

The executive summary on study of Baltic and Polish TSOs on synchronous operation of Baltic power systems with UCTE

Background

On June 11th, 2007 the Prime Ministers of the Baltic States signed the Communiqué calling TSOs from Estonia, Latvia and Lithuania to examine the feasibility of synchronous operation of Baltic transmission systems with the UCTE as a step towards full integration of the Baltic electricity market into the EU common electricity market. PSE-Operator SA as UCTE TSO adjoining Baltic TSOs was invited to the cooperation. On October 30th, 2007 the Cooperation Agreement among three Baltic TSOs and PSE-Operator was signed with the aim to work jointly within the framework of the TSOs scope of activities, competences and responsibilities with the aim to analyse, investigate, assess and evaluate all possible scenarios of integration of the Baltic electricity market into CEE regional electricity market.

As a first step of cooperation the Task Force with representatives of OÜ Põhivõrk, AS Augstsprieguma tīkls, Lietuvos energija AB and PSE-Operator SA was established with the task to conduct a pre-feasibility study, dealing with a steady state load-flow analysis only. The Task Force was under the obligation to perform the preliminary calculations and to prepare first conclusions on feasibility of synchronous interconnection.

This paper, being the Executive Summary of the work done by the Task Force, gives in a brief and condensed form the assumptions and first conclusions of the calculations.

Model and assumptions

In order to perform calculations with indicative results in the required timeframe it was agreed to use the existing, actual summer and winter reference network models of all TSOs for the year 2007. However certain network reinforcements needed to be included.

As far as the connections with neighboring countries are concerned there has been agreed as follows:

- additionally to the existing Estlink I, the Estlink II has also been modeled,
- any connection between Baltic TSOs and Swedish TSO included in the model,
- asynchronous operation of Baltic TSOs with IPS/UPS (Russia and Belarus).
- Kaliningrad area operating synchronously with Baltic TSOs.

As a precondition, to merge the models the interconnection between Polish and Lithuanian power systems had to be included with different scenarios of network development.

Calculations were performed for three network development cases in the interface Lithuania-Poland:

Case 1: 400 kV Alytus - Ełk double circuit line, 400 kV Narew - Ełk line;

Case 2: Case 1 enforced by 400 kV Ełk – Ostrołęka double circuit line, 400 kV Ostrołęka - Miłosna double circuit line, and 400 kV Kaunas – Ełk line;

Case 3: Case 2 enforced by 400 kV Ostrołęka - Olsztyn Mątki double circuit line.



Results of analysis

First of the Task Force recommendations is that for the further analysis the models including power systems' developments planned for 2015 should be used because load and generation patterns as well as the number of transmission lines can change, for certain cases significantly enough in comparison to 2007. The year 2015 is the date when the implementation of the first interconnection stage is the earliest possible taking into consideration the time needed for constructing new power plants or transmission lines. Therefore, according to the Task Force, it is necessary to perform additional steady state load flow calculations with the year 2015 models and to complete these calculations with the dynamic stability analysis - especially to get a knowledge on system performance during and after frequency disturbance and to identify the issue of inter-area oscillations in the interconnected system.

The preliminary results for case 1 (winter and summer model), obtained within the scope of work of the Task Force show that the connection between Baltic TSOs and UCTE is feasible only through the back-to-back station (asynchronous connection). Thanks to such connection TSOs can have a possibility to control power flows exchanged between power systems, otherwise sudden disconnection of generating units in Baltic countries can lead to severe overloads and voltage violation in Polish north-east part of grid and possible blackout in Baltic countries. Synchronous operation of Baltics with the UCTE is possible from the technical viewpoint for cases 2 and 3 thanks to necessary reinforcement of Polish and Baltic countries' internal grids.

