PRINCIPLES FOR DETERMINING THE TRANSFER CAPACITIES IN THE NORDIC POWER MARKET

22.09.2020

Revision	Date	Summary of updates
3. Final	2010-06-22	New version
4. Final	2011-02-18	Text about Estlink updated. Eastern Denmark - Western Denmark added to table under section 1.2. Market coupling between Western Denmark - Germany via Baltic Cable. Market coupling between Norway - the Netherlands via NorNed.
5. Final	2011-10-20	Updated text due to the adjustment of bidding zones NO2 and NO5 in Norway and new bidding-zones in Sweden.
6. Final	2012-03-28	New text for Sweden, Norway, and Denmark, under sections 5.1, 5.2, 5.3 and 5.4, respectively.
7. Final	2013-12-02	New Text for Norway, sections 5.2, 5.2.2 and 5.2.3 updated.
8. Final	2014-10-27	New general text for section 2, new text for Sweden in section 5.1 and addition of sections 5.1.4 and 5.1.5 for Sweden. Section 5.3 Finland updated.
9. Final	2014-12-10	New text on NO1A, section 5.2.3; updated text on NO2-DK1 and NO2-NL, sections 5.2.1 and 5.2.8. Updated TRMs for Norway, section 1.2.
10. Final	2015-01-22	Updates in section 5.3 on connections to Estonia and Russia.
11. Final	2016-08-26	NordBalt added
12. Final	2016-11-21	Reserve capacity for reserves in Sweden
13. Final	2016-12-08	Ossauskoski-Kalix connection deleted,

		Fenno-Skan 1 permanent reduced voltage added.
14.Final	2017-02-08	Updated with new corridor NO3-NO5. Changes in NO2-DK1 and NO2-NL.
15. Final	2017-11-30	Updated area definitions for NO3 in 5.2. Updated diagrams in 5.2.3 and 5.2.4. Updated text in 5.2.7.
16. Final	2018-04-05	Updated TRM value for Sweden (SE3) – Sweden (SE4) 1.2 and new section 5.1.2. Added TRM for Northern Norway (NO4) – Central Norway (NO3)
17. Final	2018-12-11	Updated import capacity for NO4. Updated principles for capacities in NO1 during winter load. Expressions "Elspot" and "Elbas" removed from the document. Expression "bidding area" replaced by "bidding zone"
18. Final	2020-02-11	Updates in section 5.2.1 regarding reductions on NO2-DK1 and NO2-NL. Information not relevant anymore.
19 Final	2020-09-xx	Updates in section 5.1.3 regarding reductions due to the West Coast Corridor. Updates with Cobra cable

1 DEFINITIONS OF TRANSFER CAPACITIES

The principles for determining the capacities and margins are described in the System Operation Agreement between the Nordic TSOs. The System Operation Agreement is a part of the Nordic Grid Code, and can be found at https://www.entsoe.eu/publications/system-operations-reports/nordic/Pages/default.aspx. The Nordic TSOs use definitions, which are in line with the definitions used in the European Network of Transmission System Operators for Electricity (ENTSO-E).

1.1 TOTAL TRANSFER CAPACITY - TTC

TTC is the maximum transmission of active power in accordance with the system security criteria which is permitted in transmission cross-sections between the subsystems/areas or individual installations.

1.2 TRANSMISSION RELIABILITY MARGIN - TRM

TRM is a security margin that copes with uncertainties on the computed TTC values arising from:

a) Unintended deviations of physical flows during operations due to physical functioning of load-frequency regulation,
b) Emergency exchanges between TSOs to cope with unexpected unbalanced situations in real time,
c) Inaccuracies, e.g. in data collection and measurements.

The present TRM values for each connection are agreed upon in the specific System Operation Agreements and listed below.

