In Finland, a nuclear reactor is being built – the first new nuclear plant in more than twenty years in Europe and the world's largest. Now that one country after the other has announced plans to build new nuclear capacity, all eyes are focused on the Finnish experience. A report.

Finnish reactor heralds European nuclear renaissance

Photo: Reiner Gatermann

by Reiner Gatermann

In mid-2006 the first tell-tale signs surfaced when Pertti Simola, chairman of the board of Teollisuuden Voima Oy (TVO), the company commissioning OL3, told me, 'The consortium has informed us of a delay of 6 to 9 months'. Martin Landtman, project manager on the construction site, was already showing signs of impatience then. 'In Finland', he says, 'we expect punctual delivery.'

How must Landtman feel today, now that the inauguration has been postponed by at least two years until 2011? On the largest construction site in Finland, he says, 'I will never get used to delays, they are depressing.'

In addition to the delay there has been a significant increase in the cost of the project, there is talk of between €700 million and €1.5 billion above the agreed fixed price of €3 billion. Talk of money has been consistently avoided on the construction site. Here only one thing is important: to get the reactor onto the grid as quickly as possible with no further delays and without any risk of raising doubts that safety may have been compromised. Work is carried out in double shifts six days a week. The only concession to the many Roman Catholics amongst the approximately 2,800 workers is that no work is undertaken on Sundays. Is Martin Landtman planning a holiday this year? 'Maybe in a few years', he replies wrily.

Daunting task

The Finns attracted international attention when their parliament approved the construction of a new nuclear power reactor by 107 to 92 votes at the beginning of 2002. It was planned to be the first in Europe for more than 20 years and at 1,600 MW the largest in the world. It was modelled on the German reactor Konvoi and the French N4. The building permit for the EPR3 (European Pressurised Reactor) was gained in February 2005. Olkiluoto, an island in the Baltic approximately 20 km north of Rauma, was selected as the site. There are already two reactors there, supplied in 1979 and 1982 by Swedish company Asea, now Westinghouse/Toshiba, which have been upgraded in the meantime from 660 to 840 and 860 MW respectively. The first two Finnish nuclear power plants were built in 1977 and 1981 by the Soviets in Loviisa, 100 km east of Helsinki.

The Finns set themselves a daunting task. But TVO, a non-profit electricity producer owned jointly by a number of large industrial consumers, various cities, and the semi-state owned electricity company Fortum, thought it was well equipped for it. The four existing nuclear plants have always been maintained to the necessary standard to ensure a life expectancy of 40 years. In 2007 the plants achieved their highest combined electricity production of 22.4 TWh. OL1 operated at 97.5% (7.3 TWh) capacity, OL2 at 93.7% (7.1 TWh), Loviisa1 at 94.6% (4.0 TWh) and Loviisa2 at 96.1% (4.1 TWh). In addition, the Finns were confident they could rely on the combined experience of Areva and Siemens as a recipe for success.

Still, since the beginning of construction in August 2005 the project has necessitated a steep learning curve and a great deal of additional background work. Petteri Tiippana, assistant director of Projects and Operative Safety, with the state regulatory authority STUK (The Radiation and Nuclear Safety Authority), was not surprised by the problems and delays. 'The schedule was too optimistic from the very beginning.' The list of deficiencies is relatively long and contains around 2,000 items. These range from inadequate drawings and poor-quality materials through technical errors and insufficient quality to communication problems and language difficulties. This was definitely aggravated by a certain amount of culture shock. At the latest Areva press conference to report on progress, Areva boss Anne Lauvergeon complained of administrative delays at TVO. STUK is sometimes accused of being finicky and it is suggested that the authority often demands unnecessary detail to the point of being petty. At TVO one might also hear, 'It is seldom that STUK is satisfied.' Petteri Tiippana counters, 'The conditions for all parties concerned were clear from the beginning, we have changed nothing.' However, he continually discovers design flaws and 'correcting these can easily take 9 months'. He also says there have been cases where suppliers have begun work before design approval, and controls have been introduced too late.

In its quarterly report Greenpeace has highlighted a number of criticisms. During the manufacture of main components, some repairs have been needed (e.g. mistakes in welding and manufacturing). There were quality problems in the welds and in the shape of parts of the steel liner being welded together. Heat treatment of a steam generator flange failed and the flange had to be replaced. Audits of manufacturers and suppliers show that some of them have not taken nuclear safety requirements into account in their work. And so on.

> *'We have a fixed contract at a fixed price and a fixed delivery date'*

Fact is that all those involved in the construction needed to undertake intensive additional background work. The quality requirements are now drummed into contractors and subcontractors more forcefully than ever. Checks at all levels have been significantly tightened. STUK now has two permanent inspectors at the construction site and in individual cases also sends observers to the suppliers. No deliveries may be made to the Baltic island unless they meet the requirements in every respect. 'Things must be in working order when they arrive here', states Martin Landtman firmly. The STUK inspectors have stopped work on a number of occasions. The most striking case was the discovery of faulty

Project manager Martin Landtman. Photo: Reiner Gatermann

concrete during pouring of the reactor basin. The cement had been too wet which led to a two-month halt.

