21, rue d'Artois, F-75008 PARIS
http : //www.cigre.org

C2 - 106

CIGRE 2012

Congestion Management implemented in the Dutch System by using market principles: a practical example from the TSO perspective

F. Spaan, P. van den Heuvel, J. de Geus, K. Hommes, S. A. B. de Almeida de Graaff, R. Besselink, D. Klaar
TenneT TSO B.V.
The Netherlands

SUMMARY

Congestion management is essentially a market mechanism for the distribution of scarce grid capacity in areas where this is necessary, mitigating the overloads that occur in the network and restoring security of supply. Due to the large number of requests for access to the grid of generating units, combined with the European ambition to integrate more renewable energy sources, and because the realisation of investments for structural grid development takes longer than the construction of generating units, lack of available transmission capacity has already been identified in 2007. In order to facilitate new connections to the grid, TenneT TSO B.V., the Dutch Transmission System Operator, has planned a 380kV ring structure in South-Holland, the so called *Randstad380kV* south ring. Since 2007, several steps have been taken, which were also considered in the planning of the Ministry of Economic Affairs, Agriculture and Innovation, including the prioritization of sustainable energy, consultation of market parties, implementation of a congestion management scheme and the approval of the New Electricity Act.

The congestion management scheme is being applied for the first time, since April 2011, in the Dutch system, in the South Holland area. Lack of transmission capacity, i.e. non-continuous guarantee of the N-1 criterion, in this area was expected after the connection of expected new generating units and the connection of the HVDC link with Great Britain until the *Randstad380kV* southern ring is in service (expected for the second trimester of 2013). This paper will describe the complex implementation of the congestion management scheme in the Dutch transmission network and market environment. Practical aspects, impacts and conclusions, such as improved security of the network and costs are evaluated after more than half a year of this system into practice.

KEYWORDS

Congestion Management, Dutch Transmission System, Market Model, System Security Analysis, Countermeasures

susana.de.graaff@tennet.eu

THE DUTCH TRANSMISSION SYSTEM

The Dutch system is a meshed system with three 380 kV interconnections with Germany and two with Belgium, and two HVDC links, one to Norway and the other one to Great Britain. The Dutch network is being treated as a copper plate and congestion problems have been rare. During the last years the demand for transmission capacity is increasing because of the connection of new generating units. The new power plants under consideration by market parties to connect to the Dutch grid sum up to about 36 GW of installed power (coal fired power plants, gas-fired, wind farms, among others). Therefore, when connected are expected to cause congestions in several areas of the network, the congestion management scheme must be applied.