Connection	TRM (MW)
Sweden (SE3) - South-eastern Norway (NO1)	150
Sweden (SE2) - Central Norway (NO3)	25
Sweden (SE2) - Northern Norway (NO4)	25
Sweden (SE1) - Northern Norway (NO4)	25
Sweden (SE1) - Finland (FI)	100
Sweden (SE3) - Finland (FI)	0 *)
Sweden (SE4) - Eastern Denmark (DK2)	50
Sweden (SE3) - Western Denmark (DK1)	0 *)
Sweden (SE1) - Sweden (SE2)	100
Sweden (SE2) - Sweden (SE3)	300
Sweden (SE3) - Sweden (SE4)	100-200
South-western Norway (NO2) - Western Norway (NO5)	50
Northern Norway (NO4) – Central Norway (NO3)	25
Central Norway (NO3) - Western Norway (NO5)	50
South-eastern Norway (NO1) - Western Norway (NO5)	75
South-western Norway (NO2) - South-eastern Norway (NO1)	75
South-eastern Norway (NO1) - Central Norway (NO3)	0 **)
NO1A-NO1	150
Southern Norway (NO2) - Western Denmark (DK1)	0 *)
Finland (FI) - Estonia (EE)	0 *)
Eastern Denmark (DK2)- Western Denmark (DK1)	0 *)
Western Denmark (DK1) - Netherlands	0*)

*) HVDC-connection, TRM = 0 MW
**) The capacity South-eastern Norway (NO1) - Central Norway (NO3) is a fixed value based on the expected flow on the connection the next day.
***) The TRM value for the connection Sweden (SE3) – Sweden (SE4) may vary, see section 5.1.2.

1.3 NET TRANSFER CAPACITY - NTC

The Net Transfer Capacity NTC (trading capacity) is defined as:

NTC = TTC - TRM

NTC is the maximum exchange program between two areas compatible with security standards applicable in both areas and taking into account the technical uncertainties on future network conditions.

2 SECURITY STANDARDS

The criteria for system security are based on the N-1 criterion. N-1 is an expression of a level of system security entailing that a power system can handle the loss of any single component (production units, lines, transformers, bus bars, consumption etc.). For faults having the largest impact on the power system, the term dimensioning faults is used.

If the power system is not in normal state following an operational disturbance, the power system must be restored to normal state within 15 minutes.

3 SYSTEM PROTECTION

System protection is used to limit the consequences of faults in the power system. System protection can have as its purpose to increase the system security, the transfer capacity, or a combination of these.

System protection is composed of automatic system protection equipment for the power system. A production rejection scheme is one example of system protection, as production units are automatically disconnected from the grid in the event of a fault in order to avoid overload conditions.

4 CAPACITY CALCULATION PROCEDURES

The TTC between two subsystems is jointly determined by the TSOs on both sides of the interconnection.

When determining the capacity on the interconnection between two subsystems, the capacity is calculated by the TSOs on each side of the connection by computer programs using coordinated network models. If the values differ, the lowest value is used.

The objective is to give the market as high capacity for energy trade as possible taking into account outages and faults in the network.

The ability to transmit power shall be calculated for each state of operation. This applies both to transmissions within each subsystem and to exchanges between subsystems.

In calculating the power system's ability to reliably transfer electric power with respect to the N-1 criterion the following limiting factors may be observed:

- Thermal Limitations – Thermal limitations refer to the maximum amount of electric current that a transmission line or electrical facility can conduct over a specified period of time without sustaining damage or being in violation of safety requirements.
- Voltage Limitations – Overall system voltages as well local voltage levels must be maintained within a set range of minimum and maximum limits. In general maximum voltage limits are set to prevent damage or accelerated aging of the power system or customer facilities, whilst minimum limits are set to prevent a single fault from resulting in a collapse of system voltage which would result in a partial or complete blackout of the interconnected network. Voltage collapse is closely linked to the balance between reactive power demand and resources. A highly simplified explanation is that heavily loaded lines, and loads (inductive), can be seen as reactive consumers, while lightly loaded lines and production units can be seen as

reactive providers. For this reason limitations related to voltage stability can vary dependant on variations in load and production distribution.

