

# Building programmable study platform for Activated Corrosion Products assessment

Alberto Previti<sup>1,2,\*</sup>, Benjamin Larue<sup>1,3</sup>, Nicholas Terranova<sup>2</sup>, Simone Noce<sup>2</sup>, Andrea Colangeli<sup>2</sup>, Davide Flammini<sup>2</sup>, Nicola Fonnesu<sup>2</sup>, Michele Lungaroni<sup>2</sup>, Fabio Moro<sup>2</sup>, Rosaria Villari<sup>2</sup>

<sup>1</sup>ENEA Nuclear Department, via dei Mille 21, 40121 Bologna, Italy

<sup>2</sup>ENEA Nuclear Department, via Enrico Fermi 45, 00044 Frascati, Italy

<sup>3</sup>IMT Atlantique, 4 rue Alfred Kastler, 44300 Nantes, France

Corresponding Author Email: [alberto.previti@enea.it](mailto:alberto.previti@enea.it)

Activation Corrosion Products (ACP) are one of the more challenging aspects of radiation protection assessment for the safety analysis nuclear installations. The generation, transport, and deposition of ACP in cooling circuits require powerful simulation solvers capable of representing the interplay of different physical phenomena ranging from thermal-hydraulic, chemistry, neutron activation, and radioactive decay. At the same time, the complexity of the design of cooling circuits, the harsh and peculiar radiation environments, and the peculiarity of the materials and operational scenarios of nuclear fusion machines demands the possibility to perform parametric studies, define alternative irradiation modelling, and to combine the results of the ACP simulation with subsequent post-processing and additional side calculations.

While in the framework of fusion nuclear research several initiatives and ACP calculation strategies have been proposed, the OSCAR-Fusion code, developed by the CEA with the support of EDF and Framatome, is currently considered the reference, especially for the studies in support of the ITER safety demonstration.

The goal of this presentation is to provide an overview of software architecture strategies to construct a programmable study platform for Activated Corrosion Products assessment based on the experience acquired by ENEA in the framework of EUROfusion studies in support of DEMO and ITER. By starting with the point of view of the engineer in charge of the design and safety assessment and by considering the typical numerical modeling strategy for the ACP simulation, the components in charge of defining the study platform will be outlined.

The platform under development is based on the separation of responsibility following the three-tier architecture. The presentation layer exposes the interface on which the engineer can define the ACP study by representing the circuit in the form of control volumes with materials and geometries associated, and the typology of the study to be performed, and the respective tools to perform meaningful post-processing. The data layer is composed of a set of plugins capable of serializing the internal data structures into the actual input decks for the target calculation codes, e.g. OSCAR-Fusion for ACP simulation, FISPACT or OpenMC for inventory calculations, and data science structures capable of representing and processing the output inventories to produce meaningful aggregated results. The application layer implements the business logic capable of transforming the engineering needs to the actual simulations to be done and vice versa. Special emphasis has been placed on the development of the platform as a programmable set of high-level Python classes, so that the final user may be able to define a customized workflow.

An example of application to the studies previously done at ENEA, e.g. the ITER WCLL and/or the Frascati ACP loop, will be provided.

Type of contribution:	Poster session	<input type="checkbox"/>
	Oral Contribution	<input checked="" type="checkbox"/>