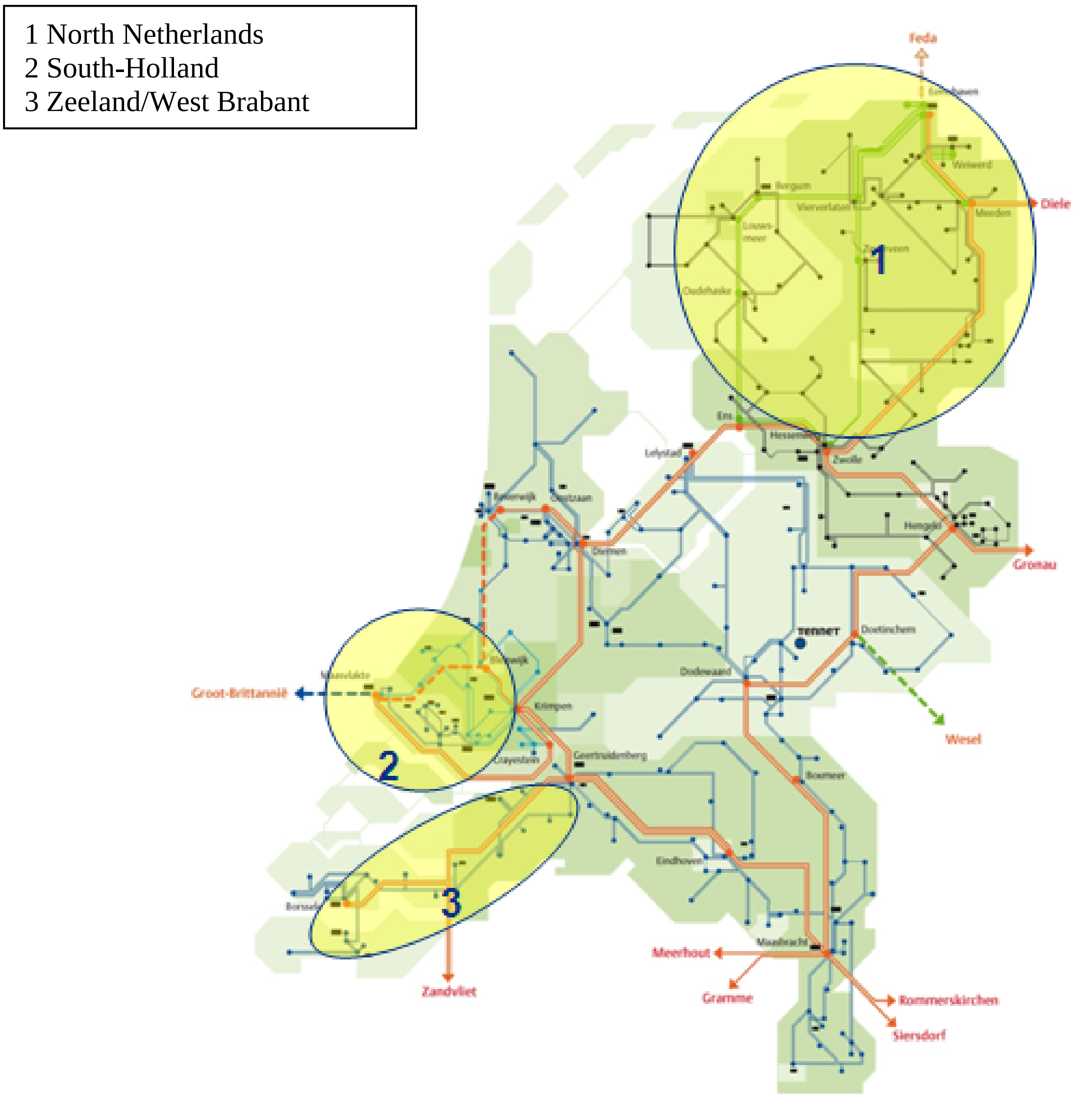

Figure 1. Dutch Transmission Network and expected congested areas

The current congested area, South-Holland, and the expected ones, North of Netherlands and Zeeland/West Brabant, are highlighted in the previous map.

CONGESTION MANAGEMENT

The description of the development of a congestion management scheme in the Netherlands is described in [1].

In the Netherlands, the transmission system operator has the obligation to provide unlimited access to the grid, to notify the Dutch regulator with the intention of applying congestion management, including investment plans to solve the congestion within a limited period of time and to apply congestion management. All market parties (bigger than 0.1 MW, including production and load) are able to cooperate in congestion management. The Dutch Minister of Economic Affairs, Agriculture and Innovation has determined the following design criteria for the congestion management scheme to meet: non-discriminatory, transparency, market-based and costs efficiency. The application of congestion management is a legal task in force on the Dutch grid code. At this moment, the costs are remunerated in the transmission tariffs. It is expected that the prioritization of sustainable energy during congestion management will be adopted later in the act.

The determination of the congestion area is based on the technical and operational feasibility, the estimated time period for congestion management and the number of market parties that can participate in the scheme. The number of market parties that can participate in the congestion management scheme is dependent on the congestion area and it is assessed based on the influence of market parties in the area, the contracted transmission capacity and the complexity of the administrative process. The congestion management scheme for a particular area ends when network investments are realised, increasing the transmission capacity to an adequate value in order to meet the N-1 security criterion without constraints.

In the final analysis, this approach results in a new balance between the available transmission capacity and the capacity supplied by electricity producers. This will enable grid operators to take adequate measures to adjust the transmission capacity, so that the grid has sufficient capacity to meet the increasing demand.

The congestion management scheme can be divided into four different phases: management scheme preparation, day-ahead implementation, intra-day implementation and verification. First, the public announcement of the expected congestion in the specific area is made. Followed by an extensive investigation of the expected amount of congestion and the technical possibilities to manage and reduce it, including an overview of the market parties that can participate in the congestion management scheme. Moreover, several technical solutions are studied, such as minimise the scheduled outages within the relevant area and evaluate topological changes. In the day–ahead (D-1) implementation, producers will daily bid for not producing on D, informing TenneT TSO. Also DSOs and Program Responsible Parties (PRP) will send the Transport Prognosis, including the production and consumption expected values, to TenneT TSO. During the D-1 security analysis, the hourly expected congestion is calculated and the amount of production that has to be reduced in the congested area is determined. TenneT chooses, conform the bid ladder principle, first the best offers, bids, until the necessary amount. As consequence, the involved PRPs will send a corrected "Transport Program" accordingly. To maintain the balance in the Dutch system, the TSO will use bids, also according to the bid ladder principle, from the rest of the grid (outside the congested area) to compensate the reduced production, i.e. in total exactly the same amount is guaranteed. On the intra-day time frame, in case of congestion, the same procedure will be applied.