- Rotor Angle Stability Limitations – The transmission network must, after a disturbance, also be able to withstand transient events ranging from a few milliseconds to a matter of minutes. The generators within the interconnected synchronous system are set operate together at 50 Hz. After a disturbance the generators may oscillate with respect to each other. These oscillations may impact system parameters such as frequency, power flows, and voltages. For the system to return to a stable state of operation, these oscillations must be attenuated and a new stable point of operation attained. If the system cannot quickly return to a stable point of operation, synchronization between generators may be lost and the interconnected system could entirely or partly become unstable. This instability could lead to widespread supply interruptions and/or damage to equipment.

Transmission capacity calculations are commonly achieved by defining a transmission corridor and using static and dynamic simulations to determine how much power can be transmitted in any direction through the corridor before thermal overloads, voltage collapse and/or instability arise following a dimensioning fault. In the corridor, an arbitrary number of lines on different levels of voltage can be included.

Capacity calculations may also consider the following operational parameters:

- Grid configuration (topology)
- Production pattern (production level and its geographical distribution)
- Load pattern (load level and its geographical distribution)
- Weather conditions (e.g. precipitation, temperature and wind which affects thermal capacity of conductors, wind power output, etc.)
- Electrical characteristics (of lines, transformers, production and consumption units, HVDC, etc.)

As TTC is the maximum transmission of active power which is permitted in transmission corridors between bidding zones, measures must be taken if the transfer capacity limit is exceeded during operation.

On the HVDC-connections, the thermal capacity (TTC) is normally used as NTC value in both directions and there is no need for any margin (TRM).

The NTC values between all bidding zones are given to nominated electricity market operators (NEMOs) for day-ahead trading in its entirety. The TSOs guarantee the NTC value given for day-ahead trading.

The remaining transmission capacity available after day-ahead market clearing is generally offered to the intra-day market XBID. The XBID capacity can be influenced by changes in prognosis, faults and changes in maintenance plans. This can both increase and decrease XBID capacity. Capacities are updated automatically when market trades between parties across borders are made. Market splitting separates the XBID market areas dynamically when congestion occurs. Changes in XBID-capacity will be done without sending an UMM, the exception is if the capacity is set to zero because of a disturbance.

5 PRACTICAL IMPLEMENTATION OF NTC CALCULATIONS

5.1 SWEDEN

5.1.1 GENERAL

Congestions in the Swedish grid are generally handled by bidding zones, with the exception of the so called West Coast Corridor in the Gothenburg area, which is located in the south west of Sweden.

The NTC values between Sweden and its neighbouring countries will normally be set to the maximum NTC value by Svenska kraftnät while intact grid conditions prevail. The NTC may however be reduced due to congestion in the West Coast Corridor, or if needed to maintain operational security. The southbound NTCs between the internal bidding zones in Sweden will vary depending on operational parameters as described in section 4, while the northbound capacities normally will be set to the maximum NTC value.

5.1.2 TRM VALUE FOR SE3 – SE4

Due to lack of plannable production in SE4 and uncertain imbalance patterns due to wind conditions, a variable TRM value is necessary for SE3 – SE4 in order to maintain operational security in the Swedish grid. The TRM value for SE3 – SE4 may therefore vary between 100 – 200 MW.

5.1.3 WEST COAST CORRIDOR

Due to high transfer levels on the West Coast there may be capacity reductions on interconnectors. The interconnectors affecting the load flow through the West Coast Corridor are:

- Southern Norway-Sweden (NO1-SE3, Hasle)
- Western Denmark-Sweden (DK1-SE3, Konti-Skan)
- Eastern Denmark-Sweden (DK2-SE4, Öresund)
- Germany-Sweden (SE4-DE, Baltic Cable)
- Poland-Sweden (SE4-PL, SwePol Link)
- Lithuania-Sweden (LT-SE4, NordBalt)

Historically when there was a need to limit the transfer through the West Coast Corridor (most often to prevent cascade tripping of lines, and subsequently rotor angle instability and/or voltage collapse, after dimensional fault), import and export capacities on all interconnectors affecting the flow through the corridor was reduced in proportion to their maximum NTC. This may still be applied if required for maintaining operational security, but as a first step an optimised approach shall be used and only at times when this is insufficient shall reductions on all interconnectors be used.

