Radionuclides usually migrate slower than the flowing water due to sorption and matrix diffusion. The performance assessment assumes that retention takes place mostly in the vicinity of the deposition holes. REPRO (RETention Properties of ROck matrix) experiments analyzed the matrix retention properties of the rock matrix under realistic conditions deep in the bedrock in ONKALO underground characterization facility at Olkiluoto, Finland. The objective was to investigate tracer transport in the rock matrix, which was representative to the near-field of the final disposal repository of the spent nuclear fuel, and to demonstrate that the assumptions made in the safety case of the deep geological spent fuel repository were in line with site evidence.

REPRO is composed of several supporting laboratory and in-situ experiments which investigate the retention properties under different experimental configurations. The first in-situ experiments were water phase diffusion experiments performed 2012-2013. Through Diffusion Experiment (TDE) studies diffusion and porosity properties of rock matrix in stress field of repository level and sorption properties of nuclides in intact rock circumstances.

The TDE experiment has been performed in three parallel drillholes drilled near to each other. Breakthrough of the radioactive tracer is monitored with on-line measurements and samplings along and perpendicular to the foliation. The non-sorbing radioactive isotope traces of HTO and $^{36}$Cl, as well as slightly sorbing $^{22}$Na and strongly sorbing $^{133}$Ba and $^{134}$Cs were used. TDE was designed to control advective flow, as it had caused problems in previous in-situ tests.

Supporting laboratory studies were performed for drillcore samples sampled from the experimental drillholes. In these laboratory experiments, i.e. porosity, permeability and diffusion coefficients of the drillcores were determined using different methods.

The TDE experiment was carried out from 2016 to 2019. A breakthrough was seen in the timeframe predicted by scoping calculations carried out. REPRO has produced data and knowledge to the safety case and the performance assessment. According to the preliminary results, values measured in the laboratory are applicable also in larger scale and in-situ conditions.