

Reprocessing

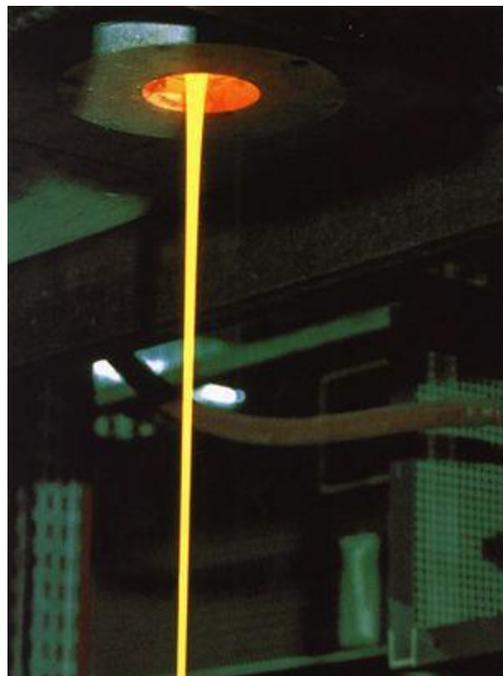
The word reprocessing means processing of the spent fuel and the reuse of fissile materials which remained (^{235}U) and were produced during operation (^{239}Pu , ^{241}Pu). The whole procedure is dangerous and complicated, since high activity material must be handled. Therefore, the various steps are performed using automatic machines and manipulators.

The fuel rods, which have been cooled for at least five years, are cut into pieces and dissolved in nitric acid. An extracting agent, tributyl phosphate (TBP), dissolved in some organic solvent (e.g. kerosene), is then mixed to the solution. The TBP molecule adsorbs the uranium and plutonium atoms. Since the density of the organic solution is less than that of the acidic fraction, when stirring is stopped, the two phases will automatically demix and can be separated.

The separated part that contains fissionable material is converted into UO_2 and PuO_2 . From this mixture, new fuel can be fabricated in the way already described. This is MOX, or Mixed-OXide fuel. Note that only a part of the spent fuel generated in the world is reprocessed and reused.

Waste management

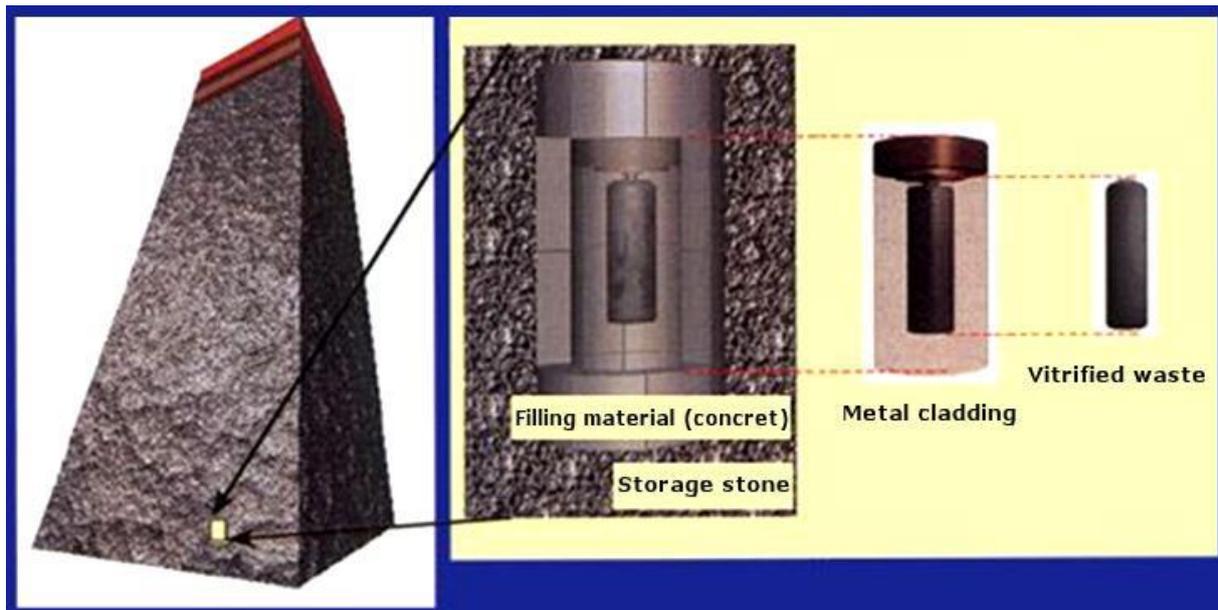
The high activity waste generated during reprocessing must be converted into a form that is suitable for final deposition. The most widespread technology for this conversion is vitrification. The waste is first annealed, then the resulting powder is mixed with silicon and other oxides, which turn into glass at high temperature. There are a lot of advantages of glass: it is heat-resistant, with stands radiation well and is insoluble. Therefore, glass safely encloses radionuclides. This glass can be filled into the waste containers, which can then transported to the final repository.



Casting of glass

Final deposition

The processed waste must be deposited in such a way that it should be reliably blocked from all living organisms, environmental effects and ground water for a very long time. For this purpose geological formations have to be found which are void of ground water and remain unchanged through geological periods. One possibility is a salt mine: if salt is present, one can be sure that there is no water in the vicinity and if the salt layer is continuous, it is also certain that earthquakes do not jeopardize the area.



A hungarian possibility for the final storage of waste is in claystone near the village of Boda. The waste is placed in the earth's crust with multiple protection (the principle is similar to the concept of defence-in-depth for reactors). The radioactive materials in this way get back to the place where uranium ore was mined from at the beginning of the process.