

# The Fifth Nuclear Power Plant in Finland from the Radiation Protection Point of View

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Teollisuuden Voima Oy

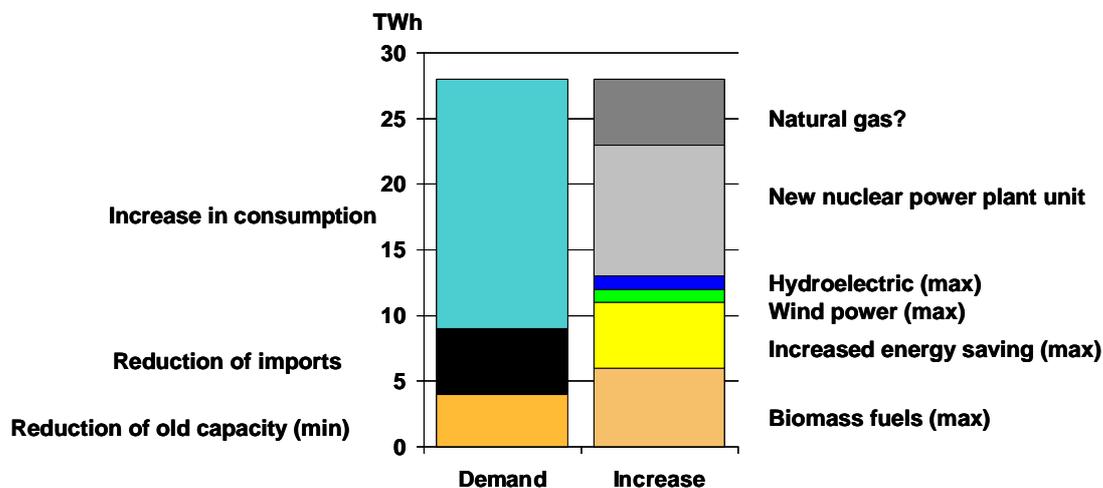
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## INTRODUCTION

Teollisuuden Voima Oy (TVO) is a private own company, which operates two ASEA Atom designed BWR units in Olkiluoto island in the west coast of Finland. TVO is founded in 1969 and the commercial operation of units OL1 and OL2 started in 1979 and 1982 respectively. After two power increase projects the current net power of 840 MW<sub>e</sub> per unit (corresponds to 2500 MW thermal power) was achieved in 1998. The company produces electricity to its shareholders at cost.

During the year 2003 over 25 % of the electricity in Finland was produced by nuclear power, meanwhile the share of import was 5.7 %. Other notable manners of electricity production are hydropower, co-generation (district heating and industry) and condensing power (fossil fuel). Up to the year 2015 the annual electricity demands are estimated to increase with 25 – 30 TWh. This is due to the consumption increase, estimated decrease of import and reduction of old capacity. (Figure 1).