Reinforcements additional to construction of the transmission lines already incorporated in the models for 3 cases calculations must include:

- reinforcement of transmission grid supplying Warsaw area and 110 kV lines in north-east area of Poland.
- construction of Harku – Sindi - Riga and Ignalina - Kruonis transmission lines and reinforcement of interconnection Latvia - Lithuania in Baltic countries.

Asynchronous interconnection (case 1) of Baltic countries and Poland is possible by the year 2015, because of construction time of 400 kV Ełk - Narew transmission line. During this stage Baltic power systems should remain synchronously interconnected with IPS/UPS.

Considering synchronous operation of Baltic countries with the UCTE the additional reinforcements in Polish and Baltic countries' grids have to be done. Considering time for preparation of right-of-way and construction time for transmission lines it seems that the synchronous operation is possible about the year 2020. As a first step towards synchronous interconnection, asynchronous interconnection (DC interconnection) should be implemented. Asynchronous interconnection shall remain in operation after synchronous connection has been built, thus improving stability of interconnection and power exchange possibilities. The third interconnection line between Poland and Lithuania (Ełk - Kaunas) will not improve significantly power exchange possibilities between Baltic countries and Poland. According to the Task Force, other additional transmission lines with different connection points in Poland and Lithuania should be studied in the scope of further feasibility study on UCTE – BALTSO synchronous interconnection.

In addition to the conclusions on technical feasibility it is necessary to underline that the transfer capacity of UCTE – BALTSO interconnection as well as Baltic countries'

ability to operate synchronously with UCTE are directly linked with the size of largest generating unit in Baltic countries or DC connections between Baltic countries and Nordel or IPS/UPS.

Assessment of associated costs

Present long-term development plan of Estonian transmission system includes construction of 330kV line Harku – Sindi with cost of 32 million EUR and construction of 330 kV line from Sindi to Riga (Latvia) with cost of 10 million EUR from Estonian side. The implementation of the lines is also precondition for interconnection of Estonian power system with UCTE.

The estimated costs for Latvian power system to be ready for synchronous operation include necessity to construct two power plants in Riga and Kurzeme region. The reason for this is because Latvia is significantly lacking of available generation capacity. The cost for both power plants 400 to 500MW each plus construction of 300km 330kV circuits for Kurzeme power plant connection is estimated about 1 billion EUR. In addition it is necessary to strengthen Latvia - Lithuania connection with new line to Ignalina that results to 17 million EUR from Latvia part. The only more or less predicted project is Riga - Sindi line where Latvia's share is about 25 million EUR. For Latvia it totals to 1050 million EUR.

Present development plan for Lithuanian includes 330kV lines Vilnius - Neris, Telsai - Klaipeda, Panevezys - Musa, Kruonio HPP -Alitus double circuit with back-to-back station and totals to 290 million EUR. In addition to existing plans it is construction of Ignalina - Kruonio HPP double circuit with cost of 65 million EUR and line from Ignalina to Latvia with cost of 6 million from Lithuania side is required and with cost of two additional lines to Poland it sums up to 260 million EUR. Therefore total cost for Lithuanian power system to be ready for synchronous operation is around 550 million EUR.

In addition if synchronous operation has to be performed before the year 2020 the cost of implementation of primary control in old power plants that fulfils requirements of UCTE should be considered with total cost for all three Baltic power systems of 80 million EUR.

Based on the technical assumptions that were made in the past the total cost for Polish power system was estimated at 654 million EUR. This estimation has covered three major groups of necessary investment. The first one, which was around 54 million EUR concerned the Polish – Lithuanian cross-border double-circuit line itself. The second group was related to the massive development of the transmission infrastructure in the north-eastern Poland and its estimated cost was 430 million EUR. The third group of around 170 million EUR was related to indispensable strengthening of some parts of the system due to the interconnection effect, enabling equal possibilities of electricity exchange for both sides.

Therefore cost for already considered and not considered projects that contribute to provision of synchronous operation of the Baltic power systems with UCTE could sum up to 2,5 billion EUR.

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