

THE FIFTH NUCLEAR POWER REACTOR IN FINLAND

Veijo Ryhänen
TVO, Finland

1. Introduction

Finland is a northern country highly dependent on foreign energy supplies. Energy consumption per capita is high due to the geographic location of the country and the energy-intensive industrial structure. A great effort has been put towards efficient use of energy in order to keep the costs at tolerable level.

In the electricity supply, there is a diversified mix of fuels. In 2002, it was decided to increase production capacity by building a new nuclear power plant unit. It will support security of supply and the fulfilment of the Kyoto commitments. Other contributing factors for the decision were the good experiences of the existing nuclear plants, the steady price of nuclear electricity and the scarcity of indigenous energy resources.

2. Supply of electricity

The use of electricity has been growing in the primary energy consumption. In 2005, the total consumption was 84.9 TWh corresponding to 16,300 kWh per capita. The industry consumes more than 50% of the electricity.

A wide selection of fuels is used in power supply, e.g. nuclear, coal, hydro, natural gas, biomass and peat. In 2005, 26% of the consumption was generated by nuclear. About one third of the electricity supply is produced in combined heat and power plants. During the last years, net imports from the Scandinavian market and Russia have covered 5-20% of the consumption.

According to the predictions, electricity consumption is growing average 1.5-2% per annum. Furthermore, there are ageing old power plants to be replaced during the next decades. Hence, there is a considerable gap between the predicted demand and installed capacity.

3. Nuclear power plants and waste management programme

In Finland, there are two units at Olkiluoto operated by TVO (OL1 and OL2, 840 and 860 MWe respectively) and two at Loviisa operated by Fortum (LO1 and LO2, 2 x 488 MWe). The use of nuclear power started already in the late 1970s, and the operating record has been very good both in technical and economical sense.

TVO (Teollisuuden Voima Oy) is a not-for-profit company owned by several Finnish utilities and industrial companies. All electricity produced by TVO is supplied at cost to the shareholders. Extensive modernisation projects of the plant units have been carried out for ensuring reliability of operation and a long lifetime as well as for increasing the production

by uprating the power outputs. The average capacity factor of the Olkiluoto units during the last 10 years is over 95%.

The national programme for nuclear waste management was launched already for 25 years ago. The facilities for underground disposal of low- and medium level operating waste and for interim storage of spent nuclear fuel have been built at both nuclear power plant sites. The programme is nowadays focused on development of a deep disposal facility for spent fuel. The implementor of spent fuel disposal is Posiva, the company jointly owned by TVO and Fortum.

Extensive studies for siting the spent fuel repository were started already in the early 1980s. Olkiluoto was selected for the site of the national final disposal facility in connection of the Government's Decision-in-Principle (DIP) for spent fuel disposal in 2001. The excavation of an underground rock characterisation facility has been underway since 2004. EUR 1.4 billion have been collected in the nuclear waste management fund for future costs of nuclear waste management and decommissioning operations.

The attitudes towards the use of nuclear power and underground disposal of wastes have developed in a positive way. According to the opinion polls among the whole population, the share of supporters of nuclear power is nowadays higher than opponents. As to waste management, a majority of the inhabitants in the host municipality of spent fuel repository are in favour of the disposal facility.

4. OL3 project

In 2000, TVO applied to the Government for the Decision-in-Principle on construction of a new nuclear power plant unit. In the next years, the gap between the demand and available capacity would have been difficult to fill by other alternatives taking into account the environmental constraints and economical aspects. The DIP application was preceded by feasibility studies of available reactor designs since 1998. Environmental Impact Assessment (EIA) was carried out in 1998-2000, and the final EIA Report was appended to the DIP application in accordance with the requirements of the Nuclear Energy Law.

In the comparison of the generation costs of different alternatives, nuclear power has been estimated to be competitive. According to the estimates by Lappeenranta University of Technology, the electricity generation cost of a nuclear power plant is about 24 EUR/MWh in the price level of 2005, based on the annual full-load utilization time of 8000 h and the real interest rate of 5.0%. This estimate was the least cost option of all the generation alternatives studied. Taking into account emissions trading, the gas-based electricity would cost 41 EUR/MWh and coal-based 52 EUR/MWh. Other alternatives (peat, wood, wind) were between 50-60 EUR/MWh. Nuclear power will also secure stable and predictable electricity price, because the growth of fuel price causes only a slight increase in the nuclear electricity cost.

The process relating to the DIP involves extensive consultation. The statements given about TVO's application were mostly positive or neutral. The Government made a positive DIP in January 2002, and it was finally ratified by the Parliament with votes 107 for and 92 against in May 2002. Prior to the ratification, the issue was debated in eight Parliamentary Committees and extensive hearings of experts were arranged. The bidding competition was

launched later in the same year, and the bids were received in 2003. Investment decision was made and the contract with the consortium formed by AREVA NP and Siemens was signed at the end of 2003. Preparatory site works were also started in this phase.

The Government granted the construction licence in early 2005, based on the application submitted by TVO one year earlier. The construction of the new unit Olkiluoto 3 (OL3) is underway at Olkiluoto, and it is scheduled to produce electricity in 2009. The reactor type is EPR having an electrical output of 1,600 MW. The construction of the new unit is partly financed by the shareholders and partly by loans from financing market.

5. Next steps in spent fuel disposal

In parallel with the new power plant project, Posiva is proceeding with the preparations for spent fuel disposal. The underground rock characterisation facility will be built by 2010. The next major step will be drawing up the construction licence application of final disposal facility by the end of 2012. The operation of the facility is due to start in 2020.

In connection with handling of TVO's DIP application, Posiva's application for the extension of the spent fuel repository was accepted. Hence, Posiva's final disposal facility will be used also for spent fuel management of the OL3 unit in the future.

6. Concluding remarks

Nuclear new build and increasing use of renewable biomass appear the best options for the necessary new capacity of electricity production in Finland. The strategy based on these options takes into account environmental aspects and the security of supply.

Several factors support the use of nuclear power as a vital energy source now and in the future. The experiences of the existing power plant units have been very positive. Generating costs are competitive and the price of electricity produced by nuclear has a good predictability even in long term. Nuclear power is a CO₂ free energy form in line with national climate targets. TVO's company form – electricity at cost to the shareholders – suits well for a long-term investment. For nuclear waste management, including spent fuel disposal, there are politically accepted solutions, and funds have been collected for future costs of waste management.