

Nuclear adventures in Finland

Claus Montonen reveals disturbing evidence of shortcuts, overspending and commercial infighting during the construction of Olkiluoto 3 – the first of a planned new generation of nuclear power stations in Europe.

In 2002, the Finnish parliament ratified a decision-in-principle by the country's government to approve an application by the power utility Teollisuuden Voima (TVO) to build a new nuclear power plant. The plant, called Olkiluoto 3, was planned for a site that hosted two older, Swedish-built boiling-water power reactors that were built in 1978 and 1980.

Such decisions-in-principle are a legal requirement for all major nuclear installations in Finland. This follows the Finnish Nuclear Energy Act, which requires that such decisions are approved by parliament. An earlier attempt by the major power utilities to get approval for a new nuclear power plant was thwarted by parliament in 1993; a still earlier application in 1986 was withdrawn following the Chernobyl accident.

The success of the 2002 application was hailed as a major breakthrough by the nuclear industry, as it brought to an end a ten-year long standstill in new nuclear power installations in Western Europe and the USA. The reasons for the success of the 2002 application after the failure of 1993 are analysed thoroughly in the book *The Renewal of Nuclear Power in Finland*.¹ An important factor was that the power utilities and the government, acting in collusion, had learnt their lessons from the earlier debacle, and had prepared means by which to counter the two major arguments of the anti-nuclear movement. The first of these arguments sets out the advantages of (and preference for) renewable energy sources and the second highlights the risks associated with high-level nuclear waste. To counter these objections the government adopted a programme for promoting renewable energy in 1999, published a climate strategy in 2001, and approved (again via a decision-in-principle) plans for a permanent deep underground depository for high-level waste in 2001.

TVO is a conglomerate owned largely by heavy metal and paper industries. The contract for building the reactor and power plant Olkiluoto 3 was awarded to a French-German consortium, comprising the companies Areva and Siemens respectively, which had offered to build the plant for a fixed price of €3 billion, based on the new 1.6 gigawatt (electricity) European Pressurised Reactor (EPR). The reactor,

which was the responsibility of Areva, was to be the first of its type. Siemens was responsible for the steam turbines and electricity generators.

Construction started in 2005 and was meant to be finished in 2009. The date of completion was pushed back several times, most recently to 2013, but in May this year the builders finally refrained from promising any fixed date for when the power station will be connected to the grid.²

I will return to some of the reasons for the delays below. The result is that costs have escalated dramatically. Construction costs are now estimated to add up to more than €6 billion; in addition, TVO is suing the supplier consortium for €2.4 billion for missing the original deadline for completion. In an effort to recoup some of its costs, Areva and Siemens are suing TVO for €1 billion for obstructing construction by sticking to excessively rigid security requirements.³ The European courts must now decide who is going to pay for the extra costs: the French or the Finnish taxpayer. It seems highly likely that Areva-Siemens made an offer below their anticipated costs in order to secure the contract, regarded as an enormously valuable reference for securing future sales.

Construction problems

Soon after the start of construction, difficulties started to appear. Lack of coordination between the multinational construction teams and frequent changes of plan combined with language problems and differences in working culture to lead to confusion and delays. A number of specific instances that occurred suggest that shop-floor know-how concerning how to meet the strict quality requirements for nuclear engineering was inadequate for this project. Assuming the teams represent the best on the continent, the errors seen have worrying implications for the levels of expertise within Europe.

To begin with, the concrete floor slab for the reactor building was cast with concrete of incorrect composition. The error was spotted and the composition changed during the casting, but the floor slab is still too porous in places.⁴

The containment building for the reactor has a wall made out of armoured concrete covered by a steel shell. The quality of the welds holding the steel armour together was not properly checked; when an employee notified the management of the problem, he was duly sacked.^{5,6} The steel shell had not been

welded using specified methods and was based on obsolete blueprints. Part of the shell was damaged when in store at the site.⁷ The result of all this was that ad hoc patchup measures were taken. This inevitably raises doubts as to the structural integrity of the containment building.

Of the four main pipes within the primary cooling circuit, three were found to have been manufactured using steel with too large a grain. The pipes had to be torn out and cast anew, but in welding the new pipes in place, cracks in the welds have appeared.^{8,9,10} It is not clear whether these cracks have arisen because of inappropriate materials or wrong methods.