As several of the above mentioned interconnectors are located south of SE3 – SE4, in the optimised approach a reduction of SE4 > SE3 down to 0 MW shall be used in conjunction with reductions on SE3 > NO1 and DK1 > SE3 in proportion to their maximum NTC, down to 70% of their maximum NTC.

A similar approach shall also be utilised in intraday such that available transmission capacity (ATC) related to the West Coast Corridor shall be reflected in the capacities SE3 – SE4, SE3 – DK1, and SE3 – NO1. This approach is to be applied to day ahead and intraday markets starting during October 2020.

5.1.4 Southbound NTCs for corridors between internal bidding zones in Sweden

The southbound NTCs between the internal bidding zones in Sweden may vary with intact grid conditions and in case of maintenance or outages. With intact grid conditions the variations are dependent on the operational conditions as is described in section 4. These capacities and flows are therefore constantly monitored by Svenska kraftnät. Near real-time calculations determine up to date transfer capacities related to voltage collapse as well as monitoring what the resulting load flows would be in the event of a various faults. In most cases, it is the capability to prevent voltage collapse after a dimensioning fault that is the limiting factor for southbound power transfer between the Swedish bidding zones. At times it can, however, also be limited by other factors such as rotor angle stability, thermal ratings of components or the need of transfer capacity for reserves.

The transfer capacities in the corridors are dependent on having reserve power in each bidding zone to replace the largest power production unit in case of failure. If not enough reserves can be obtained in a bidding zone, Svenska kraftnät will reserve capacity in a corridor to be able to transfer reserves from one bidding zone to another.

Intervals that reflect Svenska kraftnät's up to date prognosis for normal fluctuations of the NTCs (for SE1>SE2, SE2>SE3 and SE3>SE4), due to varied operational conditions as described above, will be communicated to the market via Urgent Market Messages (UMMs).

Note also that a system protection is installed in the south of Sweden, such that if too low voltages occur in case of a disturbance, the system protection will send an order for emergency power to the HVDC-links SwePol Link, Baltic Cable and Kontek. With the full system protection in use, which is normally the case, the allocated trading capacity (NTC) for SE3>SE4 can be increased by 300 MW.

5.1.5 SE4 – DE (BALTIC CABLE)

The Baltic Cable HVDC interconnection between Sweden and Germany is owned by Baltic Cable AB. Southbound and northbound NTCs may vary due to operational conditions in Germany, and northbound NTC values may also vary due to limitations imposed by the West Coast Corridor in Sweden (see section 5.1.2). Typically the limitations on the German side are due to high wind energy infeed into the German power grid, and these limitations are communicated to the market via Urgent Market Messages (UMMs) published by the German TSO TenneT GmbH.

5.1.6 SE4 – PL (SWEPOL LINK)

SwePol Link is the HVDC interconnection between Sweden and Poland and is jointly owned by the TSOs Svenska kraftnät and PSE.

With intact grid conditions PSE may limit northbound and southbound NTCs due to operational conditions in Poland. The limitations on the Polish side is often related to the infeed of wind energy in the region.

Svenska kraftnät will normally set the NTC (in both directions) to maximum NTC, unless in the event of maintenance or failure on the interconnector itself or in the vicinity of the connection point in SE4. During intact grid conditions, Svenska kraftnät will only restrict the NTC during congestion in the West Coast Corridor, as described in section 5.1.3.

The fluctuations in NTCs for PL>SE4 and SE4>PL will be communicated to the market as follows:

- Monthly UMMs providing a prognosis of the Polish view regarding the coming month's capacities. This will reflect the expected fluctuations expected due to operational conditions as well as limitations due to planned outages in the Polish grid.
- Additional daily UMMs are sent providing the Polish view regarding capacities for the following day.

5.1.7 SE4 – LT (NORDBALT)

NordBalt is the HVDC interconnection between Sweden and Lituania and is jointly owned by the TSOs Svenska kraftnät and Litgrid.

