

France's efficiency in the nuclear fuel cycle: what can *oui* learn?

By Shant Krikorian

With 58 nuclear power reactors producing nearly 72% of France's electricity in 2018, France is one of the countries with the highest share of nuclear power in its energy production. Along with this energy, however, France's nuclear fleet is also responsible for producing a significant amount of spent fuel and radioactive waste.

The strength of France's national spent fuel policy, in addition to tight legislation and a strong regulatory body, can be attributed to the standardization of its nuclear fleet and the policy of recycling its spent fuel, French experts have said. This leads to an efficient and secure supply and a reduced radioactive waste burden.

In France, all operating units are pressurized water reactors of just three standard types, all designed by Framatome: three-loop 900 MWe (34 reactors), four-loop 1300 MWe (20 reactors) and four-loop 1450 MWe (4 reactors). French nuclear power reactors, therefore, have the highest degree of standardization among countries with large nuclear fleets. This also translates into a standardized approach when dealing with the back end of the nuclear fuel cycle, which involves spent fuel and waste management, decommissioning, and environmental remediation.

To manage the nearly 1150 tonnes of spent fuel it produces every year, France, like several other countries, decided early on to close its national nuclear fuel cycle by recycling or reprocessing spent fuel. In doing so, the French nuclear industry can recover uranium and plutonium from the used fuel for reuse, thereby also reducing the volume of high-level waste.

The nuclear fuel recycling process involves converting spent plutonium, formed in nuclear power reactors as a by-product of burning uranium fuel, and uranium into a "mixed oxide" (MOX) that can be reused in nuclear power plants to produce more electricity.

"The recycling of spent fuel is a major element of the strategy of the French nuclear sector, which has more than 30 years of industrial experience," says Denis Lépée, Senior Vice President and Head of the Nuclear Fuel Division at EDF, the French electric utility company that operates the country's nuclear power plants.

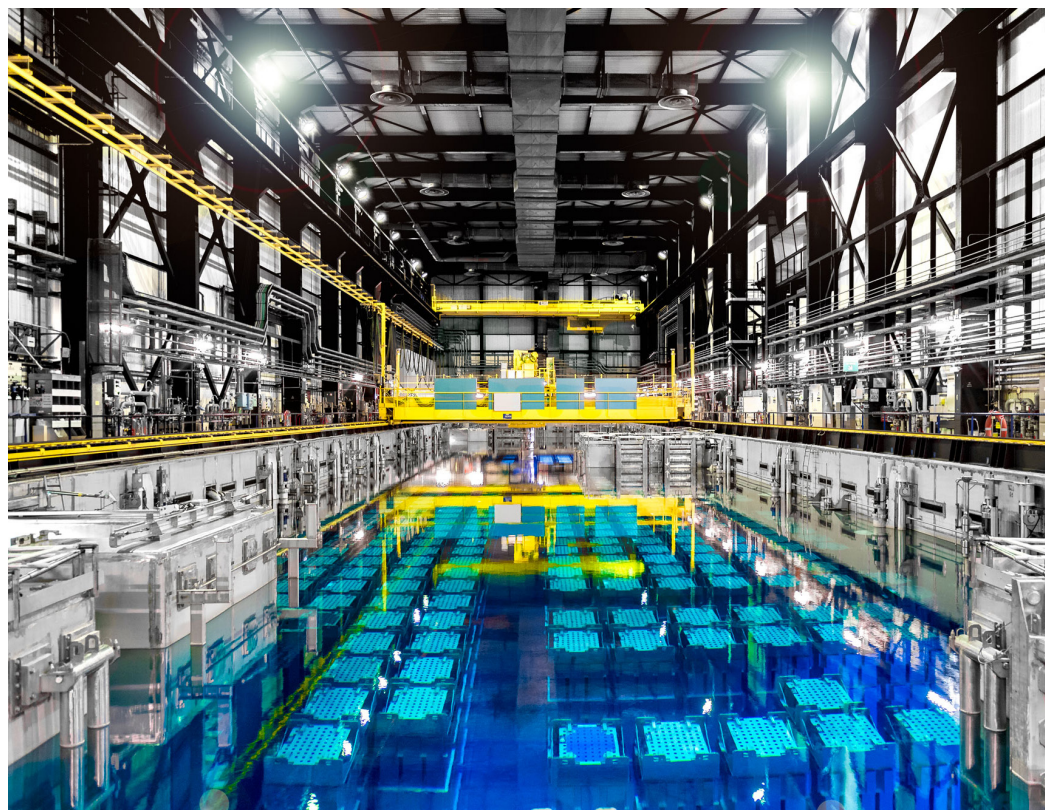
"This makes it possible to limit the volume of materials and to minimize waste, while conditioning it in a safe way. This strategy, which is an important pillar of France's overall nuclear electricity production, makes

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The Orano La Hague reprocessing facility. More than 34,000 metric tons of used fuel has been treated here since the site's operation in 1976.

(Photo: Orano)





a significant contribution to the country’s energy independence.”

Through recycling, up to 96% of the reusable material in spent fuel can be recovered. In its 6th National Report under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, France states that the national policy of recycling spent fuel has meant that it needs 17% less natural uranium to operate its plants than it would without recycling.

Orano, the French company in charge of nuclear fuel cycle activities that provides the fuel for and manages the waste from the country’s nuclear power plants, has stated that its strategy is to reprocess spent fuel while optimizing the energy yield of nuclear fuel. Reprocessing is carried out at the La Hague reprocessing plant and at Marcoule MOX fuel manufacturing plant.

Since the start of operations in the mid-1960s, the La Hague plant has safely processed over 23 000 tonnes of spent fuel — enough to power France’s nuclear fleet for 14 years.

Used fuel assemblies from various nuclear power plants are transported to La Hague, where they are kept in a storage pool. Components from the spent fuel are then separated and recyclable materials are recovered. At the Melox facility, plutonium is remixed with depleted uranium to produce MOX fuel.

This reprocessing–recycling strategy requires close and regular coordination between the various industrial actors, said John Czerwin, Senior Vice President of Marketing and Sales Support at Orano. These actors include those who manage reactors, fuel and disposal infrastructures, ensuring the coherence of the integrated industrial system.

“This confirms the benefits of this strategy: first, maintaining limited nuclear waste; second, saving uranium resources by enhancing the reuse of materials; and finally, preparing for the future in order to strengthen France’s energy independence and guarantee the sustainability of nuclear energy,” Czerwin adds.

The French Safety Authority (ASN) regularly assesses the safety impact of this approach.

Map of French nuclear facilities

(Source: EDF, CEA)