ANNUAL REPORT ON CONGESTION CAUSES AND CONGESTION MANAGEMENT IN THE CR TRANSMISSION SYSTEM

ČEPS, a.s. 31.12.2010

Contents

1 INTRODUCTION

The European energy legislation, in particular the so-called Guidelines (General Guidelines, - referred to herein as “Guidelines”) are an integral annex of the Electricity Regulation (EC) 1228/2003 (respectively the 714/2009 EC) “on conditions for access to the network for cross-border exchanges in electricity”, regulate conditions imposed on transmission system operators (TSO) in the sphere of the so called “market transparency” which is important in creating of the EU internal energy market.

Required information is published on the ČEPS, a.s. website dedicated to market transparency. Structured data are obtained from internal data systems. In cases when ČEPS, a.s. is not the primary source of required information, reference to the relevant data source is given. This is typically information concerning transmission capacities for auctions and their results which are administrated by the joint auction office for the 8 TSOs of the region, the CEE (Central East) Central Allocation Office GmbH. Textual information and also that which changes over time yet remains valid over a longer period is published in this summary Annual Report.

The document provides information describing causes and locations of the so-called congestions in the CR transmission network or information on the impact of necessary maintenance on the size of cross-border transmission capacities. This report also contains information on expected future development of cross-border capacities.

2 CAUSES AND LOCATIONS OF CONGESTIONS

The transmission system includes elements of technical infrastructure such as for example transmission lines or transformers. The size and direction of the flow in the grids is governed by laws of physics, where electricity “flows” from the place of surplus (production) to the place of deficiency (consumption) via the route of the smallest resistance, including via parallel paths. The loading on network elements is generally uneven. Failure of any element must not threaten other elements in the network, lead to their overloading, or possibly spread the malfunctioning throughout the network (the so called criterion N -1). In view of the fact that each network element has its defined permitted loading, determined by its construction design, and which has to be observed to maintain its reliability, the overall network transmission capacity is thus limited. On the basis of that it can therefore be said that there will always be technical limits in transmission networks because of the nature of things. Removal of one specific place of congestion in one part of the transmission system will create another limiting place in another part of the network because of the interconnectivity of the network.

The 440 kV and then the 220 kV transmission system in the Czech Republic was developed in gradually in order to distribute on national level power generated in major power plants to points of consumption connected to distribution systems. It was designed accordingly and dimensioned sufficiently for this purpose. If compared with some other European systems, the CR transmission network is amongst those more robust. Originally, the main aim of the international cross-border connection was to increase the operation security and to ensure mutual help in cases of adverse operational conditions in the network (system of solidarity principle) In connection with the gradual process of creating a liberalized market and implementation of various concepts of international trading, which started in the 1990s and which is to result in the creation of unified internal

European electricity market, there has been a significant increase in the utilization of cross-border profiles.

The increase of the power exchange between the individual systems as the consequence of international trade is necessarily accompanied by an increase in physical flows, which are moreover very changeable, in line with actual consumption, but also markedly by the structure of sources in the region. In our region, the central and eastern Europe (CEE), the power, generated by wind-power plants in northern Germany, and subsequent distribution of this power not only within Germany but also areas of the North and the Baltic Seas, and the consequent distribution of the output not only in the framework of Germany but also further (above all to the south) to neighbouring systems is of an increasing importance. If we consider minimum required reliability of operation of the transmission system given by meeting the standard criterion N-1, the capacity of the transmission system is approaching its limits. Especially in case of low system balance transiting flows from Northern Germany via CR system it can significantly load the internal grid. This fact was noted also by a EWIS (European Wind Integration Study) report - which deals with the situation in central European transmission systems and in CR network in the next five years.

After the gradual strengthening of the exposed border lines the limiting elements for international exchange are being moved more into the internal ČEPS network and this to a varied extent depends on the actual connection and on specific operational conditions. This situation requires ongoing evaluations of the load on all the elements of the transmission system and not only cross-border lines. Available trading capacity in individual directions is then derived from the evaluation of the operational state. In view of the increase of limits inside the ČEPS network, it can be expected that after a comparison of the values with foreign partners in the Central European region, limits on trading in the neighbouring systems will be decisive. A new mechanism, Flow Based Allocation (FBA) is being prepared to better identify such limits, varying in time and place, and to better coordinate the allocation mechanism throughout the CEE (Central East Europe) region. (see Chapter 4).

