

## Developing methodologies for the processing and encapsulation of orphan fuels and residues

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### ABSTRACT

Orphan fuels and residues are terms used to describe the nuclear waste legacy that currently does not meet the specifications required for the transport, reprocessing and disposal of nuclear waste by current methods. The orphan fuels and residues are generated from prototype, experimental or research reactors, from earlier nuclear industry activities, samples from Post Irradiation Examination (PIE) or laboratory wastes. The majority of the orphan waste inventory in the UK is held at Sellafield. The future management of these orphan fuels and residues needs to be addressed fairly promptly, with possible routes including but not exclusive to; continued storage, chemical treatment and reprocessing or encapsulation for long term disposal.

The composition of orphan fuels and residues are wide ranging but typically include uranium and/or plutonium in the form of metals, oxides or carbides. In some cases these fuels are irradiated and the media in which they are stored (e.g. solid, aqueous, oil) will provide additional challenges.

Initially we will investigate the feasibility of high temperature molten salts reprocessing methods for the treatment of carbide containing orphan wastes. Different combinations of molten salts will be used such as alkali chlorides or alkali carbonates along with different oxidising agents such as Cl<sub>2</sub>, O<sub>3</sub> or NO + NO<sub>2</sub>, for their ability to dissolve this waste type. The salt selection is of key importance for this application and it is important to not only consider the chemical properties but also the behaviour of the salt in a highly radioactive environment. If dissolution is found to be successful, methods for the separation of the valuable actinides (e.g. <sup>238</sup>U and <sup>239</sup>Pu) will be studied. We will also investigate the molten salt method above relative to solution based approaches.

The final part of the project will investigate methods for the encapsulation of any orphan fuels or residues that are unable to be processed or recycled. Any waste fuels that are halide contaminated (in particular Cl contamination) will have to be pre-treated before encapsulation to remove the halide or to concentrate the actinide waste. This is because halide provides additional challenges especially in glass encapsulation since corrosion becomes an issue.

The poster presented will give an overview of the orphan fuel problem and detail the molten salt process to be studied along with the encapsulation methodologies.