Report on alternative options for grid security analysis in relation to capacity reductions for NorNed and COBRAcable

In accordance with a request of ACM

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1. Introduction

In a planned or unplanned outage situation, the grid capacity is reduced and flows on the remaining critical network elements increase compared to the grid situation where the outage is not present. It can occur, that in such situations some internal network elements do not have sufficient capacity to facilitate an expected level of internal flows, loop flows, cross-zonal flows via AC interconnectors as well as the maximum level of cross-zonal flows over the HVDC interconnectors.

In 2020, TenneT has at times reduced the NTC capacity on HVDC bidding zone borders during significant and longer duration outage situations on critical network elements as otherwise operational security limits would be violated[1]. The reductions for NorNed and COBRAcable were for the vast majority of the time related to the fact that throughout 2020 there have been several planned and unplanned outages in the 380 kV grid of North of the Netherlands (Eemshaven area).

Within the public consultation on the NL MACZT monitoring report 2020, Statkraft has provided a response (zienswijze)[2] in which they bring forward that TenneT:

- has limited the capacity on NorNed and COBRAcable to 300 MW for almost all hours in the relevant period (i.e. 600 MW in total in the period may-august 2020) and that limited capacity remains constant, while the load on the various grid components - including congested grid components - varies.
- did not use accurate grid security calculations to determine the size of this curtailment at NorNed and COBRAcable and thus reduced the capacity more than strictly necessary.

In a response to the opinion of Statkraft, TenneT responded that:

- TenneT carefully performs calculation related to the grid security and maximum market facilitation. The calculations are performed at various points in time: annual calculations based on the various scenarios, quarterly, weekly, daily and during the day.
- During the period indicated by Statkraft in its response, May-August, in the period 29/5/2020 - 19/7/2020 an unplanned outage took place on the connection MEE-ZL380 wit. Because of this unplanned outage, TenneT was forced for a long time to guarantee the N-1 grid security by ensuring that no more than 2650 MVA of production capacity would have to be transported north of substation Meeden 380 kV.
- In order to comply with the N-1 grid security limit of 2650 MVA during this period, TenneT has taken measures for a total volume of 3140 MVA, including remedial actions, such as entering into production restriction agreements with local production units in order to limit the feed-in into the Eemshaven area, as well as reducing the NTC capacity of COBRAcable and NorNed.

As follow-up on the observations from the MACZT monitoring report 2020 and the consultation, ACM requested that TenneT[3] explores the possibilities of applying more accurate grid security calculations prior to

[1] For more information, see the NL MACZT monitoring report 2020.
[2] https://www.acm.nl/nl/publicaties/zienswijze-statkraft-over-beoordelingsverslag-tennet-actieplan
[3] https://www.acm.nl/sites/default/files/documents/brief-aan-tennet-beoordelingsverslag-en-zienswijze-statkraft.pdf

the go-live of Advanced Hybrid Coupling in combination with the day-ahead capacity calculation methodology for the Hansa region. This report presents the results of this exploration.

2. Scope of this investigation

In general, when one or more critical network elements are in outage, TenneT aims to respect the obligations on minimum capacity to be made available for cross-zonal trade by using, if needed, non-costly and costly remedial actions. However, in case operational security limits cannot be respected due to a lack of available effective remedial actions, TenneT is allowed to reduce capacity available for cross-zonal trade to a level that respects operational security limits. For a more elaborate description of the operational security process, we refer to section 4.3 of the NL MACZT monitoring report 2020.

This investigation focuses on the specific situation where, due to planned and/or unplanned outages on Dutch network elements, it is not possible to transport all possible infeed in the North of the Netherlands (including AC & DC imports, conventional generation and off-shore and onshore wind) via internal Dutch network elements. Both the COBRAcable and NorNed interconnector are connected to the Dutch grid in the North of the Netherlands, and, therefore, generally face the same limitations. In principle, even when one or several critical network elements are in outage, TenneT shall aim to respect the requirement to make available at minimum an amount of 70% available for cross-zonal trade. However, in case of a lack of available effective costly and non-costly remedial actions, TenneT might need to reduce the day-ahead NTC capacity on NL-NO2[4] (NorNed) and/or NL-DK1 (COBRAcable) to a level below 70% that respects operational security limits[5].

This investigation is based on the request of the ACM and should identify what options are available for applying more accurate grid security calculations prior to the go-live of Advanced Hybrid Coupling in combination with the day-ahead capacity calculation methodology for the Hansa region. TenneT also concluded that currently ongoing grid investments are expected to significantly reduce the need for NTC reductions on the HVDC interconnectors (see section 3.3). Therefore, the scope for alternative measures has been brought back to their applicability for the **period 2022-2023**.

The request of the ACM is interpreted as identifying whether changes to the grid security calculations could be done which would make the NTC reductions on NL-NO2 (NorNed) and NL-DK1 (COBRAcable) more dynamic, instead of applying constant NTC reductions for a longer period of time.

