STATUS AND NEAR-TERM PROSPECTS OF SMALL AND MEDIUM SIZED REACTORS

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Several Member States have SMR designs ready for deployment. These include the pressurized heavy water reactors CANDU6 (706 MW(e) net) by AECL in Canada and PHWR-220 and PHWR-540 by NPCIL in India, and they include the 610 MW(e) and 325 MW(e) Chinese pressurized water reactor designs. Recent construction of pressurized heavy water SMRs in India and Romania has been on schedule and on budget.

In Russia, construction of a pilot floating cogeneration plant of 300 MW(th)/70 MW(e) with two water cooled KLT-40S reactors began in June 2006. Its deployment date is 2012. Plans were announced to build five such plants and also two plants with 11 MW(e) ABV reactors for customers in the Russian Federation.

Several small- and-medium sized water cooled designs are of the integral type with the steam generator , pressurizer and, in some cases, control rod drives housed in the same vessel as the reactor core to eliminate primary system piping , minimizing the scope of possible loss of coolant accidents (LOCA) and reactivity initiated accidents (RIA) .

The Argentinean CAREM (from Spanish: Central ARgentina de Elementos Modulares) reactor is cooled by natural circulation, and has passive safety systems. Argentina plans to construct and operate a small prototype of 27 MW(e) by 2015, followed by larger projects with higher power ratings of up to ~300 MW(e) . Site preparation activities for the prototype have started at the Atucha site. The SMART (System Integrated Modular Advanced Reactor) 330 MW(th) design developed in the Republic of Korea is an integral PWR for electricity production and seawater desalination. Construction of a pilot or demonstration plant is planned.

The IRIS design of integral type pressurized water reactor developed by an international consortium led by Westinghouse Electric Company (USA) has unit power of 335 MW(e) but allows for twin unit NPPs. It is entering the detailed design stage and its design certification is scheduled to start in 2012. As another example, the NuScale company in the USA is designing a 45 MW(e) small integral PWR for a multi-modular NPP of 540 MW(e) . More recently, Babcock and Wilcox announced their plans to deploy their new 125 MW(e) integral reactor design by 2018 , the *mPower* , with a refuelling cycle of 5 years .

In India, construction is expected to start early in the next decade on the first 300 MW(e) advanced heavy water reactor, which has been developed for co-generation applications. The reactor is designed to operate with ^{233}U-Pu-Th fuel; it uses boiling light water as a coolant and heavy water as the moderator. The reactor designer, the Bhabha Atomic Research Centre, is in pre-licensing negotiations with the Atomic Energy Regulatory Body of India.

China is developing the modular HTR-PM, with each module having a capacity of 250 MW(th), or 100 MW(e). It is a high temperature gas cooled reactor with pebble bed fuel and an indirect supercritical steam energy conversion cycle. Demonstration of a full size module is planned for 2013. A license application has been filed and is under review. A two-module plant configuration is foreseen for the commercial version of this reactor, yielding an electric output of 200 MW(e).

In the Russian Federation, on 10 December 2009, the Russian State Corporation Rosatom and the En+ Group, a daughter company of the Rusal, have established a joint venture to finalize the design development of a small modular lead-bismuth cooled reactor SVBR 100 of 100 MW(e). De facto, during the whole of 2009, En+ has partially financed the ongoing SVBR 100 design development. The joint venture plans to license the reactor and build a first 100 MW(e) SVBR prototype in 2019. The reactor borrows from the experience of the Pb-Bi cooled reactors for Russian submarines but has a fast spectrum core. The SVBR modules are flexible in fuel cycle and application options. The strategy is to use enriched uranium (<20% ^{235}U) as the first load and then recycle the uranium and plutonium from self-produced spent nuclear fuel. At least 12 % of the fuel load could be LWR spent fuel used directly, without removing the fission products. The SVBR 100 modules could eventually be used as parts of NPPs of medium, large and even very large capacity (up to 1600 MW(e)). They are also considered to repower the current LWR plants after the original reactors in them are decommissioned.

In Japan, the Toshiba Corporation, in cooperation with the Central Research Institute of Electric Power Industry (CRIEPI) and Westinghouse Electric Company, is developing the 4S sodium cooled reactor. It has a design power of 10 MW(e) and a refuelling interval of 30 years. The US Nuclear Regulatory Commission began a pre-application review in 2007, and the formal licensing process is scheduled to start in October 2010. Construction of a demonstration reactor and safety tests are planned for the first half of the next decade.

In the USA, new private companies continue to be formed to develop and commercialize innovative concepts of small reactors. Recently, the Advanced Reactor Concepts LLC was formed to perform design development and commercialization of a 50-100 MW(e) small sodium cooled reactor with 20 year refuelling interval. The design borrows from the experience of the EBR-II reactor and fuel cycle and from feasibility studies performed in the early 2000s for the STAR family of small lead cooled reactors.