New generations: The Eureopean pressurized water reactor (EPR)

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After the 1979 Harrisburg (US) accident the nuclear industry faced a serious decline in selling nuclear power reactors. The 1986 Chernobyl disaster made sales drop off even more, as several countries decided not to build any new nuclear power plants. Since the early 1980s, industry has been working on the development of so-called inherently safe reactors.

(**483/4.4798) WISE Amsterdam** -The European Pressurized Water Reactor (EPR) is an initiative of the French-German joint venture Nuclear Power International (NPI), founded in 1989 by reactor builders Framatome and Siemens. However, this reactor cannot be called one of the long-desired inherently safe reactors; it is seen by the industry as a safer successor of the common Pressurized Water Reactor. The EPR would be the follow-up of the French N4 reactor (Chooz B1 and B2, Civeaux 1 and 2) and the German Convoy reactor (Emsland and Neckar 2). Thus far, some US$200 million has been spent on the EPR project, in which besides Siemens and Framatome, also the German electricity utilities Preussenelektra, Badenwerk, RWE Energie and the French Électricité de France (EdF) also participate. NPI thinks of finishing the design around 1998, after which a non-site-specific license procedure could start resulting finally in a first reactor in 2005 either in France or Germany.

Technology

The EPR is a pressurized water reactor: water in a cooling circuit under high pressure is heated by the heat from the reactor core. In a steam generator, the heat is passed to a second circuit in which water is formed into steam to drive an electricity-generating turbine. Characteristics of the EPR are, for example, about 1500-MWe generation capacity, doubled emergency systems, an extra concrete containment and a so-called core catcher which should prevent the penetration of a molten reactor core through the reactor containment (the “China syndrome”). The reactor would be able to use MOX fuel, even up to a 100-percent reactor core.

In September 1997, the EPR partners agreed to an economic optimization phase to be ended at the end of 1998. It is the continuation of the basic design phase that ended in June this year. The goal is to make the EPR more competitive with other sources of electricity production and cut down the costs of an EPR-produced kilowatt-hour by 15 percent. Two ideas for succeeding are an increase of power output to 1,800 MW and the abandonment of the MOX option. However, some partners doubt the idea of increasing power output, seeing it as a risk for new technical problems. Utilities ordering an EPR can make their own specific wishes on capacity and the use of MOX, EdF spokesmen Lecocq said. The optimization phase which has now started would cost about US$60 million.

Safety

Although some additional safety measures are taken in the new design, it is often said the EPR is only a kind of mixture between the existing N4 and Convoy and not a completely new design. In 1993 the German Öko-Institut finished a study on EPR and concluded that it could not meet the safety standards required by the German government. It also criticized designed systems to prevent a hydrogen explosion. Hydrogen gas is formed in an accident when hot steam reacts with fuel

cladding. The idea to burn eventual hydrogen gas in the reactor building in an early stage would even promote the threat of a serious explosion, according to the Oeko-Institut. An EPR would only be able to compete financially when it is bigger than 1000 MWe. But then the design would be more unsafe because smaller reactors are less difficult to control in cases of accident. Further, the EPR could only be financially competitive when at least 8 to 10 reactors would be ordered.

The German Lower-Saxony Ministry of Environment asked the Advisory Council for Nuclear Retreat Questions to study new designs. In 1993 it concluded that the EPR would not be a totally new design and also not inherently safe. It could not fit in less risky and ecologically safe energy production. Proof of a safer reactor is based on calculations, not on practical experience with the EPR. The council points to the possibilities that planned changes in design could lead to new risks. The question of what to do with radioactive waste cannot be answered with the EPR concept.

Future prospects

In 1994, German Environment Minister Klaus Töpfer set new safety standards for new reactors. The probability of a core melt should be reduced to once in a million years and only in 1 percent of those accidents may radioactivity be released outside the containment (so once in 100 million years). Evacuations, however, should not even be necessary in such a very unlikely event. Töpfer's successor, Angelika Merkel, is strongly in favor of building an EPR in Greifswald, in former East Germany. In 1995 she asked the industry to promise an order within five years. Early this year electricity producer Bayernwerk AG said it would start a non-site-specific license procedure after the 1998 Bavaria state elections. But Bayernwerk would start the procedure only when the utilities RWE and Preussenelektra join for the states Baden-Würtemberg and Mecklenburg-Vorpommern. But licensing could be a problem in Germany as seven of the nine states are ruled by the social-democratic SPD, formally anti-nuclear. According to government officials, the licensing of new reactors would be handed over to the federal government, which is in favor of new reactors. In the next three years, a new federal atomic law has to be developed to harmonize with European laws. In the new atomic law, the federal government would be responsible for licensing for safety and technical standards. The states could only deal with site-specific items like seismic conditions and local environment. The federal Ministry for Environment and Reactor Safety would submit the new law in 1999, about the same time when the first EPR license procedures can start. Although actually no new production capacity is needed till 2010 in Germany, the reactor could be built in five years, NPI claims.

In France the electricity producer EdF is interested in building an EPR. Preparation work was even started already in Le Carnet (see also WISE NC 471.4666) and (467.4642). It was an open secret that EdF wanted to build one or two EPRs at this site despite strong local protest. Wanted (past tense, because on September 16, Prime Minister Jospin announced the end of the Carnet plans and also the plan to classify the site into a protected area (see WISE NC 478.4744). New capacity is not needed in France till 2010 but EdF wanted to start sooner to gain experience with the new reactor.

NPI also hopes it might have a chance in the United Kingdom, where a series of older gas-cooled reactors will be shut down the next century. When the UK decides to keep a 20-percent nuclear share in electricity production, the EPR would be an alternative, according to Siemens KWU Power Engineering Division head Huettl. Through the recently announced BNFL-Siemens nuclear fuel cooperation (see WISE NC 482.4785), British nuclear industry is connected to the EPR project. This new cooperation between BNFL and Siemens is feared by the French nuclear industry: they see it as a serious threat to their economic position. According to French Nuclear Energy Society spokesman Vignon, the proposed UK-German deal would force Framatome to review its further cooperation with Siemens. He fears more difficulties in EPR development due to competition on the fuel market. Other possible future for the EPR is expected by Merkel in former Eastern Europe, where new

capacity is needed more than in Western Europe, also for replacement of older unsafe RBMK Chernobyl-type reactors and the VVER pressurized water reactors.

Economics

The development of the EPR was said to cost over 1 billion French Francs (about US$157 million) and construction about DM4.5 billion (US$2.5 billion). In October this year, German Minister of Reactor Safety Merkel said her government would not offer financial help for utilities willing to build an EPR. She could only promise regulatory support and a generic license procedure. On a 1996 German Atomic Forum meeting, the electricity utility Preussenelektra pleaded for financial governmental help to persuade utilities to order the EPR. Building a reactor would not be justified by electricity demand reasons but necessary for the promotion of the EPR internationally.

Concluding: the new French government which does not like nuclear as much as the former; the German government which is not willing to co-finance the first plant and does not need new capacity; no outlook for new nuclear capacity in the UK and Russia has no finances to buy foreign technology. All this makes the future of the EPR very dim. China could be a possible market, but if the French are allowed to build new nuclear capacity, why not built the N4 reactor instead of the EPR?

Sources :

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P.S.

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