2.1 Transmission capacities during planned maintenance

2.1.1 Export direction

Planned outages for maintenance, repairs and new investment are optimized in terms of extent and timing and they are coordinated with producers and foreign partners. In particular, the switching off of cross- border lines reduces the transmission capacity of the profile and hence the total export capacity of the entire transmission system. The limitations are given by these factors

The export direction 50 Hertz Transmission and Tennet is limited in case of a planned switch-off of some border line to Tennet (Hradec - Etzenricht or Přeštice - Etzenricht). When there are large flows between Northern and Southern Germany (due to reallocation of output from wind-power plants) part of the flows is shut off via the national transmission system of the Czech Republic.. The limiting elements are then the lines in the path between Chrast- Přeštice-Kočín depending to the current generation in the plants Temelín, and Prunéřov.

The export direction APG and SEPS is limited by the planned switch-off of some line to APG (Slavětice-Dürnrohr, Sokolnice - Bisamberg),
The export direction SEPS is limited in case of a cumulated switch-off of two lines on this profile or changes of connection in linked substations.

Depending on the transit overflows via the transmission system which are given by the transit character of our transmission system and which we cannot influence, the **total export ability of our system is after strengthening approx. 3000 to 3500 MW**.

2.1.2 Import direction

Import from the direction PSE-Operator. The most severe congestion arises if more than one 400 kV line is switched off on the profile. Fulfillment of the criterion N-1 is here monitored, unlike on the other profiles, by a current overflow automatic device on both 220 kV lines, so if set limits are exceeded these congested lines are automatically switched off. A limitation on the import direction naturally reduces the total transit via the Moravian transmission system and thus relieves the load on profiles in the export direction and vice versa.

Import from Germany and Austria: The most significant limitation happens during periods with higher production of wind power plants in Northern Germany and transiting flows through the Czech grid together with import from the same direction. Such cumulated flows reach limits already in the base operational situation of the grid. Since Austria has also an importing power system with imports from Germany within the same control zone, possible imports from Austria to the Czech Republic will probably be incoming from the energy surplus area, i.e. from Northern Germany.

Depending on the transit overflows via the transmission system which are given by the transit character of our transmission system and which we cannot influence, **the total import ability of our system is after strengthening approx 2000 to 2500 MW (valid in even imports from all directions**)

This value given by the transmission system can be limited significantly by forced operation of own sources providing ancillary system services (issues of regulation ability of the system above all in periods of low national consumption and unlimited production by photovoltaic sources).

3 EXPECTED DEVELOPMENT IN CONGESTION LOCATIONS

The commissioning of the second 400 kV line to Austria (Slavětice - Dürnrohr), in November 2008 eliminated till then the weakest point in our transmission system, particularly in connection to Austrian network. This increased the base transmission capacities in the export direction to at least 3,000 MW.

The gradual growth in imports into the Czech power system was assumed in a number of studies in view of the decommissioning of certain generating plants and an increase in consumption in the Czech Republic during the period 2015 to 2020 but it has to be revised in view of the current economic development (drop in the consumption curve by up to 10 per cent) and the increase of construction of new sources (natural gas combined cycle, photovoltaic and nuclear power plants). In spite of the time-limited deficit regimes of transmission systems which already occur today (increased breakdowns of sources), the export character should prevail also in future years.

In the near future the transmission system will have to come to terms with an increased number of necessary outages of lines not only for the necessary reconstruction because of their age, but also because of construction of new ones necessary for the further development of the

transmission system. In connection with the new output requirements of the transmission system this will result in the need to adopt extra measures, and also in a subsequent limitation of transit, export or import abilities of our transmission system. These activities will be taking place for several months.

