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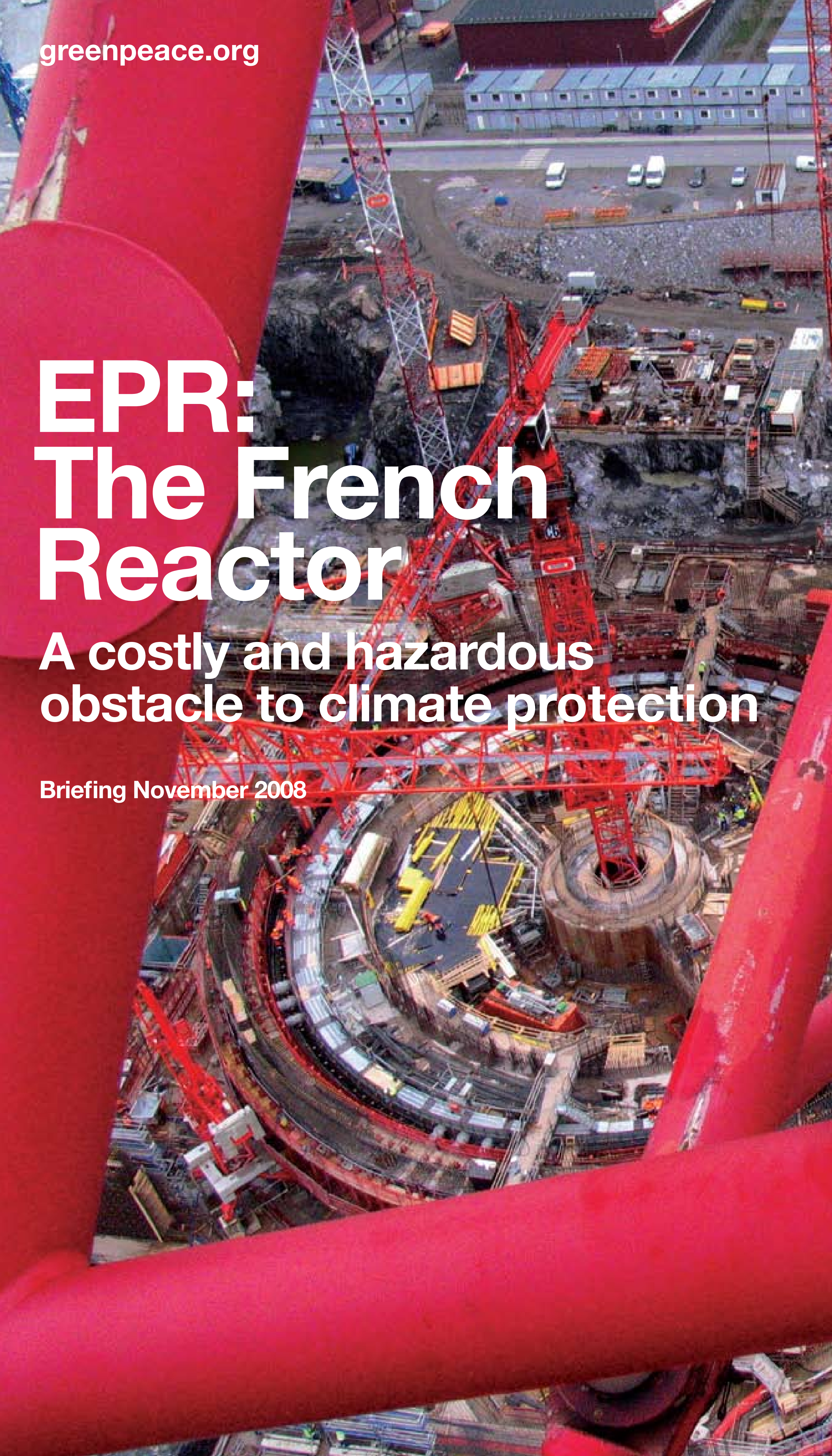

EPR: The French Reactor

A costly and hazardous obstacle to climate protection

Briefing November 2008

Catalysing an energy revolution

EPR: The French Reactor
a costly and hazardous obstacle to climate protection

The French EPR* Reactor 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. A study of the EPR's blueprints and experience at the two sites where EPRs are under construction, in Finland (Olkiluoto 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 that is safer, cheaper, more mature and more reliable than any other. It has been presented 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 minimised, 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.

