EPR – European Pressurised Reactor

The European Pressurised Reactor (EPR) is a new reactor design developed by the French company AREVA in co-operation with the German firm Siemens. Serious doubts have been raised about the safety and cost of the EPR. Study of the EPR's blueprints and experience at the two sites where EPRs are under construction, in Finland (Olkiluto 3) and France (Flamanville 3) has revealed weaknesses in design, problems during construction phases and soaring costs.

Despite this the EPR is enthusiastically marketed as the world's largest reactor, with a power generation capacity of 1600 MW. The EPR is promoted as a nuclear power plant which is mature, safer, cheaper and more reliable than any other. It's backers present it as the only example of an advanced "third generation" reactor; a flagship of the nuclear 'renaissance'. Promotional materials promise, for example:

> *"The EPR is the direct descendant of the well proven N4 and KONVOI reactors, guaranteeing a fully mastered technology. As a result, risks linked to design, licensing, construction and operation of the EPR are minimized, providing a unique certainty to EPR customers." [1]*

The only certainty with current EPR projects is that they are not delivering on these promises in four key areas.

Safety

The EPR is a pressurised water reactor which in many ways differs little from the majority of existing "second generation" reactors. Its concept is based on developments dating from the 1970s. It includes some additional improvements but attempts to make the reactor more competitive also have their downsides.

- **Large volumes of radioactivity.** The EPR is the largest reactor ever built with a core that contains more radioactive elements than any other reactor. In addition, for reasons of economy, it is designed to burn fuel longer. However, this leads to increased radioactivity and more dangerous nuclear isotopes. The mixed-oxide (MOX) fuel used by the EPR is a mix of uranium and plutonium, which also results in a higher output of hazardous materials.

  In event of a serious accident the impacts could be vast, releasing large quantities of radioactivity into the environment. A study conducted in 2007 by Large Associates, a British nuclear engineering consulting company, showed that were a serious accident to occur in France it could require the evacuation of hundreds of thousands of people, would involve the serious contamination of many thousands of square kilometres and may produce thousands of human fatalities.[2]

- **Terrorism.** Having been designed prior to 2001, the EPR does not reflect the changed security situation following the 9/11 attacks in the United States. While it has robust containment, pathways vulnerabilities have been identified that could lead to radioactivity bypassing the containment unit under certain scenarios.[3] The ability of the containment to withstand the impact of a large aircraft was placed in doubt in leaked official French documents in 2003. One of the reasons for delays and complications with EPR construction in France has been the need to reinforce the containment unit because the original design did not meet required safety criteria.

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- **Weaknesses in construction.** Apart from problems with the EPR design blueprint, there is growing evidence from construction sites in Finland and France that the nuclear industry cannot ensure proper construction. Problems made public to date include:
  - **Concrete base**: In Finland, the concrete base slab on which the power plant is positioned was poorly built. The concrete of the reactor's base slab is more porous than allowed, making the structure more vulnerable to chemically-reactive substances. This can lead to long-term deterioration of the reactor containment building. The concrete has a high water content, which could, under certain accident conditions, lead to rapid formation of cracks.
    At the EPR construction site in France, inspectors recently found that concrete has been poured incorrectly, the concrete base slab for the reactor has developed cracks and steel reinforcing bars have been wrongly arranged. The poor composition of the concrete may lead to cracking and faster deterioration in sea air conditions. (The Flamanville reactor is situated on the coast.) In both cases, problems emerged due to weaknesses in, or the absence of, quality control. After long series of critical reports following inspections, the French safety agency ASN took an unprecedented step and on 21st May 2008 ordered the construction work to be stopped until a satisfactory solution could be provided.
  - **Containment**. The inner steel containment liner - a crucial safety device – has suffered from a number of problems during construction in Finland. It was manufactured by a Polish company that had no previous experience of nuclear projects. Safety standards were breached in welding and dozens of holes were cut in the wrong places. The bottom of the liner is deformed and was damaged during storage. The sub-standard quality of the liner could lead to greater releases of radioactivity in the case of an accident. In France similar problems have occurred, the containment liner has been welded by a company without the required certification and one-quarter of the welds are deficient.
  - **Poor cooling pipes.** Following efforts by a subcontractor to save time and reduce costs the components of the primary cooling circuit at the Finnish reactor were found to have too large and irregular a grain size. All eight pipes have been recast but it is unclear whether the new methods have resolved the problem or led to new ones. Failure of the primary coolant circuit can initiate a severe nuclear accident.
  - **Other problems** were detected in Finland. The Finnish nuclear safety authority STUK detected and documented 1,500 safety and quality problems in the EPR project.