Svenska kraftnät will normally set the NTC (in both directions) to maximum NTC, unless in the event of maintenance or failure on the interconnector itself or in the vicinity of the connection point in SE4. During intact grid conditions, Svenska kraftnät will only restrict the NTC during congestion in the West Coast Corridor, as described in section 5.1.3.

5.2 NORWAY

The Norwegian power grid is divided into bidding zones in order to handle large and long-term congestions. New bidding zones can also be established in case of strained regional energy situations. Other congestions will under normal conditions be managed through the use of the Balancing Market as special regulations covered by Statnett. Large congestions in the grid may arise on short notice, for example due to a fault or a forced outage of a critical transmission line. The market will be informed about a new bidding zone division at least four weeks before it comes into force.

From 15 March 2010, Norway has been divided into five bidding zones. The current zone definition is valid as of 28 August 2017:

- NO2, a south-western Norway bidding zone limited by the 420 kV line Rød-Hasle, the 420 kV line Rjukan-Sylling, the 300 kV line Vemork-Flesaker, the 300 kV line Tokke-Flesaker, the 300 kV line Hof-Flesaker, the 132 kV line Grønnvollfoss-Skollenborg, the 132 kV line Hof-Skollenborg and the 300 kV line Blåfalli-Mauranger, where the first node of each line is located in the south-western zone (NO2).
- NO5, a western Norway bidding zone limited by the 420 kV line Sogndal-Høyanger, the 132 kV line Grindsdalen-Mel, the 300 kV line Mauranger-Blåfalli, the 420 kV line Dagali-Ringerike, the 420 kV line Nore 1-Sylling, the 420 kV line Usta-Ådal, the 300 kV line Nes-Sogn, the 300 kV line Hemsil 2 – Sogn and the 132 kV line Flå-Sandum, where the first node of each line is located in the western zone (NO5).
- NO1, a south-eastern Norway bidding zone limited by the 420 kV line Rød-Hasle, the 420 kV line Rjukan-Sylling, the 300 kV line Vemork-Flesaker, the 300 kV line Tokke-Flesaker, the 300 kV line Hof-Flesaker the 132 kV line Grønnvollfoss-Skollenborg, the 132 kV line Hof-Skollenborg, the 420 kV line Dagali-Ringerike, the 420 kV line Nore 1-Sylling, the 420 kV line Usta-Ådal, the 300 kV line Nes-Sogn, the 300 kV line Hemsil 2-Sogn, the 132 kV line Flå-Sandum, the 300 kV line Vågåmo-Ø.Vinstra and the 132 kV line Ulset-Savalen, where the second node of each line is located in the south-eastern zone (NO1).
- NO3, a middle Norway bidding zone (NO3) limited by the 300 kV line Vågåmo-Øvre Vinstra, the 132 kV line Ulset-Savalen, the 420 kV line Høyanger-Sogndal, the 132 kV line Mel-Grindsdalen, the 300 kV line Verdal-Tunnsjødal and the 420 kV line Namsos-Tunnsjødal, where the first node of each line is located in the zone middle Norway (NO3).
- NO4, a northern Norway bidding zone, north of NO3.

The determination of the NTC value between two bidding zones is based on thermal restrictions, voltage or stability limits in the transmission system in order to maintain an agreed level of security of supply. The NTC value may also be affected by outages of major transmission lines in the Norwegian grid. This happens when the outage is close to cross-border connections and/or when it is impossible to relieve the congestion through counter-trade in the Norwegian system.

5.2.1 NO2-DK1 (Skagerrak) and NO2-NL (NorNed)

The net transfer capacity on the HVDC-cables between Norway and Western Denmark is 1632 MW in both directions, with reference point in the receiving end. The reference point for procurement of grid losses will be determined on an hourly basis and the grid losses will be procured in the exporting area. During summer, in periods with high temperature, the NTC value may be reduced due to thermal restrictions on the HVDC-link.