In order to verify the implementation of the congestion management scheme, TenneT TSO receives daily the hourly measurements of each connection and compares it with the corrected "Transport Program" sent by the PRP. In case of mismatch, an imbalance penalty will be applied to the PRP that didn't follow the program.

PRACTICAL EXAMPLE

Since April 2011, congestion management is being applied to the South-Holland (Zuid-Holland) area, and it has occurred since October on the 380kV line between Maasvlakte and Crayestein. Congestion is mainly being caused by the excess of production in this specific area of the network due to a new generation unit of 870 MW. Daily, according to legislation, after the network security analysis, additional bids are requested from the market to solve the expected congestion.

Figure 2. South-Holland congested area

The South-Holland congested area includes the 380 kV network delimited by Westerlee, Maasvlakte, Simonshaven, Craijestein and Krimpen substations, including the 150 kV network Botlek between Maasvlakte – Simonshaven. For this area, it is technically feasible to remotely monitor and operate the network. The operational feasibility is guaranteed for the 380 kV grid and the available counter measures are sufficient to solve the congestion in the area. The operational feasibility regarding the 150 kV network is more complex, because the transmission capacity in this part of the network is fully utilised. Furthermore, during the congestion management period, several topology changes will be performed in the 150 kV network to enable the conclusion of the Randstad380kV southern ring expected to be in operation in the second trimester of 2013. These topology changes result in a higher loading of the existing 380 kV network, therefore increasing the expected congestion.

Based on the current schedule for the commissioning of the ring, the required time for the congestion management scheme in South-Holland meets the time period specified in the Dutch grid code, which is between 1 and 4 years.

The implementation of the described congestion management scheme has revealed some limitations in the methodology. TenneT receives a limited and often insufficient amount of bids, both upwards and downwards, that limits the capacity to solve and mitigate the expected congestion because of limited amount of power. Additionally, errors in the production and load forecast results in a wrong prediction of the congestion in the operational planning.

Based on the forecast data and the network topology the amount of congestion is determined by a load flow tool. The required redispatch to solve the congestion is determined, taking into account network security constraints and optimum use of upward and downward bids. In case the load flow tool fails, a backup tool is used to determine the necessary redispatch, based on maximum allowed production in the Maasvlakte area.

On the 3rd of November 2011, there was congestion during several hours of the days as illustrated in table 1. Between 17h00 and 18h00, the available power was not sufficient to solve the expected congestion.

Time	Available Power (MW)	Expected Congestion (MW)	Used Power(MW)	Difference between Congestion and the Used Power (MW)
6-7	100	0	100	-100
7-8	175	0	175	-175
8-9	400	267	400	-133
9-10	550	298	550	-252
10-11	550	266	550	-284
11-12	550	265	550	-285
12-13	550	303	550	-247
13-14	550	382	550	-168
14-15	600	344	600	-256
15-16	600	469	600	-131
16-17	450	414	450	-36
17-18	250	417	250	167
18-19	150	0	50	-50

Table 1. Congested periods on the 3rd of November 2011

Figure 3 shows the load flow patterns for a 380 kV line in the South-Holland area. The forecasted flow is indicated by the red line and based on production and load forecasts submitted by PRPs. The forecasted flow exceeds the limit of 2600 MW therefore congestion management must be applied. The allowed flow in the 380 kV line is shown by the green line. In order to fulfil the security limits of the network, the flow must not exceed 2600 MW. The realized flow is shown by the blue line. The deviation with the green line is caused by inaccurate forecasts and the unavailability of sufficient bids (for upward and downward adjustments of production):

- The number of bids is low
- The amount of upward and downward production bids is small
- Bid periods are not flexible (for instance a bid can be a reduction of power of 200 MW for a period of 4 hours).

This is illustrated by the following three examples:

- Example 1: To solve the congestion, starting at 7 AM, a block bid had to be applied starting at 5 AM.
- Example 2: For a certain day, the excess downward bid amounted to an average of 150 MW per hour.
- Example 3: Due to insufficient bids the flow could not be reduced to the allowed level, leading to grid security risks.

.

