measurements on fuel rod assemblies stored in spent fuel pools. Performing non-destructive measurements directly on-site would prevent heavy, sensitive and costly operations and would enable larger measurement campaigns to enrich statistical databases.
The principle of the measurement is to determine the speed and attenuation of the acoustic waves propagating in the gas at the plenum level of the rod. This measurement is performed using a piezoelectric transducer pressed onto the rod to generate an acoustic wave. Then, the reflections of the sound wave are received by the transducer and analysed : the composition is linked to the time of flight of the acoustic signal and the pressure can be retrieved by a calibration process analysing the amplitude of the reflected signal. In 2012, the feasibility of the measurement has been proved on tests performed on irradiated fuel rods. During the past 10 years, important improvements have been carried out on the sensor design and the data processing method in order to target lower pressure and composition ranges. The actual generation of sensors enable measurements covering a wider range of the fuel cycle from 30 bars to 70 bars and down to 0.0% of xenon, i.e. pure helium. The challenge of the measurement lies in the different parameters, which can evolve during the fuel cycle, and need to be taken into account.
The spring used to maintain mechanically the fuel pellets inside the rod constitutes one of the most important parameter to consider. The spring is located at the plenum level and can affect the propagation of the acoustic waves and more precisely, decrease their intensity. It implies that, the thicker the spring, the smaller is the measured amplitude. Nevertheless, this effect cannot be simply investigated during the calibration process as for different assemblies and manufacturers, the springs are geometrically different. Therefore, in our model, this element is studied as part of the losses that are recalculated for a given dimension. The different improvement that led to the validation of the system in laboratory conditions will be presented as well as the consideration, by the numerical model, of the different type of springs.

Primary authors: AYACHE, Diba (IES, Univ Montpellier / CNRS); GILLET, Stanislas (EDF/DCN/PEL/DER); RAMIANDRISOA, Liana (EDF/R&D/PRISME); REECE, Christopher (EDF/DCN/PEL/DER); FERRANDIS, Jean-Yves (IES, Univ Montpellier / CNRS)

Presenter: AYACHE, Diba (IES, Univ Montpellier / CNRS)

Session Classification: #05 - Nuclear Power Reactors and Nuclear Fuel Cycle

Track Classification: 05 Nuclear Power Reactors and Nuclear Fuel Cycle