* EPR: European Pressurised Reactor, sometimes marketed as an Evolutionary Power Reactor

image Greenpeace activists occupy cranes above the Olkiluoto 3 EPR construction for one week. As of August 2008, the Finnish Nuclear Safety Authority (STUK) reported 2,100 safety and quality defects in the construction


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The European Pressurised Reactor
Key Issues

1. Safety

The EPR is a pressurised water reactor that, in many respects, actually differs little from the majority of existing "second generation" reactors. Its concept is based on developments dating from the 1970s. It includes some claimed improvements, but the attempts to make the reactor more competitive also have their downsides when time and budget pressure lead to rush and the hiring of incompetent workers.

Information in August 2008 has revealed that the safety culture in Olkiluoto 3 is in disarray. Employees were prevented from speaking about the ongoing construction, including issues such as safety problems, or workers rights.

Large volumes of radioactivity

The EPR is the most powerful reactor ever built, with a core that contains more radioactive elements than any other. 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 the 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 involving the EPR 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 might result in 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 and vulnerabilities have been identified that could lead to radioactivity bypassing the containment unit under certain scenarios.[3] The ability of the containment unit to withstand the impact of a large aircraft was placed in doubt according to official French documents leaked in 2003. One of the reasons for delays and complications with EPR construction in Finland has been the need to reinforce the containment unit when the original design did not meet the safety criteria required in Finland.

Rush and incompetence

According to articles published in the industrial periodical many 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 industrial periodical 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 at times been 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]

Weaknesses in construction

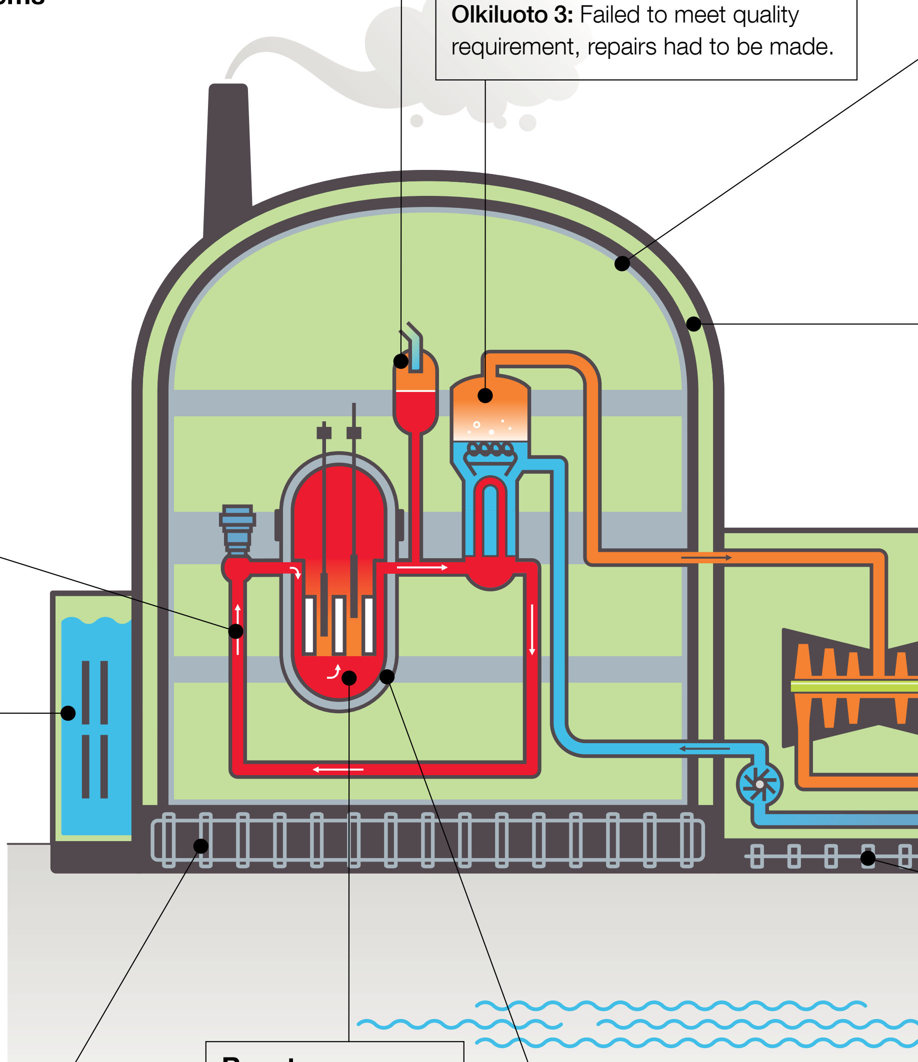
Apart from problems with the EPR design blueprint, there is growing evidence from construction sites in Finland and France that in reality the reactor has more safety and reliability weaknesses. Several problems have been made public to date…