Frayed nerves

But in contrast to Greenpace, who see the whole project as being a major environmental disaster, STUK boss Tiippana is reasonably relaxed. The major problems in his view are, firstly, that a whole generation of nuclear power plant construction experience has been lost. Secondly, awareness of the highly sensitive nature of nuclear power, which hardly exists any longer within the industry, has to be rebuilt. Finally, the construction of a nuclear power plant is a compact, coordinated and sensitive project the like of which is rarely encountered in other areas. In addition, Martin Landtman emphasises, the timely discovery of faults demonstrates the effectiveness of the control system. He does admit he would prefer to have fewer complaints and loss of time. He acknowledges but is not impressed by the Greenpeace arguments. Areva site manager Philippe Knoche considers them 'too general' while Tiippana simply states that the majority of Greenpeace's criticisms is based on flaws 'which we have uncovered' and the remainder of the criticism does not hold much water.

Despite the time pressure, the frayed nerves and the awareness that a great deal of money is at stake, or perhaps because of it, there is a community spirit in Olkiluoto which is rather astounding. 1905 companies from 28 countries are involved in this project, mostly from Germany (912), followed by Finland (708) and France (109), while Poles represent the largest portion of the workforce, ahead of the Germans, and the French and Slovaks together on third place. Despite this, there are no dramatic recriminations amongst the major partners, at least not outwardly. The French contractor Areva 'fully respects' STUK even though the authority is of the view that Areva 'does not bring the necessary experience as principal manager into such a project'. This is countered by Philippe Knoche with a list of around 100 international Areva projects. 'They constantly push us so that we will become better and better. Our interaction with them has become progressively more intensive.' His TVO colleague Landtman says, 'The atmosphere is positive and constructive.'

At times up to 18 cranes rise over Finland's largest construction site. There is a confusion of excavations, concrete walls, reinforcing steel, steel footbridges between the various construction sites and a Babel of tongues. Philippe Knoche reports: 'Now everything is running according to plan.' 110,000 of the planned 250,000 m3 of concrete have been poured. 200,000 m3 will be swallowed by the double-walled reactor building. It has already risen 30 m above the ground, and will reach a total of 63 m in height. It must be able to withstand the force of a super jumbo such as an Airbus 380, or a fighter plane crashing into it. Pipes and pipelines have been laid in all directions. The first of the four planned turbines has been installed. A few kilometres away from the construction site are the single-storey wooden houses of the workers. Their common characteristic is satellite dishes. Every second Sunday in the nearby village of Eurajoki a Catholic church-service is held in the Protestant church.

There is no doubt that all those involved are more than well aware that, 'we are all in the same boat.' Nothing may be permitted to stand in the way of the construction process. Martin Landtman points out, 'time-wise there is no room for manoeuvre.' However, 'the schedule is ambitious.' Petteri Tiippana expresses his reservations: 'Every stage has its teething problems, the installation phase is the next challenge.'

If there is one thing the Finnish are sensitive to it is when questions of the safety of Olkiluoto 3 are posed, as Greenpeace does. Rauno Rintamaa, energy expert of the Technical Research Centre of Finland (VTT), comments: 'In the whole world there has never been a nuclear reactor which has been as well protected against both external and internal attacks as this one.' In addition to aircraft attacks the reactor is protected against a nuclear meltdown. TVO chairman of the board Pertti Simola adds, 'The Finnish regulations are often stricter than those of the EU, and in some areas TVO demands more than the Finnish state.' Only in one area have concessions been made: The international seismic criteria have not been met as 'we don't have earthquakes'.

> *'It looks like Olkiluoto is viewed by Siemens as a black box'*

Even though the topic of finances is generally ignored on the construction site, in the headquarters of Siemens in Munich and Areva in Paris an enormous problem is clearly anticipated. Until now the Finns have not been prepared to compromise. 'We have a fixed contract at a fixed price and a fixed delivery date', insists Martin Landtman. Objections by the companies that there have been changes to the original planning which have created additional costs have not been accepted by TVO. 'The conditions were clear from the beginning and they continue to be in force,' says the chairman of the board Pertti Simola. In his view the increased costs must be covered solely by Areva and Siemens and their subcontractors.

Siemens and Areva have not said much about this, only that they have begun to make provisions for losses. Analysts estimate the cost increases at between 700 million and 1.5 billion. Bernd Laux of the brokerage firm CAI Cheuvreux has said that an assessment of the Siemens portion at €500 million was 'not unrealistic'. He also notes that Siemens could end up being hit twice as hard because it is both a major shareholder in Areva, owning 34% of their shares, and it is the supplier and installer of the turbine system. Bernd Laux says, 'It looks like Olkiluoto is viewed by Siemens as a black box. They are told what is going to happen at short notice and have no say.'

