



UKRENERGO

State enterprise | National power company

NTC Calculation

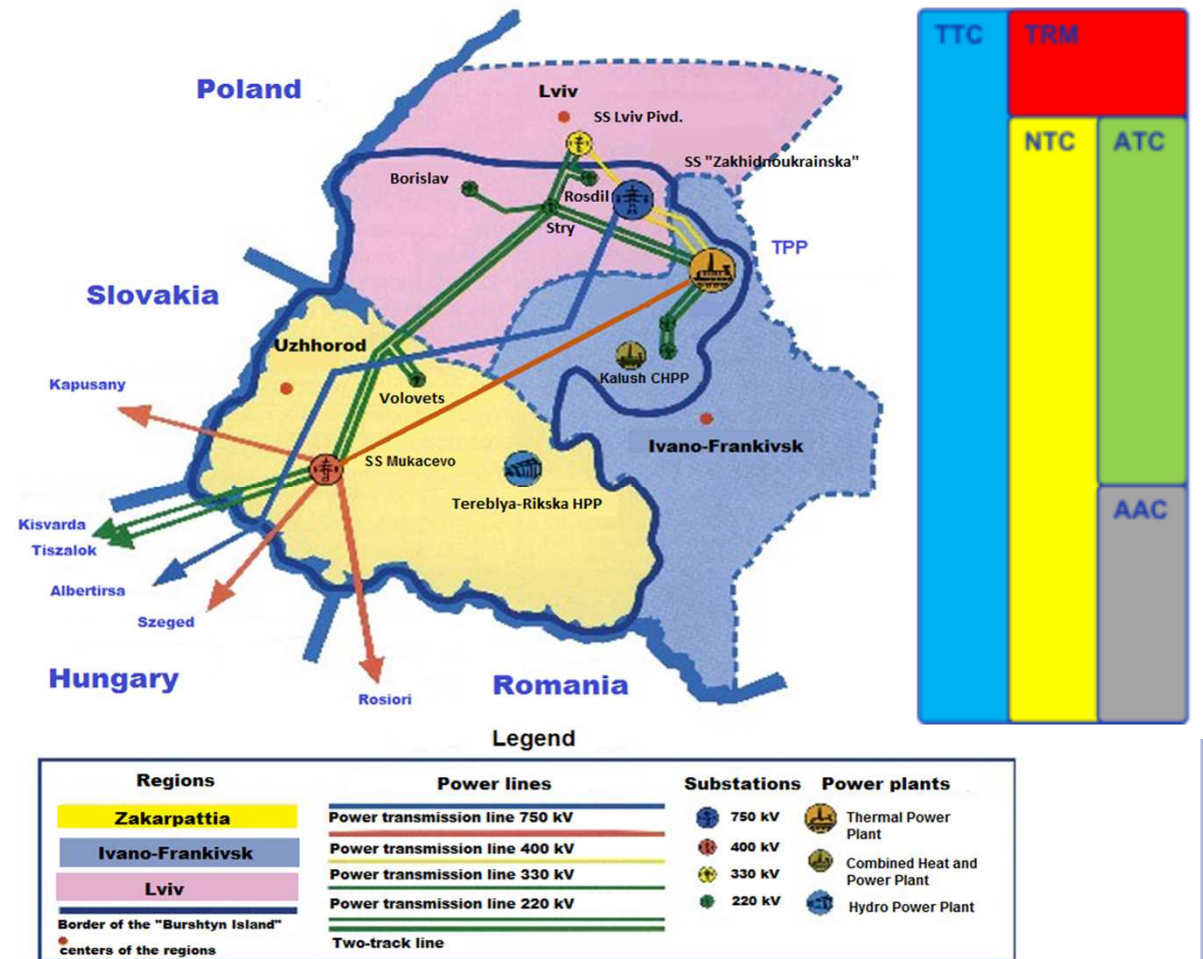
Introduction



137 electrical substations 110-750 kV
21,3 thousand km OHL 220-750 kV.

Introduction

- Capacity for a normal electrical scheme:
- From Ukraine:
- to Slovakia – 400 MW;
- to Hungary – 650 MW;
- to Romania – 400 MW.
- Total – 1450 MW.
- To Ukraine:
- from Slovakia – 400 MW;
- from Hungary – 450 MW;
- From Romania – 400 MW.
- Total – 1250 MW.



