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Target Accuracy Requirements and an evidence-based background for MSFR safety assessment

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From the very beginning of the nuclear era, a mission of fast neutron reactors (FRs) has been foreseen [1], [2] in its double functionality, combining a generation of power and a conversion of fertile materials (U-238 and Th-232) into new nuclear fuels to make energy resources practically inexhaustible.
Since then, due to conjuncture changing, one used to consider fast reactors as elements of the global fuel cycle intended to play as traditional roles –to be a robust source of energy and artificial fissile materials, –as complementary ones –to burn plutonium and minor actinides accumulated in LWRs spent fuel [3].
At the same time, the nuclear engineering community considers, inter alia, some innovative FR concepts with fuel reprocessing fully immersed in a nuclear reactor like Molten Salt Fast Reactors (MSFRs) [4].
Over there, of course, enhanced flexibility of the fuel cycle in MSFRs should be supported by their extraordinary safety potential [3]. Unfortunately, in the case of MSFRs due to a fundamentally limited operational background, assessors have to rely, largely, on comprehensive simulations than on pure expert judgment.
Of course, these simulations, models, and relevant tools should be somehow validated against objective observations to ensure a sufficiency of their Predictive Capability Maturity (PCM) [5]. Yet any integral experiment (IE) taken alone cannot reproduce phenomena or processes of interest while an extrapolation basing on indirect data and Data Assimilation (DA) can [6].
These indirect IEs might be selected 1) focusing on phenomena essential as for reactor control as for accidental process management, 2) combining nuclear-driven and non-nuclear experimental data in the validation of relevant codes and models, and 3) establishing realistic Target Accuracy Requirements (TARs) for the best estimate and penalizing models.
We are discussing some factors of informativeness of IEs in terms of pre-defined "accidental states"(ASs)–subsequent phases of the core degradation.

[1] E.Fermi, The Future of Atomic Energy, United States, (1946), http://www.osti.gov/accomplishments/documents/fullText/ACC0043pdf
[2] Nuclear Fuel Cycle Science and Engineering, 1st Edition, Ian Crossland, Woodhead Publishing, 2012
[3] J.Serp et al., The molten salt reactor (MSR) in Generation IV: Overview and perspectives, Prog. Nucl. Energy, 77, 2014
[4] I.Babuska, J.T.Oden, Verification and validation in computational engineering and science: basic concepts, Computer Methods in Applied Mechanics and Engineering, 193, 36–38, 2004
[5] G.Palmiotti et al, A global approach to the physics validation of simulation codes for future nuclear systems, Annals of Nuclear Energy, 36(3), 2009

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