The ABWR reactor in Japan and the UK

What has been the operating experience of the four ABWRs that have been in operation in Japan? It should be noted that performance is affected by Japanese utility operating strategies.

Compared with utilities elsewhere, they have had longer shutdowns for maintenance and refuelling, and shorter periods between refuelling outages. The UK has been taking a different approach, aiming to minimise periods when reactors are not generating. It will be for Horizon to decide whether to follow UK or Japanese precedent on that operating regime.

> It is not hard to make a change that has huge ripple effects through the design

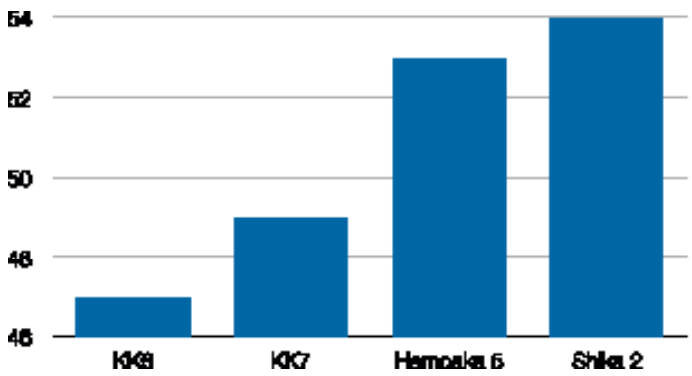
There have been four reactors of the Hitachi-GE ABWR design used at the site in operation in Japan, all of which have remained closed since the Fukushima accident in 2011. Two more that were under construction since the accident also await revival.

Construction periods have got longer for each plant.

As for operation, IAEA figures show that the two Kashiwazaki-Kariwa reactors – the models for Wylfa – demonstrated high load factors in the 80 and 90% range in early years – the load factor gives the amount of power actually produced by the reactor as a proportion of what would be produced if the plant operated at full design rating at all times. In later years they have been less successful. That was partly because of an earthquake in 2007. Hamaoka and Shika have suffered a variety of technical problems in and around the reactor and all four plants have been hit by damage to the turbines (supplied by Hitachi and GE).

That may not provide a guide for the UK. The biggest lesson in reducing the cost of a nuclear plant, according to Humphrey Cadoux-Hudson, EDF Energy's managing director for UK nuclear development, is to make it an exact copy of an earlier plant. "If you make a change to a nuclear power plant it leads to lots more changes," he told a recent World Nuclear Association meeting. "It is not hard to make a change that has huge ripple effects through the design. And it's not just engineering. [With an exact copy] all the people [involved] know what the design >

ABWR CONSTRUCTION: MONTHS TO COMMERCIAL OPERATION



Source: IAEA

is and that the technical specifications work." He added: "In a world where you are concentrating on a changing design, your supply chain can't focus on improving efficiency".

Those words could apply to EDF's nuclear competitor at Wylfa.

The plants are not identical to their Japanese parents, in fact Nuclear Intelligence Week said "there's enough difference that any talk of a series effect is unlikely". The UK reactor is based on the first two units to go into operation, Kashiwazaki-Kariwa (KK) 6 and 7 "plus improvements implemented at Shika 2, Shimane 3 and Ohma 1", Hitachi-GE says. Variations are always required to adapt a design for specific site circumstances, and in any case the original design is elderly – work started at KK6 in 1992.

But the UK GDA process has, in addition, required a host of substantial design changes. There is an extensive list in Office of Nuclear Regulation documents.

Some changes involve hardware that could increase capital costs – add new containment that provides aircraft impact protection, and re-siting of emergency generators, for example. Some changes will present "first of a kind" challenges in both build and operation. They include a major redesign of instrumentation and control systems. That could extend a construction process that had already been slowing in the reactors completed in Japan (see chart) and will require comprehensive commissioning tests.

Other changes could have wide implications that may not reveal themselves in the reactor's early years.

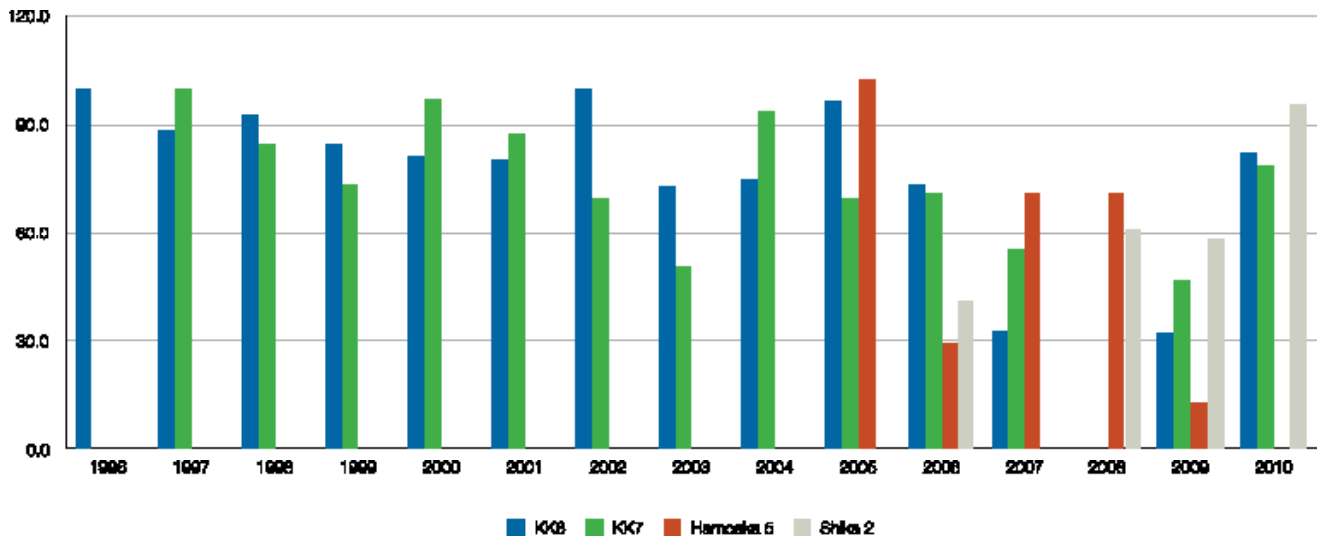
For example, the ONR required changes to the chemistry of the water system in the reactor. It said: "While there is extensive operating experience of this regime globally, this will be the first time that any BWR will operate with this chemistry regime from the beginning of life. This decision will also impact on other aspects of the detailed plant design, such as material choices."

The choice of materials and how they age in the chemical environment are exactly the type of issues where series-build and experience of ageing issues help operators avoid unexpected problems during the reactor lifetime. NP

Weblinks

@ ONR's design assessment for the ABWR

ABWR OPERATION: CAPACITY FACTORS



Source: IAEA Capacity factor: The actual energy output of an electricity-generating device divided by the energy output that would be produced if it operated at its rated power output (Reference Unit Power) for the entire year.