The net transfer capacity on the HVDC-cable between Norway and the Netherlands is 723 MW in both directions, with reference point in the sending end. The reference point for procurement of grid losses will be determined on an hourly basis and the grid losses will be procured in the exporting area.

5.2.2 NO5-NO2

The NO5-NO2 corridor consists of a single 300 kV line and is therefore vulnerable to large changes in the load flow patterns in southern Norway. The conductivity of this line is low compared to the multiple line corridors NO5-NO1 and NO2-NO1. Accordingly, the physical flow is expected to predominantly stay well below the thermal capacity of the corridor.

During periods of high flow in either the NO5-NO1 or NO2-NO1 corridors, reductions could still be necessary to manage so-called transiting flows. This issue is characterized by significant differences between planned market flow and actual physical flow and is caused by the lack of a grid model in the market clearance. When the price level of an area differs from the surrounding areas the market clearance will utilize all the available capacity to set up a theoretical flow, including capacity that is routed through one or more neighbouring areas with a very low combined conductivity. The actual flows resulting from the corresponding distribution of production will however comply with the laws of physics and might exceed the physical capacity in one corridor in the range of several hundred MW, while falling correspondingly below the planned transmission in another.

The most manageable solution to this issue is to limit the transitional corridor to a level that corresponds to the optimal flow level of the constrained corridor. As a result, the capacities NO5-NO2 and NO2-NO5 will vary depending on the production balance in both NO5 and NO2, local production close to the connection, consumption in the Bergen area and anticipated exchange on the HVDC-connectors and the NO1-SE3 corridor.

5.2.3 NO2-NO1 AND NO5-NO1: NO1A

As of January 2015, the optimization principle of *special constraint* limitation is introduced in the day-ahead price algorithm for the combination of NO2-NO1 and NO5-NO1. The additional constraint between NO5/NO2 and NO1 is referred to as NO1A, where the “A” indicates that a Line Set is implemented in the price algorithm for the related connections. This is the same model that is applied at cut B in Denmark, on the sum of corridors NO2-DK1 and SE3-DK1.

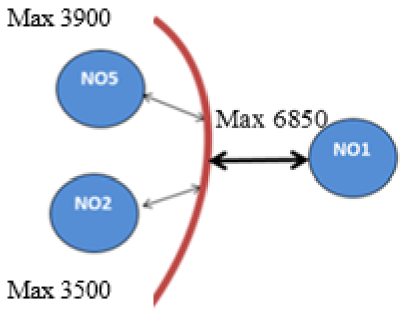

FIGURE 1 PRINCIPLE SKETCH OF THE NO1A CONCEPT

The special constraint limitation allows for controlling the sum of two or more corridors, while not placing unnecessary limitations on either of the individual connections. In the case of NO2-NO1 and NO5-NO1 this indicates that full individual capacity can be expected for an extended amount of time, as the dynamical stability limit is placed on the NO1A-NO1 corridor. This also means that the NO1A special constraint may cause price differences between NO2/NO5 and NO1 without full utilization of either corridor, given that the market utilization of the NO1A-NO1 corridor corresponds to the capacity of the special constraint. High utilization of both corridors at the same time is expected when consumption in the Oslo-area peaks at daytime in the winter months. Reductions aimed at managing the combined capacity are handled by the Line Set restriction. For the remaining parts of the year, the issue of full utilization of both corridors simultaneously is expected to be insignificant.

During winter, capacities NO1A-NO1, NO2-NO1 and NO5-NO1 is expected to be given in the mid capacity range, according to the ranges in relevant market messages. Capacity in the high range will be given in situations with favorable load flow and high reserve volume in NO1. At net deficit higher than 6000 MW in NO1 capacity NO1A>NO1 may be reduced below the normal range.

Minor variations in maximum capacities should still be expected subject to load flow patterns as described in section 5.2.2.

5.2.4 NO1-SE3

The market corridor between south-eastern Norway (NO1) and Sweden (SE3) consists of the 420 kV Hasle-corridor and the 132 kV transmission line Eidskog-Charlottenberg. The calculated NTC-value NO1-SE3 is the sum of these capacities.

