Fast reactors are flexible towards the plutonium management : the European project PuMMA has provided demonstrations.

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The European project PUMMA (Plutonium Management for More Agility) is dedicated to the different Pu management options in GEN4 systems to assess the impact on the entire fuel cycle. Fast neutron reactors with associated fuel cycle strategies have been chosen to cope with these options because they are flexible: they offer the possibility of isogeneration, burning or breeding plutonium.
22 partners contribute to this project with a total budget of around 7 M€. PUMMA started in October 2020.

The key Objectives

- Evaluate fuel cycle scenarios: Assess the impact of different plutonium management strategies on the entire fuel cycle.
- Study MOX fuel behavior: Characterize MOX fuel with 45%Pu content through irradiation experiments in both nominal/incidental conditions.
- Investigate thermo-mechanical properties: Examine the thermo-mechanical properties of MOX fuel across a range of compositions and irradiation levels.
- Conduct dissolution tests: Study the dissolution behavior of spent fuels with high plutonium content, extending beyond previous studies limited to 30% concentrations.

The methodology and main outcomes PUMMA employs a multi-faceted approach involving:

- Extended qualification domain: Identifying the current technological readiness level (TRL) in each field.
    - Expanding the licensing domain of MOX fuel to cover a wider range of compositions and conditions in order to cover different objectives for plutonium management. This was based on the results of three experimental irradiations.
    - Expanding the PUREX process for dissolution of spent fuel up to 45%Pu with a complete experimental programme. o Expanding the fuel properties laws from 20 to 100%Pu
- Code calibration and validation: Verifying the capabilities of computational systems.
    - Improving the validation of codes used for fuel cycle simulations with several options: open to closed fuel cycle, Pu burner-breeder-isogenerator, Pu mono

or multirecycled in SFR, LFR and GFR. Improving also the accuracy with sensitivity studies on the most impacting parameters.
    - Improving fuel performance analysis with benchmark exercises among several codes with code-to-code and code-to-experience comparisons.
- Experimental data: Conducting experiments to support code validation and safety assessments.
    - 3 post-irradiation experimental programmes on irradiated fuels CAPRIX, TRABANT1 & 2
    - Properties measurments on MOX fuels with 40 to 100%Pu.
    - Dissolution tests on powders, fresh fuels and irradiated fuels in different conditions (time, HNO3)
- Education and training: experts and young researchers involved together in all the R&D activities
    - Secondments of students to european labs for several weeks/months
    - Production of a MOOC (Massive Online Open Course) on fuel cycle for GENIV systems.

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