Storage site

The Finns put a lot of trust in nuclear power and it has always received well over 60% public support. There is the desire to make their power supply independent from Russian oil and gas and generally reduce electricity imports and the use of fossil fuels. However, the most important argument in favour of increasing nuclear power capability is to meet the obligations of the Kyoto protocol. According to the government, Finland has no alternative in this regard. OL3 would reduce Finland's CO2 emissions by 10 million tons annually. 29% of Finland's electricity consumption is currently covered by cogeneration plants, followed by nuclear power (25%), coal (16%), and hydroelectric power (15%). Wind power contributes just 0.2%. Finland is not a 'wind-land'. 14% of consumption is covered by imports. Finland is a member of the northern integrated grid system which includes Sweden, Norway and part of Denmark.

A further explanation for the high level of acceptance of nuclear power in Finland is the fact that the country has apparently succeeded in finding a suitable permanent waste storage site for the highly radioactive spent fuel rods. Originally the government was of the opinion that the Loviisa waste should be sent to the Soviet Union without any obligation to take it back. After all, they had supplied the reactors. The Olkiluoto fuel rods were supposed to be reprocessed overseas and taken back. Later the government and parliament changed their minds. Uranium waste is now not to be reprocessed and stored permanently in Finland. After a search lasting nearly 15 years the parliament voted by 159 to 3 in favour of Eurajoki as the storage site, the community to which the island of Olkiluoto belongs. One reason is that this site 'offers the possibility to bring the canisters back to the surface at a later date'.

Posiva Oy was founded by TVO (60%) and Fortum (40%) to undertake the Onkalo storage project. Just 2 km away from the Olkiluoto reactors they have been drilling deep into the granite since 2004. In the meantime they have reached 240 m. By 2012 this is expected to be 520 m. At this level, and at 420 m, research stations are planned. A total of 9 km of tunnels will be built. It will be possible to drive through 5.5 km of them in 5.5 m x 6.3 m pipes. The storage capacity was initially planned for 9,000 tons of uranium. This includes 1,000 tons from Loviisa after its operational life span of 50 years, 2,500 tons from both Olkiluoto reactors after their operational life spans of 60 years, and finally 2,000 tons from the third reactor there after its operational life span of 60 years. In view of the plans for the construction of further nuclear power plants in Finland, Posiva Oy wants to provide for their operating life spans, too. Therefore the company registered an environmental impact assessment (EIA) with the government in the middle of May with the goal of increasing the Onkala capacity to 12,000 tons of uranium and the underground storage area from 190 to 240 ha. This is approximately equivalent to the needs of an additional not yet decided upon reactor. Depending upon its origin the waste will be sealed in 3.6, 4.7 or 5.2 m long copper canisters. These have a diameter of 1.052 m and a wall-strength of 50 mm. The fuel rods, a total of 28,000, will be enclosed in a bentonite covering within the copper canisters. The shaft

OL1 and OL2. Photo: Reiner Gatermann

will also be sealed with compacted clay and everything enclosed in 1.8 billion-year-old and earthquake-proof granite.
According to the current schedule the construction application for Onkalo is to be presented to the government by the end of 2012. It must also be approved by parliament. Finally, before permanent storage can be started in 2020, both authorities must give their consent.

Attraction

Since the start of construction in Olkiluoto in 2005 there has been no end to foreign delegations knocking on the door of the Baltic island. The new construction has become an attraction for politicians, researchers, technicians and environmentalists. Even though the Finns haven't exactly advertised the high-ranking guest list on the construction site, the visit by Michael Glos, the German Minister of Economic Affairs, in spring is well-known. They are somewhat proud that they have sparked off a European-wide debate on nuclear power through their decision in favour of OL3, and this just 22 years after Chernobyl.
For the Finns, the nuclear renaissance does not stop with OL3. Three companies have begun an environmental impact assessment for three further nuclear power stations. TVO has already applied for permission to build a fourth reactor on Olkiluoto. Fortum will follow soon, as they wish to build a third reactor annexed to their two existing ones in Loviisa. Finally, the newly founded company Fennovoima Oy is preparing an application this year. The German Eon has a 34% share in Fennovoima. Eon is now looking with its industrial partners for a suitable location for the 1,000 to 1,800 MW reactor. The industry believes that in addition to OL3, Finland requires two further nuclear power plants while the Minister of Economic Affairs Mauri Pekkarinen believes that one more will be sufficient.

> *'When we've got this one up and running we can sell nuclear power to the whole world'*

The resurrection of nuclear power is hindered, as always, by two major obstacles: financing and permanent waste disposal. The Finns appear to have come the closest to finding a solution to both problems. Currently experience for a new generation of nuclear power is being gathered in Olkiluoto at what will probably be a very high price. But optimism reigns on the Baltic island. Letting out a deep sigh an engineer for a foreign supplier is convinced: 'When we've got this one up and running we can sell nuclear power to the whole world.' ■