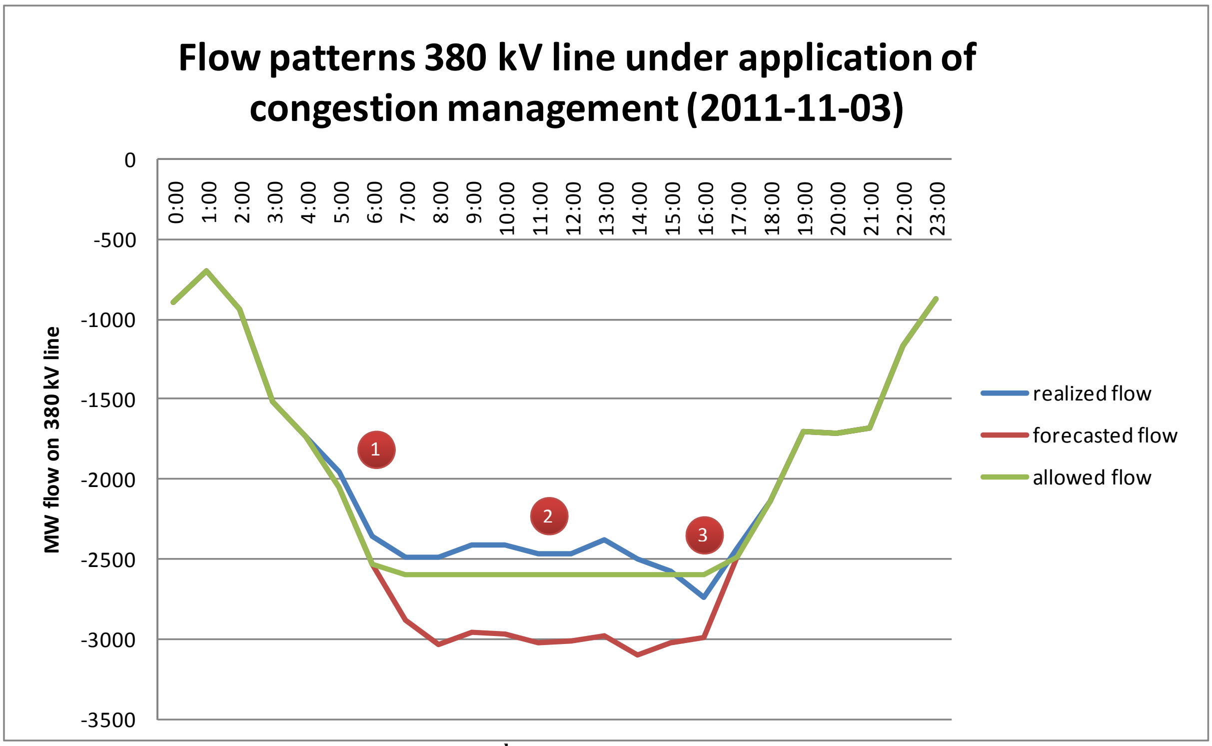

Figure 3. Flow on the 3rd November 2011 (data not yet validated)

To solve a congestion in a specific area, it is necessary to compensate the decrease/increase of transit with an upward/downward dispatch outside the congested area, thus a balance problem arises, because the upward and downward regulation bids does not always match, and the differences between offers must be minimised. The minimum difference will ensure that the most cost-effective choice is made. Table 2 shows the difference that occurred on the 3rd of November 2011.

	Balance Energy(MWh)	Used Energy(MWh)	Difference (MWh)
3-11-2011	3737,50	3802,50	65,00

Table 2. Energy balance on the 3rd of November 2011

CONCLUSIONS

Congestion management is a mechanism to determine and mitigate overloads in the network due to scarce transmission capacity in a specific area. Due to an increasing demand for transmission capacity, deficit of capacity can occur in an area where more electricity is produced or consumed and this surplus has to be transported via the existing transmission grid. In order to maintain adequate security levels, congestion management is a temporarily solution, which allows a more flexible use of the network, facilitating the connection of additional production/consumption to the network, while the structural reinforcements are being realized.

The congestion management scheme is being used to solve congestion in the South-Holland area since October 2011 and improvements to the methodology were identified, such as more clear notifications and procedures from TenneT, improved coordination between the commissioning of production units and planned outages in the network, the improvement of the production and consumption forecast (so-called Transport Prognosis) and measurements and the priority to production from renewable energy sources. It can also be concluded that not enough market parties are participating in the mechanism and therefore the amount of available power, to solve the congestion, does not always correspond to the capacity needs.

BIBLIOGRAPHY

[1] Dennis Klaar, Siem Bruijns, Klaas Hommes, Development of a congestion management scheme in the Netherlands, Operation and Development of Power Systems in the New Context Symposium, Guilin City - Guangxi Province, China. 28 - 30 October 2009.