Simplifying the transport and storage of spent fuel from nuclear power reactors

By Nicole Jawerth

Storing AND transporting highly radioactive spent nuclear fuel requires taking precautions and strong safety and security measures. Until now, separate containers, or casks, have typically been used for storage and transport of spent fuel from nuclear power plants to the place of storage and eventually to the place of disposal or recycling. Another approach, using dual purpose casks fit for both storage and transport, simplifies this process, in turn making it both cheaper and safer.

To learn more about these unique casks and their role in the safe management of spent nuclear fuel, IAEA Bulletin Managing Editor Nicole Jawerth sat down with Bernd Roith, from the Transport and Predisposal Section of the Swiss Federal Nuclear Safety Inspectorate (ENSI). Roith has eight years of experience working with transport and storage solutions for spent nuclear fuel. He is also regularly involved as an expert in IAEA projects on strengthening the safe management of spent fuel.

Q: With spent nuclear fuel being a mixture of radioactive elements, such as uranium and plutonium, its safe and secure handling is paramount. What exactly is a dual purpose cask and how does it fit into the safe and secure management of spent fuel?

A: There is no 'one-size-fits-all' solution for spent fuel management; each country has its own process and strategy. Some countries store spent fuel in pools and others use canister-based systems or special buildings with dry conditions. Reprocessing fuel is another approach used by some countries.

Dual purpose casks (DPCs) are one of the dry storage and transport options. These casks are designed to ensure that there is no release of radioactive material, whether they are in storage or being transported. While their exact features depend on a country's spent fuel management needs, these casks are, generally speaking, large, fairly narrow, barrel-like containers that hold spent nuclear fuel or high level radioactive waste during transport and interim storage. DPCs are normally made of steel or cast iron and have a bolted, double-lid system that prevents leaks, while still making it possible to safely and simply retrieve the fuel as necessary.

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—Bernd Roith, Transport and Predisposal Section, Swiss Federal Nuclear Safety Inspectorate

Each DPC must meet strict safety standards and cover four major functions: mechanical integrity, heat removal, shielding and criticality control. Putting all of this into one design, while also conforming to international transport and national storage requirements, makes the development and use of DPCs very complex, but, once set up, they simplify other steps in the management process.

Q: What are the advantages of DPCs when compared to other storage methods?

A: DPCs eliminate some of the additional handling of spent fuel. Typically, with many other options, different storage containers or facilities are needed at each step, which means additional fuel transfers, and often these containers are not designed to be transported on public roads. With DPCs, they can be packed with fuel, transported to and placed in interim storage and then transported to the final storage or reprocessing facility, all without rehandling or repacking. This makes them one of the most popular options for countries where spent fuel is transported on public roads.

Q: How does the IAEA fit into the development and use of DPCs?

A: A DPC's design is influenced by the type of storage facility and its location. This means it's not easy to set up defined requirements that fit all DPCs worldwide without taking these differences into account. The IAEA has established safety requirements related to DPC transport and is in a position to harmonize the different storage requirements for DPCs across countries. So, when countries start producing nuclear energy, they can turn to the IAEA's supporting documents to decide whether DPCs work for them, and how to design and use DPCs for dealing with spent fuel.

The IAEA also coordinates research on how to optimize the design and use of DPCs. For example, one of the discussions raised at IAEA meetings involves the ageing of fuel placed in dry storage. DPCs are generally designed for at least 40 or 50 years of use, but now there is more consideration being given to using them for 100 years or more. This might require modifications of the actual designs or new designs to reduce the possible impact of long-term storage on the DPCs and ensure that they continue to meet high safety standards, whether they are in transport or in storage.

Q: What do you think the future holds for DPCs?

A: DPC designers are always trying to improve their designs as nuclear power plants evolve. As nuclear power plants are operating for longer periods, more spent fuel is generated, and therefore there is an aim to optimize designs to maximize the fuel content of each DPC. It also means using new materials to accommodate longer storage, as well as higher heat loads as nuclear power plants use more enriched fuel. The new designs are also likely to be more simplified, making them easier and cheaper to manufacture, while still meeting all transport and storage requirements.

Some countries are phasing out nuclear energy production, and the current generation of experts will eventually retire. Younger people's interest in working in this industry may also go down, but it's clear that we will need people in the future. This is where the IAEA can really help through organizing e-learning courses and providing training to build knowledge.

Dual-purpose casks at the ZWILAG storage facility in Switzerland.

(Photo: ZWILAG)