4 PROCESSES NECESSARY FOR CALCULATION OF MAXIMUM CAPACITIES UNDER DIFFERENT CIRCUMSTANCES

ČEPS makes use of all available information to compute maximum available transmission capacity for trade with electricity under different planned situations. While annual tradable capacities are computed to satisfy all planned situations within the transmission system of the Czech Republic and significant changes in foreign systems (checked on approx. ten models of significant combinations during a year), monthly tradable capacities are computed on four to five basic models representing individual weekly regimes of planned operation. The daily increases of tradable capacities use further improved models which include besides the planned changes in networks also anticipated international overflows (including predictions of wind power stations production).

The number of models which are available and the accuracy of input information determine the structure of both the published tradable capacities as well as their prediction. The resulting values depend on the results of calculations done by foreign partners and can only be detailed in close collaboration with them.

A new common mechanism is being developed at the international level (in CEE framework) for coordinated auctions based on flow-based principles (FBA), which should guarantee that the rules for reliability of operation and maximum use of transmission capacities of interconnected systems are adhered to (see concept of FBA Group in the regional grouping TOP8). This mechanism envisages exchanges of information and joint calculations of daily capacities with hourly system models. This new FBA system is still in its preparatory stage only. Within the FBA concept it is not possible simply to evaluate transit and export abilities of the CR transmission system; and the utilization of available capacities (on the so-called critical elements) is to be governed by market demand only.

5 SCHEME FOR CALCULATION OF CAPACITIES (NTC based)

The calculation of cross-border capacities proceeds from the original methodology ENTSO-E which takes into account the specifics of transit systems such is the CR system where there are significant mutual ties between individual border interconnectors. This chapter shows the scheme for calculation of transmission capacities on individual cross-border profiles. The basic formula for available transmission capacity calculation on the individual cross-border profiles is:

$$ABCp = TBCp - FRMp - NTFp - (PF+LF)p = NBCp - (\Sigma\ PTDFi * AACi\ ) - (LF+PF)p$$

ABCp Available transmission border capacity on p-th profile.

TBCp Total border capacity of profile is calculated from capacities of individual transfer points in profile, taking into account their non-uniform load and security N-1 criterion.

FRMp Reserve on p-th profile including load-frequency control error, outage of the largest generation block in each system

NBCp Net transmission border capacity on p-th profile

NTFp Part of physical flow through p-th profile including model share of all existing transactions.

PTDFi Coefficient of model division of transaction in i-th direction to p-th profile.

AACi Capacities already allocated for period in preceding phases of allocation (yearly/monthly auctions).

(PF+LF)p Residual flow via profile after deduction of shares of already allocated capacities. It means this includes loop flow based on unequal distribution of generation and consumption among neighbouring systems and parallel flows caused by transactions between other systems. Since individual flows are superposed and their size depends on operating changes in systems they cannot be easily separated. Typical residual flow for a given period and profile is calculated from statistical assessment of data from archive of actual flows in a past period.

To publish values applicable simultaneously to all profiles with a required advance it is necessary to compute available tradable capacities, which simultaneously exhaust "available transmission capacities" (see definition below) on all profiles until complete exhaustion o of the first of them. Then following equation is valid:

$ABC_j - \Sigma(PTDF_{ji} * VOK_i) = 0$

index j identification of profile at which the available tradable capacity was first exhausted;

$j \in \{p\}$

PTDFji coefficient of transaction ratio in i-th direction on profile j

VOKi available tradable capacity in i-th direction

Note: A special case arises in imports from Germany and Austria where the limit is moved inside the transmission system and in order to calculate the import capacities it is also necessary to monitor other combinations of line outages.

Available tradable capacity for the given period (year, month, day) is transmission capacity in MW guaranteed for the whole of this period, that is for all planned regimes and all anticipated situations, including output loop and physical flows and with the exception of the so-called “force majeure” cases and cases listed in Article 24 of Act 458/2000 coll. It is possible to get more accurate tradable capacities on individual profiles as part of the daily allocation.

See also user information in the Transmission System Codex.

The procedures meet the requirements of the European energy legislation - Regulation No 1228/2003 respectively 714/2009 and guarantee reliability of operation in the specific conditions ČEPS as the transmission system operator (TSO).