The maximum NTC NO1>SE3 is 2145 MW, and SE3>NO1 is 2095 MW.

During summer, in periods with high temperature, the capacity may be reduced due to thermal restrictions on the lines in the Hasle-corridor.

During winter load, the capacity from NO1>SE3 is normally between 2100-2145MW.

The maximum physical capacity on Eidskog-Charlottenberg is 95 MW in both directions. In peak load situations (winter period), the capacity is reduced to about 50 MW due to constraints in the transmission grid close to the Eidskog-Charlottenberg connection.

5.2.5 NO1-NO3

The NTC value given to the market between southern and middle Norway is a fixed value based on the expected flow on the connection the next day. The direction may deviate from normal direction of the flow between low and high price area. This is due to physical laws in the power system: A variation in the traded balance in South-Norway will hardly influence the physical flow between South- and Middle-Norway, as the impedance through this corridor is high compared with the impedances in parallel grid in Sweden and between South-Norway and Sweden. Power may thus flow south from NO3 to NO1 even when there is full export from South-Norway (to Sweden), and vice versa.

5.2.6 NO5-NO3

In the same way as for NO1-NO3, the 420 kV connection between NO5 and NO3 runs in parallel with the comparatively high conductivity grid in Sweden. This means that the physical flow is affected by the flow pattern in Sweden, as well as the individual net positions in NO5 and NO3. As a result, the physical flow may differ significantly from market flow, and also from what the prices in NO3 and NO5 suggest.

The main principle for the corridor is to provide the market with hour-to-hour capacities that can be physically realized. Thus, the NTC capacity will initially be given to the market in the form of a band ranging from +500 to -500 MW. In order to avoid market loop flows that are not physically achievable, the limits of the band may vary between 0 and 500 MW. If a situation with an expected flow higher than 500 MW occurs, the capacity will be higher than 500 MW.

In cases where the market flow is expected in the opposite direction to the physical flow, the NTC values can be fixed to correspond with the prognosticated physical flow.

5.2.7 NO3

The import capacity to middle Norway will vary, depending on the distribution of the production in middle Norway and the volume and distribution of production in southern Norway, northern Norway and Sweden.

The lowest capacity to middle Norway occurs in cases of high transmission from southern Norway (NO1 and NO5) and low transmission from northern Norway. The highest import capacity will appear when the transmission through the four corridors is balanced compared to the physical limits of the transmission lines.

In situations with high import from NO1 and NO5, the expected physical congestions imply a maximum import capacity in the range of 2600-3000 MW, depending on the distribution of production, consumption and the load flow towards the area. Off-peak conditions will usually give a total import capacity well below this level, as southbound flows to NO1 and NO5 can be expected even with fairly high total imports to NO3. See also sections 5.2.5 and 5.2.6 on capacity management for these corridors.

The export capacity from NO3 is determined by high transmission in the NO3-SE2-corridor and the NO3-NO1-corridor, or by a combination of congestions in the corridors NO4-SE1, NO4-SE2 and NO3-SE2.

5.2.8 NO4

Where NO3 in general is a deficit area, NO4 is normally a surplus area with export to NO3 and Sweden. The NTC values NO4-NO3, NO4-SE1 and NO4-SE2 are based on the expected physical congestions. The total export capacity from NO4 is in the range 1500-1800 MW. The highest export capacity will occur in situations with high load flow from NO4 to NO3. Low production and high consumption in the northern part of NO4 could cause a lower export capacity. The total export capacity from NO4 towards Sweden (NO4-SE1 and NO4-SE2) will normally be 800 MW. The allocation between the two corridors is depending on expected congestions between SE1 and SE2. Normally the capacity NO4-SE1 is 600 MW, and NO4-SE2 is 200 MW.

The maximum import to NO4 is 1050 MW. The maximum import capacity from Sweden to NO4 (SE1-NO4 and SE2-NO4) is normally 850 MW. NO3-NO4 is normally 200 MW, but could be up to 400 MW in periods with high production in NO3 and large deficit in NO4.

