Fact Sheet from two European Technology Platforms

European nuclear energy developments and radioactive waste management

The nuclear industry is facing major changes, with the development of new reactors and new cycle options in the coming decades. How will these changes affect the nuclear waste management? In all circumstances, there will still be a need for geological repositories for the radioactive waste.

Nuclear Energy and Applications

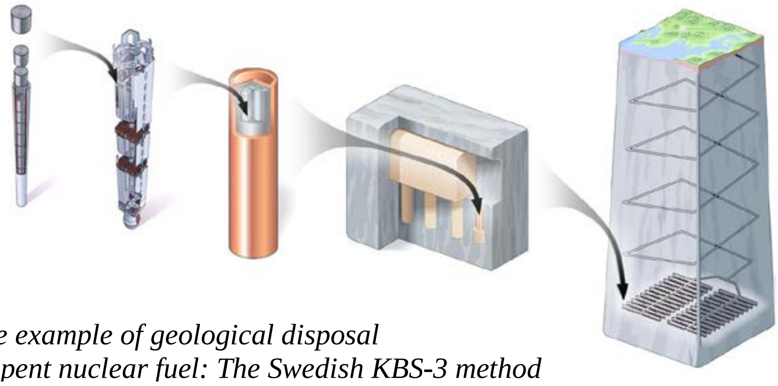
Today, 27 % of the electricity generated in the EU comes from more than 130 nuclear power reactors currently in operation in 14 Member states. For these member states, nuclear power is a reliable source of base load electricity and is an important part of the energy mix. In addition to electricity generation, society benefits from nuclear production of medical and industrial radioisotopes. As with most industry, **the nuclear industry produces waste which needs careful management.**

Radioactive Waste

Waste that arises from the day-to-day operation of nuclear reactors is mainly short-lived low- and intermediate-level waste. The spent nuclear fuel contains most of the radioactivity, which gives rise to long-lived, high-level radioactive waste. Nuclear research and development and the use of radioactivity for other purposes than energy production also generate an appreciable amount of waste, including high-level waste. **This waste will require disposal**. Today, there are several repositories for operational waste in different countries. These are either built on the surface or in underground caverns. **No repository for high-level, long-lived waste has yet been built – but good progress is being made in some countries**. Such a repository will entail disposal at several hundred metres depth due to the content of long-lived radioactivity.

Geological Disposal of High-Level Waste

As of 2007, the quantities of spent fuel in storage in Europe amount to ca. 44,600 tons equivalent Heavy Metal (te HM). This inventory will almost double by 2030. The highly radioactive spent nuclear fuel contains uranium, plutonium, as well as other radioactive components. The fuel in its entirety can be considered as waste, and disposed of after some decades of storage to cool off. It is also possible to separate the uranium and plutonium from the other components in order to manufacture new fuel. If the fuel is reprocessed, the **waste products are separated and conditioned for disposal**. For example, the high-level radioactive waste components are commonly immobilized in glass. Thus, today, we have two main types of high-level waste: spent nuclear fuel and high-level radioactive glass (vitrified waste). **Both of these forms of high-level waste need to be separated from humans for a very long time. This will be done by disposing of the waste in deep geological repositories, the first of which is expected to be in operation in 2025**.



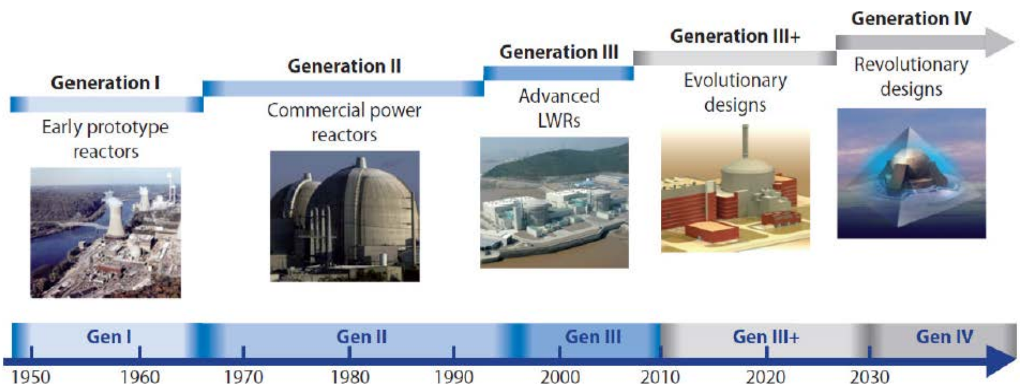
One example of geological disposal of spent nuclear fuel: The Swedish KBS-3 method

New Reactor Systems

Most nuclear reactors that are in operation today are so called Generation II or III, while the newest reactors, with improved safety and efficiency, belong to Generation III+. All of these are run with uranium dioxide fuel and the build-up of certain fission products limit the utilization of the fuel. There are ways to improve fuel utilization, but to radically increase the energy output from the mined uranium, new types of reactors will be needed. These are so called Generation IV reactors, whose development aims to provide a competitively priced supply of energy and an optimum use of natural resources, while addressing nuclear safety, waste, proliferation resistance and public perception concerns. **Though the recycling of actinides in Generation IV systems would maximise the energy gained from mined uranium, it cannot eliminate the need for geological disposal**. These new reactor systems would still generate substantial amounts of radioactive waste, although the proportion (in volume) of high-level waste would be smaller. Moreover, the amount of plutonium to be disposed would be greatly reduced, thereby lowering the proliferation risk and the intrinsic radiotoxicity of the waste. On the other hand, the efficient burning of minor actinides (americium and curium) in **Generation IV systems (if applied) would notably contribute to reduce the waste thermal output and thus the repository footprint**. **Disposal of waste from recycling will thus have certain advantages as compared to spent fuel disposal**. This should be weighed against an increased complexity for the different components in the fuel cycle and increased safety, security and safeguards requirements for the process chain. Lastly, actinide recycling does not reduce the calculated peak doses delivered by the Generation IV wastes to the repository environment in the long term: these doses are associated with long-lived fission and activation products. **Reactor, fuel and recycling development must continue to consider, from the very beginning, waste management and disposal for the various types of waste generated**. The research and development on new reactor systems needs to be performed in close cooperation with waste disposal organizations.

No Need To Wait

Generation IV reactor systems may be operational on a commercial scale around 2050. The amounts of plutonium recycled for their operation will be largely provided by the tens of thousands tons of spent fuel put in storage in the next decades. **Therefore, there is no reason to delay the disposal of existing spent nuclear fuel, nor of the other long-lived waste**. It is also important that **management options for the wastes generated from future reactor systems are developed in parallel with the licensing and operation of geological disposal facilities for current wastes.**



Approximate time scale for deployment of reactor systems