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In-Can Vitrification of ALPS Slurries from Fukushima Effluent Treatment Waste using DEM&MELT technology

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Introduction

After the accident in the Fukushima Daiichi nuclear power plant, a large amount of contaminated water has been treated using several decontamination systems. Various natures of adsorbents and chemicals have been used in these systems and the resulting waste — Fukushima Effluent Treatment Waste (FETW) — have been stored on Fukushima Daiichi site. Consequently, management routes for treatment and disposal of FETW have to be defined. One of the most promising treatment method for final disposal is vitrification using the DEM&MELT technology. This technology is developed within the consortium gathering CEA (French Alternative Energies and Atomic Energy Commission), Orano, ECM Technologies and Andra (French national radioactive waste management agency), in order to offer an in-situ, robust, simple and versatile In-Can vitrification solution, adapted to the requirements of decommissioning and dismantling operations. An applicability evaluation contributing for development of the DEM&MELT technology to treat FETW has been performed by CEA, Orano and ANADEC between 2018 and 2021 through a funding from the Japanese Ministry of Economy, Trade and Industry as The Subsidy Program “Project of Decommissioning and Contaminated Water Management”.

In-Can Vitrification of ALPS Slurries

A large amount of waste have been stored on Fukushima Daiichi site. Among this waste, ~80%vol. are sludges and slurries that have been generated by three systems: ACTIFLO, ALPS and Evaporative concentration apparatus. The ALPS (Advanced Liquid Processing System-Multi Radionuclides Removal) system itself generated about 70%vol. of sludges and slurries with two types of slurries produced by iron hydroxide coprecipitation and calcium carbonate/magnesium hydroxide coprecipitation. Laboratory scale studies have shown that it is possible to incorporate a mixture of both types of slurries into a borosilicate matrix with high waste loading. Based on an upscaling methodology, next stages consisted in (i) evaluating the volatility of radionuclides surrogates during elaboration on bench scale mockup of the DEM&MELT process and (ii) producing, on an In-Can pilot scale process, a container of about 100kg of vitrified waste by direct feeding the slurry mixture. Pilot-scale tests results permitted to improve the feeding system. The next step was to produce a 300 kg CAN for testing on the DEM&MELT industrial prototype available at CEA Marcoule (France), equipped with the improved feeding system. The purpose of this paper is to highlight the applicability of treating ALPS slurries, representing the major volume of waste present in FEWT, using DEM&MELT technology.