

PWR Reactor Vessel and Reactor Internals Segmentation and Packaging

Background

Typically, pressurized water reactor (PWR) reactor internals segmentation and packaging projects include a separation of the highly activated material (that is, baffle plates, core formers, core region of the core barrel, core support plate and in-core instrumentation thimbles) from the rest of the material (that is, core barrel remnants, core support assembly, thermal shield and upper internals). The highly activated materials are segmented, packaged to fit in fuel-assembly-sized waste containers and stored with the spent fuel. The other materials are segregated by activity; some are sometimes repackaged into the reactor vessel and grouted for disposal with the vessel, and some are compacted and shipped to a low-level waste repository.

With more than 30 years of experience in the development of PWR reactor vessel internals (RVI) segmentation and packaging technology, Westinghouse is an industry leader in segmentation for the decommissioning market.

Description

The primary challenges of a PWR RVI segmentation and packaging project are to separate the highly activated materials from the less-activated materials and to package them into appropriate containers for disposal. This process requires the specific-sequence disassembly of various internals components and systems that must be temporarily staged in the refueling cavity where they await further segmentation. Since most refueling cavities have limited space, it is important to plan carefully so that the available space is optimized. Installation of equipment in the cavity to support segmentation and handling operations must be limited.

For the recent José Cabrera project, there were a number of activities that needed to be completed before the actual cutting activities could start. Among those activities were: cutting of the wall between the reactor cavity and the spent fuel pool, securing the pool integrity, installing a new working bridge, and cleaning the pool floor and water.

The José Cabrera project included the segmentation of the reactor vessel head, reactor vessel, upper internals, lower internals and operational waste.

Benefits

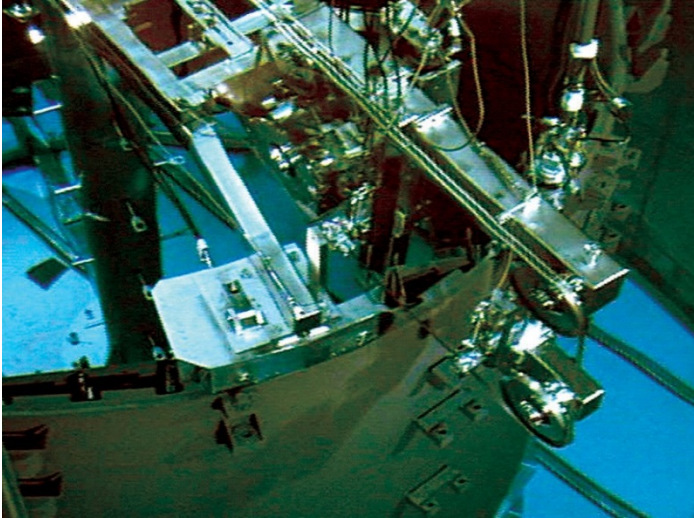
In recent years, the cost of control and disposal of highly irradiated secondary waste has risen. As a result, Westinghouse has opted to use mechanical cutting methods instead of abrasive and thermal methods to minimize the generation of secondary waste. Based on our extensive experience using mechanical cutting, Westinghouse has found that equipment design and reliability are paramount to a steady-state cutting operation. This results in cost savings from schedule adherence that carries throughout the entire project.

Cutting technology, however, is just one part of the process. Westinghouse has also developed a variety of radioactive waste containers, special handling tools, support fixtures, service bridges, video-monitoring systems and customized rigging, all of which are required for a successful RVI segmentation and packaging project.

As an original equipment manufacturer of nuclear steam supply systems and a global provider of engineering and field services, Westinghouse has first-hand knowledge of the choices that must be made to best integrate project planning, management, engineering and implementation to be successful in such technically challenging projects.

Experience

Building on tooling concepts and cutting methodologies developed decades ago for the successful removal of nuclear fuel from the damaged Three Mile Island Unit 2 reactor, Westinghouse has continually improved our approach to internals segmentation and packaging by incorporating lessons learned and best practices into each successive project.



Use of a band saw for reactor internals segmentation

PWR internals operate at high pressures and high temperatures, which can result in hardened, heat-affected zones. These zones, and the number of PWR internals, present challenges that Westinghouse is uniquely positioned to meet, as we can leverage and combine our reactor design knowledge and technology innovation for optimized planning for our customers.

Westinghouse also applies a continual improvement approach, using past challenges to improve and perfect our methods. Our progress was evident during the José Cabrera decommissioning project, which, by various measures – including cost, scheduling, safety, personnel exposure and secondary waste generation – has been one of the most successful PWR decommissioning and internals segmentation projects performed to date.

Site	Duration	Project
Three Mile Island Unit 2	1986 – 1989	Core support assembly dismantling
Yankee Rowe	1992 – 1994	Internals segmentation and packaging
Haddam Neck	1999 – 2002	Internals segmentation and packaging
San Onofre Unit 1	2001 – 2002	Internals segmentation and packaging
Chooz A	2010 – 2020	Reactor vessel and internals segmentation and packaging
José Cabrera	2010 – 2015	Reactor vessel and internals segmentation and packaging
EDF 900 MW plants	2011 – 2015	Guide tubes segmentation
Neckarwestheim 1	2015 – 2018	Reactor vessel and internals segmentation and packaging
Bohunice V1 (2 units)	2017 – 2023	Full primary systems
Unterweser	2018 – 2021	Internals segmentation and packaging
Grafenrheinfeld	Contracted	Internals segmentation and packaging
Gröhnde	Contracted	Internals segmentation and packaging
Isar 2	Contracted	Internals segmentation and packaging
Brokdorf	Contracted	Internals segmentation and packaging