- **Rush and incompetence.** Problems with the EPR project in Finland can be attributed to a combination of a tight time schedule and considerable cost pressure. Similar circumstances are likely to apply to other future nuclear projects. The unrealistic price and construction timetable of Olkiluoto 3 have been a strong incentive for AREVA NP (a daughter company of AREVA, formerly known as Framatome ANP) to cut costs and to refuse to perform time-consuming corrections when problems arose.[4] According to articles published in *Nucleonics Week*, AREVA's attempts to reduce costs led the company to select cheap, incompetent subcontractors and overlook safety-related problems. In addition, nuclear safety training was not provided to workers.[5]
  Because of fast-track licensing, Olkiluoto 3 subcontractors have used outdated blueprints and Finnish authorities have been at times unable to supervise work as they have not had the necessary design documents. New reactor designs are inherently harder to build and control because of their larger size and fuel burn-up which places high demands on construction. The stagnation of nuclear construction over the last decade has resulted in a shortage of competent personnel and companies.[6] In France, reports from ASN inspections repeatedly mentioned that the problems arise from "haste without any quality assurance process" [7]

Nuclear waste

AREVA claims that one of the advantages of the EPR is that it will produce less waste than other reactors. But the EPR does not solve the nuclear waste problem. While the promise is that the volume of waste produced will be reduced by 15 percent, this is only done by playing with numbers. The waste that is produced will be more dangerous because it will be more radioactive. With regard to radioactivity, the EPR will not be a step forward: improved fuel combustion rates simply lead to more dangerous waste. In addition, by being able to function with 100 percent MOX fuel (a mixture of uranium and plutonium oxides) the EPR will be a major link in the nuclear reprocessing system, which is highly contaminating.

Costs

The EPR has been promoted as a technology that makes nuclear energy cheaper and more competitive. When the decision was made to build an EPR in Finland, in 2002, the government promised that it would cost Euro 2.5 billion and take only four years to build. The final contract, three years later, put the price at Euro 3.2 billion and construction time was set at 4.5 years. Since construction began, less than three years ago, a variety of technical problems have led to a two-year delay, extending the construction period to at least 6.5 years. The estimated additional cost is Euro 1.5 billion, raising the current price tag to Euro 4.7 billion, almost double the initial estimate. More problems, delays and cost overruns are likely to occur before the project is completed.

The construction contract was signed as a fixed-price, turnkey delivery arrangement from AREVA and Siemens. Extra costs will most likely be borne by the two companies. Nonetheless, AREVA is seeking to claim some of the additional costs from the investor, the Finnish utility TVO.

Financing for the Finnish EPR has benefited from State support in the shape of a Euro 570 million loan guarantee provided by the French export agency COFACE. The low interest rates offered by French and German State-controlled banks may be in violation of EU legislation and are the subject of a pending complaint with the European Commission and the European Court.

Nuclear power obstacle to combating climate change

Nuclear power could at best make only a negligible contribution to CO_2 reduction; even then many years after massive cuts are needed and only by depriving real climate solutions of funding. Currently 439 commercial nuclear reactors supply around 15 percent of global electricity providing only 6.5 percent of overall energy consumption. Even if today's current installed nuclear capacity was doubled it would lead to reductions in global greenhouse gas emissions of less than five percent and would require one new large reactor to come online every two weeks until 2030. An impossible task: even in countries with established nuclear programmes, planning, licensing and connecting a new reactor to the grid typically takes more than a decade.

Regarding experience with the Finnish EPR, the International Energy Agency (IEA) warned against the risk of relying on the new reactor for emission cuts, saying in 2004 that any delays would inhibit Finland's ability to meet its greenhouse gas reduction targets under the Kyoto Protocol. That risk has become a reality.

In August 2007, after 27 months of construction, the project was officially declared to be between 24 and 30 months behind schedule and at least Euro 1,500 million (US$2,230 million) over budget. Unlikely to be operational before 2011, OL3 will not be ready in time to contribute to Finland's Kyoto target.

For more information, read the Greenpeace briefing, *"Nuclear Power – Undermining Action on Climate Change"* (2008) [8].

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Notes:

[1] Framatome ANP: EPR; brochure, March 2005

[2] *Assessments of the Radiological Consequences of Releases from Proposed EPR/PWR Nuclear Power Plants in France*, Large Associates, February 2007

[3] *Démarche de dimensionnement des ouvrages epr vis-à-vis du risque lié aux chutes d'avions civils*, DGSNR/SD2/033-2003

[4] *Management of safety requirements in subcontracting during the Olkiluoto 3 nuclear power plant construction phase*, Investigation report 1/06, STUK (Finland's Radiation and Nuclear Safety Authority), 10 July 2006, 18

[5] Ibid., at 23

[6] Greenpeace Finland's briefing on Olkiluoto 3, March 2008. http://www.greenpeace.org/international/press/reports/fact-sheet-olkiluoto-3

[7] ASN letter from Flamanville-3 inspection dated January 25th, 2008

[8] *Nuclear Power – Undermining Action on Climate Change,* Greenpeace International, March 2008. http://www.greenpeace.org/international/press/reports/nuclear-power-undermining-ac

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