Another problem, as yet still unresolved, concerns the automatic control system. An unconditional requirement of the contract stipulated that there should be two completely independent control systems that can work in all circumstances. The Finnish Radiation and Nuclear Safety Authority (STUK) and the French Autorité de Sûreté Nucléaire (ASN), which are overseeing the construction of a second EPR at Flamanville, together with the British Health and Safety Executive (HSE), which is looking at the EPR design for possible approval in the UK, have issued a joint statement to the fact that the proposed design for the control systems does not lead to sufficient independence of the two systems.^{11,12} They state that the systems are too dependent on computers and electronic networks, which could lead to fatal vulnerability in the case of computer malfunction. Furthermore, they say that the highest-level control systems are not sufficiently well insulated from lower-level control systems, which might mean that failures in lower-level systems could incapacitate the highest level systems. These authorities have called for a redesign of the automatic control systems, but none has so far been forthcoming.

Adventures still to come

Undeterred by the setbacks experienced at Olkiluoto 3, the Finnish nuclear lobby has been pressing for more new reactors. In 2009, three applications for new nuclear power stations were submitted to the government. In spring 2010, the government proposed the approval of a decision-in-principle for two of the applications: a fourth reactor at Olkiluoto for TVO, and one for the consortium Fennovoima, one partner of which is the German E.ON. The latter application was clearly favoured on regional and possibly also political grounds: Fennovoima promised to build the station in northern Finland, a region hit hard by the recession and suffering high

unemployment, but showing strong support for the major party in the present coalition government, the Centre Party. The main argument presented by the nuclear lobby, however, centered this time on the benefits of nuclear power in an energy mix designed to minimise climate change by curbing greenhouse gas emissions.

The submission by the campaign group for which I work, Technology for Life,¹³ to the public hearings on the decision-in-principle pointed out that all existing and planned nuclear power stations could be replaced by a large number of small-to-medium sized biofuel-burning power plants (burning mainly forest residues). Such a scheme would have the additional advantages of generating local employment and being much less vulnerable both to sudden failures of generating units and to global resource shocks than the envisaged configuration of a small number of large units depending entirely on imported fuel. (Even if there are plans for opening uranium mines in Finland, there are none for building enrichment plants, which would be an impossibility given the present national and international political situation). I repeated our arguments in front of the parliamentary subcommittee in charge of preparing the decision for parliament, but our arguments, as well as those of many other organisations, fell on deaf ears. On 1 July 2010, parliament voted in favour of the decision-in-principle to build two additional power reactors. Thus Finland is set for more nuclear adventures.

During the debates, it struck me that one of the major reasons for the success of the nuclear lobby in a small country like Finland is the narrow base of experts (in this case, nuclear engineers). The small numbers (just a few dozen) of them that we have frequently change employer, from power utility to the government's Ministry of Employment and Economy, and then to the safety authority STUK, and to the State Technical Research Center VTT, which is the first to be called when the administration needs advice on matters related to technology. The result is that both the watchdogs and those being watched speak with one voice, making it hard for genuinely independent opinions to be heard. (At times STUK has made critical comments, but only after mounting public pressure following disclosures of malpractice.) Ideally, the politicians should form their own opinions based on more general considerations, but in practice they seem to be intimidated by the unanimous opinions of the 'experts'.

Last month I employed a carpenter for repairs on our house. It turned out he had also been working on the

Olkiluoto 3 reactor. Based on what he had seen and on what he had been told by his workmates, he said that when the reactor starts up, he intends to be as far away from Olkiluoto as possible.

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Nuclear renaissance in the west?

The 'renaissance' of nuclear power in other western countries is also proving problematic, especially where it involves the EPR plant.¹

In **France**, a new EPR is being built at Flamanville. Construction began in December 2007, and is currently running at least two years – and perhaps as much as three – behind schedule. Costs have grown substantially, with the latest estimate being €5 billion – 50% higher than that originally quoted. Similar to the Finnish experience, problems have been encountered with the quality of concrete and welding.

In the **USA**, the programme intended to have new nuclear reactors online by 2010 is running at least eight years behind schedule, despite offers of government subsidies. The latest problem is that the partnership between French utility, EDF and US utility, Constellation to build EPRs has been dissolved due to concerns over high costs.

In the **UK**, the safety assessment of designs of two new reactor types – the EPR and the American AP1000 – encountered delays due to concerns about the lack of independence of the main control systems (see main article). The government is proposing that various 'financial support mechanisms' be introduced to enable new nuclear build to take place.² It claims these would not technically be subsidies (a claim disputed) – which would be contrary to government policy.

But in **China**, nuclear build is proceeding more swiftly. One reason is that the reactor designs under construction would not have passed the more stringent safety assessments required in western countries.

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