Pressuriser

Failure can lead to loss of coolant or pressure, with reactor meltdown as a result.
Olkiluoto 3: Four out of five pieces had to be recast because of malfunction. Problems were not detected by regular inspections.
Flamanville 3: Following the problem of non-conformity in quality control, the French Nuclear Safety Authority asked Areva to prove the good quality of components of the pressuriser that were manufactured in Italy.

Steam generator

Rupture can lead to loss of coolant and reactor meltdown.
Olkiluoto 3: Failed to meet quality requirement, repairs had to be made.



Primary cooling pipes

Rupture can lead to loss of coolant and meltdown.
Olkiluoto 3: All eight huge pipe circuits failed to meet required safety criteria and had to be recast. The steel of the refabricated pipes was also found to be of inferior quality.

Spent fuel pool

Located outside of the containment. Damage due to airplane crash or other external event can lead to massive leakage and contamination.

Reactor base-slab

Failure can affect power plant's stability and lead to leakage of contamination from molten reactor.
Olkiluoto 3: Concrete mixture was improper, with too-high water content, leading to high chemical vulnerability and danger of cracking.
Flamanville 3: Concrete mixture did not meet required standards, and base-slab has already developed cracks. Reinforcement steel bars were arranged and welded improperly. Repeated failure to improve quality forced state inspectors to order suspension of the works for one month in May 2008.

Reactor

The world's largest reactor, with the largest amount of radioactive materials inside. Potentially running on "MOX" fuel with increased content of plutonium.

Reactor vessel

Failure can lead to outburst under high pressure, loss of coolant and meltdown.
Olkiluoto 3: Five out of six components failed to meet French safety criteria and had to be remanufactured. Problems with welding occurred.

image Greenpeace activists scale 100 metre high crane in protest occupation at the construction site of Olkiluoto 3. With operation already postponed to 2012, Olkiluoto will not be ready in time to contribute to Finland's Kyoto target

Containment inner steel liner

Failure leads to loss of airtightness of the containment and can cause leakage of radiation to the outside.

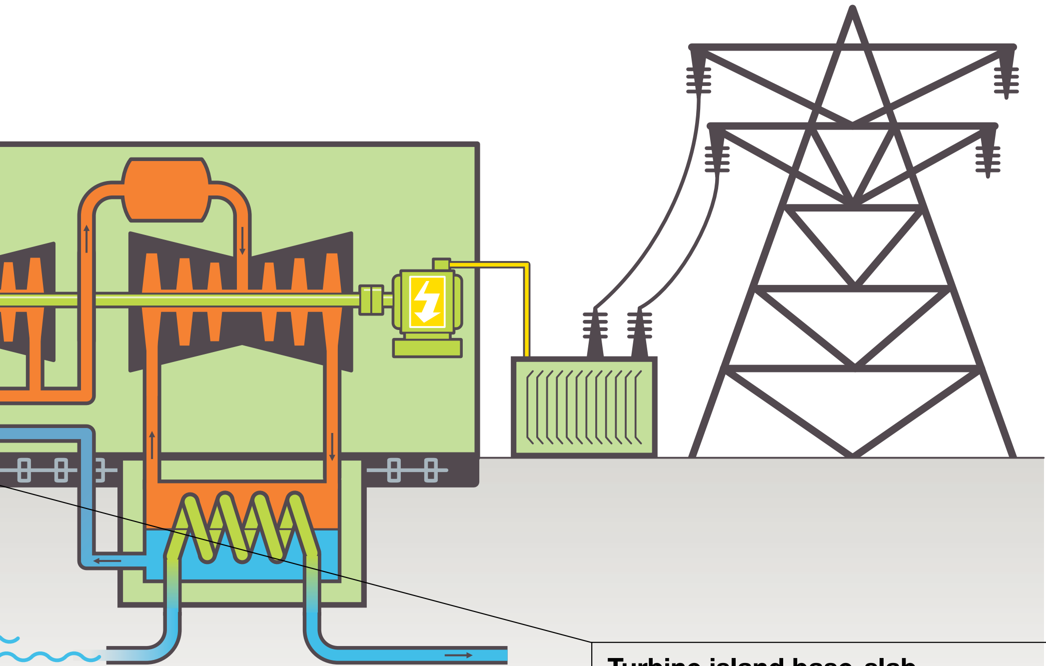
Olkiluoto 3: Manually welded in a Polish machine yard with no experience of nuclear construction. Welds were defective. Dozen holes cut in wrong places. Badly stored and damaged in storm. Defects in welding continued in assembly of the liner in Olkiluoto.

