

## INTERNSHIP OFFERING – Master 2

### *Monitoring corrosion of low-temperature carbon steel as a function of pH*

**Location & labs:** EDF R&D Lab. Les Renardières (Sud 77) Laboratoire de Réactivité de Surface (LRS) at Sorbonne Université – Paris

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### **Research project**

Protecting secondary circuitry from corrosion during construction/testing and unit shutdown phases, particularly carbon and low-alloy steels, is a major challenge for the French nuclear power plant. Current practices for the wet preservation of steam generators, involving the use of large quantities of hydrazine, pose a problem, as this product is CMR (Carcinogenic, Mutagenic and Reprotoxic), its future use is not assured (REACH regulations), and its supply appears increasingly uncertain. Its substitutability must therefore be assessed. Less toxic substitutes have been under study for several decades, and the use of these alternative products in EDF power plants is currently under discussion, in particular for the preservation of materials during the construction and testing phases of the EPR2 reactors. With regard to the shutdown conservation of high-voltage reactors in operation, engineering is also looking into the possibility of reducing the required hydrazine concentrations, or even proceeding with high-pH conservation without a reducing agent.

In view of the amount of data available in the literature, in addition to that obtained internally at EDF R&D, and the recurring and growing needs, the idea of developing a corrosion modeling tool for carbon and low-alloy steels was discussed. In addition to capitalizing on data already acquired and optimizing our test campaigns, this tool is needed to predict, for example, the impact on deposited oxide layers of a change in chemical conditioning. The simulation could also be used for other applications, such as the corrosion of carbon steels in reducing agent-free media like river water. The corrosion kinetics thus determined will serve as input data for the prediction of degradation phenomena.

The aim of this internship is to develop an experiment to monitor the corrosion rate and kinetics of steel coupons in various aqueous media of interest, using electrochemical methods (corrosion potential monitoring, Electrochemical Impedance Spectroscopy and polarization curves). These measurements will be used to observe the passivation of steel in the medium under consideration, measure the corrosion rate to monitor its evolution over time, and simulate this evolution.

The proposed work plan is thus:

- Literature analysis;
- Setting up the test: setting up the experiment in the laboratory, then testing its correct operation;
- Perform corrosion tests at various pH values and corrosion rate measurements. Characterization of corroded coupons (Scanning Electron Microscopy)

### **Applicant profile**

- Student in 2<sup>nd</sup> year of Master or 3<sup>rd</sup> year of engineering school with a good background in electrochemistry and/or material science
- Autonomous, meticulous, rigorous
- A good level of English is required

**Internship period:** Ideally from mid-January 2024 for 6 months

**Applications:** Send CV + covering letter + grades for the year Bac +4

**Possibility for a Doctoral thesis:** Yes