5.3 FINLAND

When defining the NTC value on the AC interconnection between Finland and SE1, the forecasted power balance in northern Finland is taken into consideration as well as the predicted connection of power plants having influence on the system stability. Typically due to winter temperatures the deficit in northern Finland increases and this will be taken into account when defining NTC from Finland to Sweden. During night time the NTC may be reduced according to the forecasted deficit volume to manage system stability during heavy transmission from south to north Finland.

The transit flow to/from northern Norway through Sweden and Finland may affect the NTC values up to 120 MW.

The transfer capacity between southern Finland and SE3 on Fenno-Skan 1 and 2 connections is normally the nominal HVDC capacity. Due to cable condition of Fenno-Skan 1 the operational voltage is reduced permanently and thus reduces the max flow of Fenno-Skan 1 to 80 % of the nominal. The temperature dependent capacity on Fenno-Skan 1 is not anymore available because of cable condition.

The NTC between Russia and Finland consists of three 400 kV interconnections. The two 110 kV lines, which are not owned by Fingrid, are not included in the NTC. The import NTC from Russia to Finland is max 1300 MW. From 1st of December 2014 export from Finland to Russia has also been possible on max 320 MW NTC. The total trade volume of the connection is offered to Nord Pool through RAO Nordic.

Estlink 1 and EstLink 2 are the HVDC connections between Estonia and Finland. Estlink 1 has a nominal capacity of 350 MW in both directions. During winter, 15 MW temperature dependent overload capacity can be used. EstLink 2 has a nominal capacity of 650 MW. The losses of the connections are purchased on both ends, which gives 16 MW additional capacity to the market. The entire capacity of Estlink 1 and EstLink 2 is available for market. The NTC for Estlink and EstLink 2 is determined taking into account the grid configuration and constraints in Estonia and Finland.

5.4 DENMARK

The capacity on the HVDC-cables between Eastern Denmark and Germany (Kontek) refers to the measurement in Bjæverskov in Denmark. This means that because of the losses in the connection the NTC value is 585 MW to Denmark and 600 MW to Germany.

50 MW of disturbance reserves can be used on the overload capacity between Eastern Denmark and Germany.

In very rare situations the calculated NTC value between Western Denmark and Southern Norway plus Sweden depends on the power production in the northern part of Jutland. In periods with high wind production the import capacity can be reduced. To handle these special situations an optimization limit is in place in the market algorithm Euphemia for the so called cut B in Western Denmark. It works as a limit both for the sum export allowed from Western Denmark to Sweden and Southern Norway and for the opposite i.e. the sum import.

The capacity on the HVDC-cables between Sweden and Western Denmark refers to the measurement in Vester Hassing in Denmark. This means that because of the losses in the connection the NTC value is 680 MW to Denmark and 740 MW to Sweden.

The day-ahead NTC capacities on the connections between Denmark and Germany (AC from Western Denmark (bidding zone DK1) and HVDC from Eastern Denmark (bidding zone DK2, Kontek) are made available to the MRC (Multi-Regional Price Coupling) for market coupling between Denmark and Germany.

The capacity on the HVDC-cables between Western Denmark and Netherlands (Cobra) refers to the sending end. Losses is bought in balancing market. The day-ahead NTC capacities on the connections between Denmark and Netherlands HVDC) are made available to MRC (Multi-Regional Price Coupling)

In a situation of decoupling of Multi-Regional price calculation, the capacity on the two connections will be subject for a shadow auction where market participants can buy capacity and utilize it on the spot markets.

6 REASON CODES AND AREA/ LOCATION CODES

To ensure a high level of transparency of how day-ahead capacities between the bidding zones are determined, codes for capacity reduction are used. Each capacity has one code for every hour. The codes consist of four numbers, where the two first numbers informs about what type of capacity reduction it is, and the two last numbers informs about location of the constraint. The capacity reduction codes can be studied at http://www.nordpoolspot.com.