Flamanville 3: Quarter of welds identified as deficient. Welding done by company without required qualification.

Containment

Failure can lead to massive leakage of radiation and contaminate environment. Ability to withstand airliner impact doubtful.

Olkiluoto 3: Steel framework of the containment was welded for at least half a year without mandatory tests, oversight and guidelines. Problems with quality of concrete.



Turbine island base-slab

Olkiluoto 3: Designed by an Indian subcontractor who had not taken Finland's winters into account. Thermal expansion of concrete not taken into account and the blueprints had to be redone.

image Greenpeace activists welcoming French Prime Minister Dominic De Villepin to Finland. Supplied by French Company Areva, Olkiuloto 3 is already 50% over budget

2. 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 will be reduced by 15 percent, 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 scheme that is highly contaminating.

3. 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 in summer 2005, a variety of technical problems have led to a three-year delay, extending the construction period to at least 7 years.
The currently 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.
In September 2008, Nucleonics Week quoted an Areva official, saying that Euro 4.5 billion will be a minimum price for any new EPR.[8]
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.

4. Nuclear Power: an obstacle to tackling climate change

Nuclear power could at best make only a negligible contribution to CO^2 reduction, coming many years too late. It would also deprive 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 installed nuclear capacity was doubled it would only 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 2008, 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$2,000 million) over budget.
In October 2008, it was revealed that the delay is already three years. Unlikely to be operational before 2012, Olkiluoto 3 will not be ready in time to contribute to Finland's Kyoto target.
Similarly in November 2008, not learning anything about the construction problems and delays in Finland, it was revealed that the EPR in Flamanville has been delayed for a year.
For more information about nuclear power and climate change, read the Greenpeace briefing, "Nuclear Power – Undermining Action on Climate Change" (2008).[9]

There is a clear scientific consensus that global greenhouse gas emissions must peak and decline by 2015, and must be more than halved by 2050, or the global climate will suffer changes with catastrophic consequences. The nuclear industry, which has been in decline in Europe, has seized upon the climate crisis as a revival opportunity, claiming to offer a carbon-free contribution to our future energy mix.

Nuclear power is an expensive and dangerous distraction from the real solutions to climate change. Greenhouse gas reduction targets can only be met through using the proven alternatives of renewable energy technologies and energy efficiency. Every Euro spent on nuclear power is a Euro stolen from the real solutions to climate change.

Avoiding the most severe impacts of climate change requires governments, individuals and businesses worldwide to take immediate action. The world must get on a course to stay as far below a 2° Celsius temperature rise as possible. That course can only be reached by employing sustainable and renewable energy and energy-efficiency. Binding commitments are needed for industrialised countries to cut emissions by 30% in 2020 and 80% in 2050, with domestic measures, and to direct massive funds for decarbonisation in developing countries.

Greenpeace Recommendations

An end to the nuclear age:

- Phase out existing reactors
- No new construction of commercial nuclear reactors
- Stop international trade in nuclear technologies and materials
- Phase out all direct and indirect subsidies for nuclear energy

A renewable energy future:

- Divert state funding for energy research into nuclear and fossil fuel energy technologies towards clean, renewable energy and energy efficiency.
- Set legally-binding targets for renewable energy.
- Adopt legislation to provide investors in renewable energy with stable, predictable returns.
- Guarantee priority access to the grid for renewable generators.
- Adopt strict efficiency standards for all electricity-consuming appliances.

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
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 25 January, 2008
8 Nucleonics Week, Platts, 4 September 2008
9 Nuclear Power – Undermining Action on Climate Change, Greenpeace International, March 2008. http://www.greenpeace.org/international/press/reports/nuclear-power-undermining-ac

Greenpeace is an independent global campaigning organisation that acts to change attitudes and behaviour, to protect and conserve the environment and to promote peace.

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