Studsvik

Treatment and conditioning of metallic intermediate level waste

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Abstract

In 2011 SKB started an R&D program for evaluating different disposal concepts for LL-LILW. The purpose was to develop alternative repository concepts and conditioning methods for LL-LILW and to evaluate and compare them from a range of parameters. A comparison between identified repository concepts was reported by SKB in 2013. The material should be of such a quality that SKB can make decisions of which concepts that are to be further investigated in a safety analysis.

As a part of the R&D program for the LL-LILW disposal facility, Studsvik was assigned to investigate whether melting of metallic LL-LILW is technically feasible and, if so, what the requirements are to build and operate such a facility. Specific concern was given to the following metallic components:

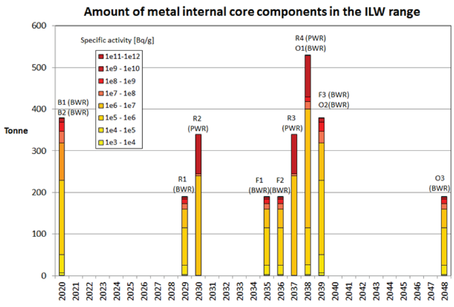
- Core components and reactor internals from both boiling water reactors (BWRs) and pressurized water reactors (PWRs).
- Reactor pressure vessels from PWRs.

Conclusions are

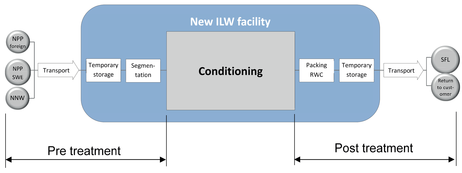
- Studsvik also investigated alternative techniques for embedding of metallic ILW components.
- Conditioning by embedding has potential to ensure long-term safety
- Die casting and direct loading were considered both technically possible and economically realistic.

Introduction

- Sweden fronts its first NPP decommissioning in 2020.
- In addition significant amounts of core components from maintenance and upgrades are stored awaiting a conditioning and disposal route



Process flow



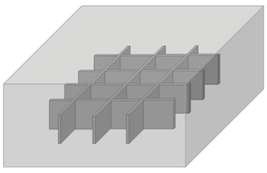
Conditioning concept

Long term safety

- Low area/volume ratio (lower exposure area for corrosion)
- Homogenized activity gives an evenly distributed activity within the ingot resulting in a lower surface activity.

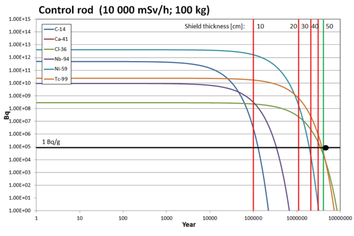
Direct embedding of ILW

- Direct embedding of ILW components to delay corrosion and leakage of radioactivity in final repository
- Embedding material should if possible outlive the decay of critical nuclides in the component until harmless levels have been reached
- Embedding material should be corrosion resistant, non brittle and dense
- Embedding also decrease the dose rate and thereby simplifies handling



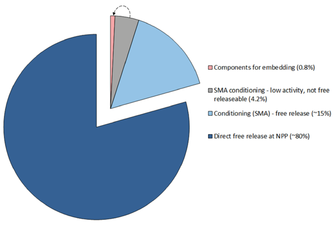
Long term safety – Example

- Delayed corrosion by embedding component in steel (corrosion rate 0.1 μm/year)
- The conditioning concept has potential to ensure longterm safety by delaying corrosion of component
- Additional advantage with less area/volume ratio for some components
- Additional advantage with avoided risk with leakage from sealing of package lid



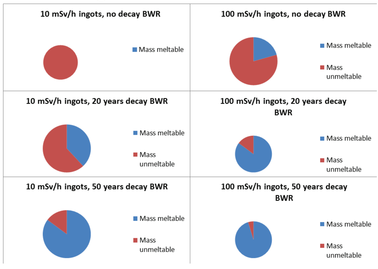
Other advantages

Decommissioning of metal components for a BWR reactor



Reuse of material subject to disposal possible

Percentage meltable, BWR internals



Conclusions

Advantages for melting as conditioning method do not out-weigh the safety and handling issues of processing metals with high dose rates.

Embedding of ILW is preferred compared with direct melting as

- Leakage of radionuclides can be both delayed and decreased
- Has potential to strengthen the repository long-term safety case
- Simplifies post-treatment handling

Embedding techniques

- Die casting and direct loading were considered both technically possible and economically realistic

Further investigations on the subject are needed.

Percentage meltable, BWR (RPV + internals)