*Arvydas Galinis, Vidas Lekavičius*

# UNIT SIZE OF THE NEW NUCLEAR POWER PLANT IN LITHUANIA AND ITS RESERVATION OPTIONS

Lithuanian Energy Institute, Lithuania, +370 37 401957, galinis@mail.lei.lt
Lithuanian Energy Institute, Lithuania, +370 37 401957, vidas@mail.lei.lt

## OVERVIEW

Increased security of energy supply is one of major factors predetermining plans of construction of the new nuclear power plant in Lithuania. However, size of nuclear units, currently available in the market, is relatively large in comparison with the power demand or total installed capacity of power plants in Lithuania or even in the Baltic (Estonia, Latvia, Lithuania) power system. Large capacity of nuclear units requires corresponding reserve capacities that should be accessible in the case of failure of the nuclear unit. Unit size of nuclear power plant, accessible reserve capacity, reliability of power system and security of energy supply are factors tightly interrelated one with another. Reliability of power system should be not reducing increased security of energy supply after commissioning of the new nuclear power. Therefore selection of unit size for the new nuclear power plant and analysis of reservation options are very important issues for the Baltic power system. This presentation discusses estimation of rational unit size of the new nuclear power plant in Lithuania looking from the point of view of future power system development and various reservation options. The future development of generating capacities in the Baltic states, maneuverable characteristics of existing and new power plants, existence of links with neighboring power systems, their capacities, loads and flow directions, different standards regarding reserve capacities in neighboring power systems and other factors are taken into account when analyzing rationale unit size and reservation of the new nuclear power plant.

## METHOD AND CONTENT OF THE ANALYSIS

Currently Lithuanian power systems, as well as power systems of Estonia and Latvia are operating synchronously with the power system of former Soviet Union (IPS/UPS). Primary reserve is provided by Russian power system, requirements of secondary and tertiary reserve are met jointly by IPS/UPS and power systems of Baltic states. In the future this situation may change significantly because Baltic states have an intention to join UCTE for synchronous operation, new generating capacities will be built in these countries or obsolete capacities will be decommissioned before commissioning of the new nuclear power plant or during it's operation, new lines connecting Baltic power systems with UCTE and Nordel will be built. Some of these events are relatively certain (new CCGT units in Lithuania and Latvia, links Lithuania-Poland, Lithuania-Sweden, Estonia-Finland), some of them still have much bigger degree of uncertainty (commissioning or decommissioning of other generating capacities, synchronous operation with UCTE and others). In this relation problem of reservation of the new nuclear power plant in Lithuania was analysed in parallel with optimisation of development and operation of generating capacities in the Baltic states in the long term perspective, taking into account different degree of uncertainty of various factors and events. For this purpose special mathematical model was developed and applied. This model also took into account existence and capacity of interlinks with other power systems (UCTE, Nordel, IPS/UPS), rational flows through these lines during

normal and emergency cases. The main idea of this analysis was estimation of rational structure of generating capacities, their operation regimes; allocation of primary, secondary and tertiary reserve capacities inside the Baltic power system and use of interlinks in order to provide sufficient reserve capacity in each time moment in the case of failure of unit at the nuclear power plant. The least cost criterion was used in this analysis. Unit size of nuclear power plant was exogenous variable. Its value analysed was 500 MW, 800 MW; 1100 MW; 1300 MW and 1600 MW. Up to 90 cases were analysed that, among others, describe following conditions:

1. Baltic power system operates asynchronously with UCTE, Nordel and IPS/UPS:
    a) No any links with third countries;
    b) Estlink (350 MW);
    c) Estlink (1000 MW), SwedLit (1000 MW);
    d) Estlink (1000 MW), LitPolLink (1000 MW);
    e) Estlink (1000 MW), Link with IPS/UPS (1500 MW);
    f) Estlink (1000 MW), SwedLit (1000 MW) and LitPolLink (1000 MW);
    g) Estlink (1000 MW), SwedLit (1000 MW), LitPolLink (1000 MW), Link with IPS/UPS (1500 MW).
2. Baltic power system operates asynchronously with Nordel but synchronously with UCTE (1000 MW; 1500 MW; 2000 MW):
    a) Estlink – 350 MW;
    b) Estlink – 1000 MW;
    c) Estlink – 350 MW, SwedLit –1000 MW;
    d) Estlink – 1000 MW, SwedLit –1000 MW;
    e) Estlink – 1000 MW, SwedLit –1000 MW, IPS/UPS (1500 MW).
3 Baltic power system operates synchronously with IPS/UPS (1500 MW).
    a) Estlink – 350 MW;
    b) Estlink – 1000 MW;
    c) Estlink – 1000 MW, SwedLit –1000 MW;
    d) Estlink – 350 MW) , UCTE (1000 MW);
    e) Estlink – 1000 MW) , UCTE (1000 MW);
    f) Estlink – 1000 MW, SwedLit –1000 MW) , UCTE (1000 MW).

After estimation of rational allocation of reserve capacity analysis of static and dynamic stability of the power system was performed for the operation regimes corresponding minimal and maximal load of power system. However, static and dynamic stability of the power system will be not discussed in the presentation because it made only minor corrections of the results obtained from optimisation analysis.

**CONCLUSIONS**

1. Due to the lack of primary reserve unit size of even 500 MW of the new nuclear power plant is too big for Baltic states if their power system would operate isolated and no reserve capacity would be obtained from UCTE, Nordel or IPS/UPS.
2. Unit size of 1600 MW is too big when power system of Baltic states operates synchronously with UCTE but capacity of the link is only 1000 MW. 1300 MW is acceptable. Unit size of 1300 MW is boundary in the case capacity of EstLink would be not extended or link SwedLit would be not constructed. In the case larger unit is installed its operating capacity is reduced in order not to have possible disturbance in the system larger than available reserve capacity.
3. In other cases analyzed unit size of 1600 MW is acceptable.