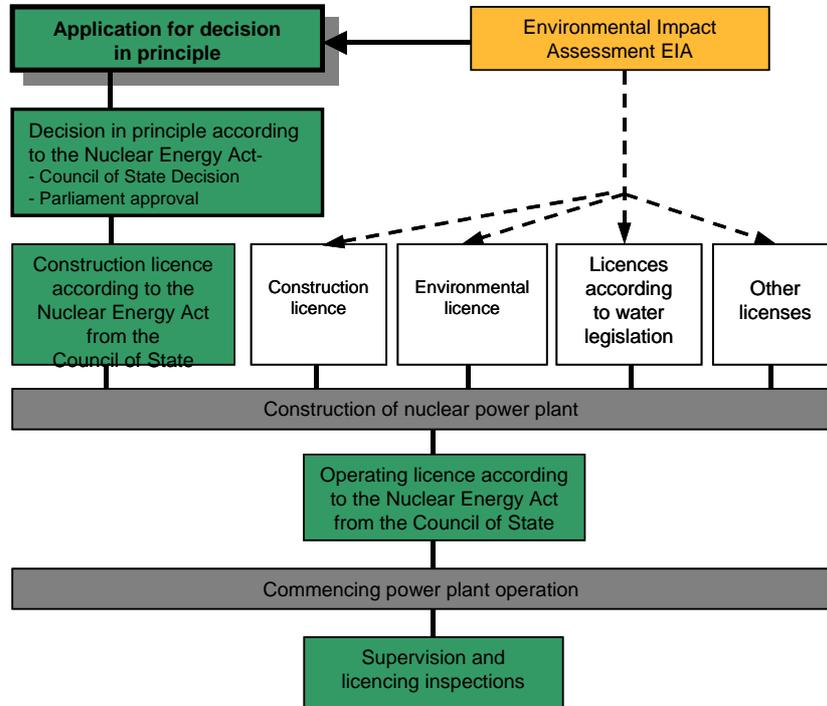


Source: Council of State National Climate Strategy and Finergy

**Figure 1:** Additional electricity demand and production increase until 2015.  
(This estimation was originally released in 1999)

## OVERALL VIEW ON THE NUCLEAR POWER PLANT LICENSING AND PROCUREMENT PROCEDURES

The licensing schedule is shown in the Figure 2. In the late 90's the preparedness phase was carried out. The Environmental Impact Assessments (EIA) for two alternative sites, Olkiluoto and Loviisa were issued. During this phase a number feasibility studies for potential light water reactor concepts were also done.

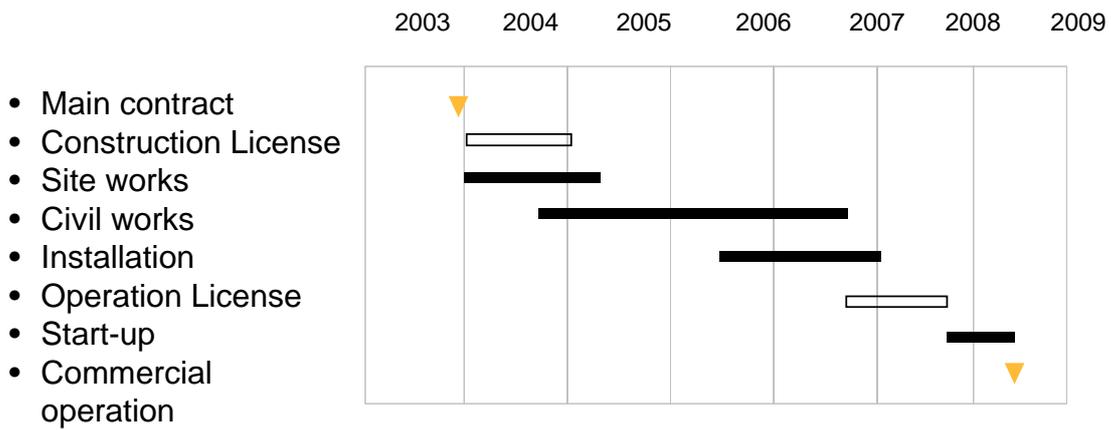


**Figure 2:** Summary of the licensing procedure of the new nuclear power plant.

TVO put in the application for Decision In Principle (DIP) in the autumn 2000. The Council of State (i.e. Finnish government) accepted the application 17<sup>th</sup> January 2002 and the Finnish Parliament confirmed the decision after voting 24<sup>th</sup> May 2002 (107 in favour, 92 against). The decision in principle noted that the construction of a new light water reactor, PWR or BWR, on either of the two existing nuclear power plant sites in Finland, Loviisa or Olkiluoto is in accord with the "overall good of the society". The electric output of the new unit is limited to 1000 - 1600 MW<sub>e</sub>.

Bid invitations were sent out on 30<sup>th</sup> September 2002 and the bids were received on 31<sup>st</sup> March 2003. During the bidding phase a number of bids by different power plant suppliers were evaluated. Olkiluoto was selected as the location of the new power plant in October 2003. The turnkey contract with consortium Framatome – Siemens was established in December 2003.

