SOLUTION FOR MANAGEMENT AND DISPOSAL OF MULTIPLE DESIGN DEFECTIVE FUEL ELEMENTS

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Abstract

The paper describes the opportunity of reprocessing damaged multi design fuel assemblies (of PWR, BWR or VVER origin), which is an effective solution in terms of global risk reduction. The paper also broaches the necessary associated packaging and transport logistics, the legal framework, and the management options for separated materials.

A number of European reactors (PWR, VVER1000, BWR) use fuel assemblies from different fuel designers and manufacturers. When new fuel designs are proposed or new manufacturing processes or sites qualified it may happen that a higher number of fuel defects occur before reaching design robustness and maturity. Some earlier fuel designs do not allow repair, i.e. fuel assembly disassembling and reassembling in order to extract a damaged fuel rod, inspect it and repair and replace it with a dummy rod. In other cases rigid fuel designs and the fuel assemblies' condition after a few cycles of irradiation may introduce a high risk of fuel rod rupture during its extraction. All this together with the restricted accessibility of the reactor pond during normal reactor operation make it very difficult to inspect fuel defects and determine their root cause. Consequently defective fuel has to be classified in the worst damaged fuel category (as compared to "only" gas leaking fuel) along with fuel debris which is almost always present. In addition, storing such damaged fuel assemblies in the reactor pond may lead to operational and safety challenges for the reactor operator. The defective fuel management is therefore a matter of concern for all nuclear operators.

Reprocessing such damaged fuel assemblies allows to get rid of the above mentioned risks and challenges. This way defective fuel is eventually replaced by just a few final vitrified and compacted residue packages, specifically designed for long-term storage pending transport to future geological disposal facility.

A wide portfolio of industrial and appropriate solutions adaptable to several types of defective fuel assembly including conditioning solution, transport cask designs compatible with any fuel designs to be reprocessed are already available, such as Quivers/Fuel rod canisters, Fuel Rod Capsules and Capsule canisters for wet or dry storage or transport. Various cask designs exist for that purpose and specific operations are implemented for preparing the defective fuel assemblies for transport.

Over several decades Orano has successfully performed the treatment of various type of defective coming from all around the world. In order to transport the defective used fuel assemblies/rods to the reprocessing plant, Orano proposes a comprehensive range of qualified and proven solutions.

More than 460 leaking and damaged fuel assemblies as well as capsule canisters and quivers have been reprocessed at La Hague, using normal process and tools with specific operating conditions and monitoring. Orano pursues developing technologies and dedicated tests in operational conditions to enlarge its portfolio to reprocess new design of defective fuel to meet its customer expectations.

In addition to many shipments of defective fuel assemblies performed for EDF needs, Orano has, also, a strong international experience in transportation of defective fuel assemblies: shipments were performed from Germany, Switzerland, Belgium, Italy etc. to the La Hague plant in France with a large range of TN casks family.

Reprocessing is the best way to fully manage defective fuel in a risk mitigating approach.

Orano continues developing technologies that meet customers' needs satisfying stringent safety requirements.