- The methodology for NTC calculation was approved by Resolution of the NEURC 08/08/2018, No. 893.
- This methodology takes into account the commonly used provisions that are used in the ENTSO-E and aimed at implementation the obligations of Ukraine within the framework of the Energy Community, in particular the Directives 2009/72/ EC of 13 July 2009 on common rules the internal electricity market and the repeal of Directive 2003/54/EC and the Regulations (EC) №714/2009 of the European Parliament and of the Council of 13 July 2009 on access conditions to the network for cross-border exchanges of electricity and repeal of Regulation (EC) №1228/2003.

- NTC is used as an indicator for conducting trading of electrical energy between market participants and applied in each direction of the interstate boundaries. NTC is determined by the formula

$$\text{NTC} = \text{TTC} - \text{TRM}.$$

- The value of TRM is determined for each interstate boundary separately. For TRM calculation used comparison of statistical data actual power flows with planned power flows, which are measured with a 1 minute interval (or other minimal time).

$$\text{TRM} = \frac{\sum_{i=1}^n X_i}{n} + \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}},$$

X_i - exceeding the deviation of the actual flow of power through the interstate boundary over the plan for the i -th measurement

\bar{X} - the arithmetic mean of X_i , is calculated by the formula:

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n},$$

where n is the number of measurements in the data set.

The value of TRM is rounded off to the nearest multiple of 50.

- Available Transfer Capability calculated as $\text{ATC} = \text{NTC} - \text{AAC}$

- method A, according to which the change in the generation is proportional to the generating power of the generating units of the IPS of Ukraine and neighbor power systems in the basic mode. The calculation continues until stability is violated. This method shows the theoretical maximum value of the TTC, since it does not contain any restrictions on the generation of units that are involved.
- method B, takes into account the real possibilities of generating units in accordance with the real reserves of active power of the generating units for downloading and uploading. The change in the generation is proportional to the reserves of the active power of the units.
- method C, takes into account real possibilities of units in the same way as method B, and also use a list of generating units which are involved in balancing and establishes the priority of their uploading / downloading in order to increase / decrease generation.
- For TTC calculations methods B and C are preferable, A can be used only in case of impossibility using methods B and C !!!

- The NTC value between power systems of **Russia and Ukraine** is determined by the Regulations on the parallel operation, which is coordinated by both TSOs.
The NTC value is defined for power flow in both directions, taking into account the criterion N-1, seasonal changes of temperature, permissible levels of current, voltage, voltage stability and reliability of transmission.
- The NTC value between power systems of **Ukraine and Belorussia** is determined by the Instruction on the regimes of parallel operation of the Belarusian IPS and IPS of Ukraine, which is coordinated by the two TSOs.
- The NTC value between power systems of **Ukraine and Moldova** is determined by the formula: **NTC = NTC_{UA-OD-MD} - C**
NTC_{UA-OD-MD} determined by the Instruction ОД-10 of the SE "NPC" Ukrenergo" and coordinated by both TSOs.
C - the amount of consumption of part of the IPS of Ukraine, which receive energy through the power system of Moldova, and this consumption is in the range from 650 to 1000 MW (depends on the period of the year and hours).
- The NTC value between power systems of **Poland and Ukraine** is determined as capacity of OHL, because power flow occurs only from the power system of Ukraine to power system of Poland, done by reconnecting generating units of Dobrotvirskaya TPP to one interstate OHL.

NTC Calculation

Calculation of values of TTC, TRM, NTC of interstate boundaries are carried out by using common input data for system operators concerning:

- an actual general network model;
- a list of critical network elements;
- a list of agreed emergency situations / remedial actions;
- planned repair of equipment;
- limit values of currents for equipment, voltage levels, frequency, limits of dynamic and static stability

Results of NTC agrees with the respective TSOs. In case of discrepancies between the NTC values, a smaller amount is used.

Calculation of the TTC, TRM, NTC, AAC and ATC values is performed:

- 1) for the annual auction - annually before the annual auction;
- 2) for monthly auctions - monthly before the monthly auction;
- 3) for daily auctions - if necessary.



Thank You for attention!