The execution phase started in the beginning of the year 2004. The commercial operation of the plant is planned to start before the end of this decade. The overall time schedule of the process is shown in the Figure 3.



**Figure 3:** Olkiluoto 3 overall schedule

### BID EVALUATION PHASE: RADIATION PROTECTION ASPECTS

About 100 persons participated in the evaluation work in total, half of them full-time and the rest part-time. Special attention was paid on the correct handling of confidential and secret information. E.g. evaluation group has own data network, which was physically separated from TVO's administrative network and from the outside world. Eight working groups were formed to carry out the technical evaluation of the received bids:

- Contract
- Fuel Contract
- Technical group
- Scope of Delivery
- Reactor Core
- Safety
- Calculation
- Operation & Maintenance

Most of the radiation protection issues were handled in the Operation and Maintenance group, which also was in charge of evaluation of O&M-issues, waste handling, chemistry and outage performance as well. Certain questions were also co-operated with other working groups, especially Safety group and Technical group.

The call for bids, with respect to radiation protection, was based on the EUR-document (European Utility Requirement). EUR-document was however reviewed and completed with further demands from YVL-guidelines, other relevant national requirements, TVO's own expertise and operation experience.

The most essential requirement is the minimization of both collective and individual doses. As stated in the ICRP publication 60, BSS 96/29/Euratom, YVL 7.9 etc. the individual radiation exposure of workers is limited to 50 mSv/year and to 100 mSv/5 years. Taken into account the decreasing international trends and the possibly strengthened recommendations and limits in the future the maximum individual dose target in Olkiluoto 3 was set to 5 mSv/year. The collective annual dose target given in the YVL 7.9 is less than 2.5 manSv/GW<sub>e</sub> as two years running mean for operating units. YVL 7.18 states that the target for planning of new NPP units is less than 0.5 manSv/GW<sub>e</sub>/year (life time mean). TVO defined the target value of the annual collective dose to be less than 0.5 manSv for Olkiluoto 3 (life time mean). During accidents the maximum allowable dose for workers, who are not performing life saving actions is set to 50 mSv and the maximum allowable dose for public during normal operation and anticipated incidents is less than 0.1 mSv (site specific value).

Some key issues, which have a significant contribution on the effectiveness of radiation protection are shieldings, plant lay-out, placing of RP-facilities, source term minimization, corrosion, deposition of corrosion and fission products, water chemistry, fuel handling, maintenance activities in the controlled area and in-service inspections.

As a result to the bid evaluation the power plant unit equipped with EPR (European Pressurized Water Reactor) nuclear island and Siemens' turbine island was chosen. The radiation protection aspects, which were taken into account during the evaluation process were not deciding. All plants bid could be acceptable at least after some modifications. The EPR concept is based on the newest German and French PWRs. Framatome ANP names both N4-generation (Civaux 1 and 2, Chooz B1 and B2) in France and the Konvoi-generation (Neckarwestheim 2, Emsland, Isar 2) in Germany as references.

## **MAIN ACTIVITIES DURING THE EXECUTION PHASE AND CONDUCT TO OPERATION**

One of the most important tasks before the start up is the developing enough competence and understanding on the behaviour of the new unit. TVO has a lot of experiences on operation of BWRs and has during its history managed to keep both individual and collective exposures relatively low. An extremely important and challenging objective is to receive equal results in the future in OL3 as well.

Most of the employees have worked since 70's or 80's in TVO and many of them will retire within the next ten years. Obviously the change of generation makes further challenges to everybody in the company. Up to the present the interest in working in the nuclear power company has been sufficiently high. Radiation protection organisation, which is today common for all nuclear facilities in Olkiluoto will certainly expand.

During this year the focus is in the licensing process and generating a good co-ordination between all parties attending the project. For example the collection of YVL guides are continuously under updating but none NPP have been licensed in accordance with them before.

Later the most resources will be needed for commissioning and procurement of systems and equipments not included to the turnkey delivery.