[4] Statnett is working on the implementation of a virtual market area 'NO2A' to be implemented on the DC interconnectors connected to bidding zone NO2 per mid-November. This note still refers to NO2 as the bidding zone to which the NorNed interconnector connects.
[5] For a more elaborate description of situations which have occurred in 2020 and have led to a reduction of NTC capacity on NorNed and COBRAcable, we refer to section 6.3 of the NL MACZT monitoring report 2020.

3. Reflection on the expected future needs for NTC Reductions on COBRAcable & NorNed during outages

TenneT carefully performs calculations related to the grid security and maximizing market facilitation. The calculations are performed at various points in time: annual calculations based on the various scenarios, quarterly, weekly, daily and intraday.
For a more elaborate description of the grid security assessment, we refer to section 4.3 of the NL MACZT monitoring report 2020, where the week ahead and the day-ahead/intraday grid security assessment are described in more detail.

This section summarises the NTC reductions which have happened in 2020 which triggered this report, the reductions applied so far in 2021 (January-September), and an outlook on the need for future reductions in relation to currently ongoing grid investments.

3.1 Reductions in 2020

In the NL MACZT monitoring report 2020, TenneT reported on the amount and frequency of reductions applied on the NL-DK1 and NL-NO2 bidding zone border. Not all reductions on these bidding zone borders were triggered by TenneT. The figure below shows that for 19% of MTUs for DK1->NL and 14% of MTUs for NO2->NL, the MACZT was below the minimum MACZT due to a reduction by TenneT.

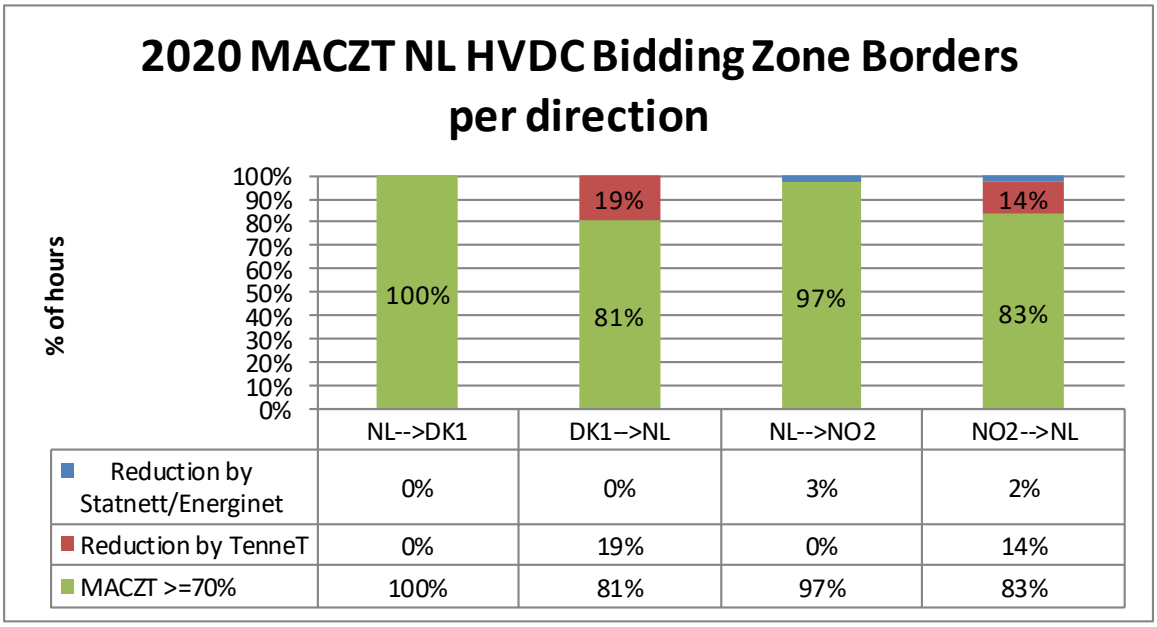


Figure 1: Percentage of the time when the relative MACZT is above 70% on the NL HVDC borders, per direction, for the full year 2020. Source: NL MACZT monitoring report 2020

During the period indicated by Statkraft in their zienswijze (May-August 2020), an unplanned outage happened on the network element MEE-ZL380 wit from 29/5/2020 to 19/7/2020. This element of the 380 kV grid in the north of the Netherlands carries a relatively large amount of flows from generation in the

Netherlands (onshore and offshore) combined with flows of AC and DC interconnectors; load has less impact in this part of the 380 kV grid. The grid in the north of the Netherlands is illustrated in Figure 2.

Because of this unplanned outage, TenneT was forced for a long time to guarantee the N-1 grid security by ensuring that no more than 2650 MVA of production capacity, instead of the 5790 MVA of total installed generation capacity that might have to be transported from the area north of substation MEE380[6] otherwise.

This 2650 MVA of production capacity is based on the contingency of a failure of the parallel connection (MEE-ZL zwart), in which case the produced power (installed capacity of 5790 MVA) would have to be transported through the 220 kV grid via 3 transformers in substation EEM380.

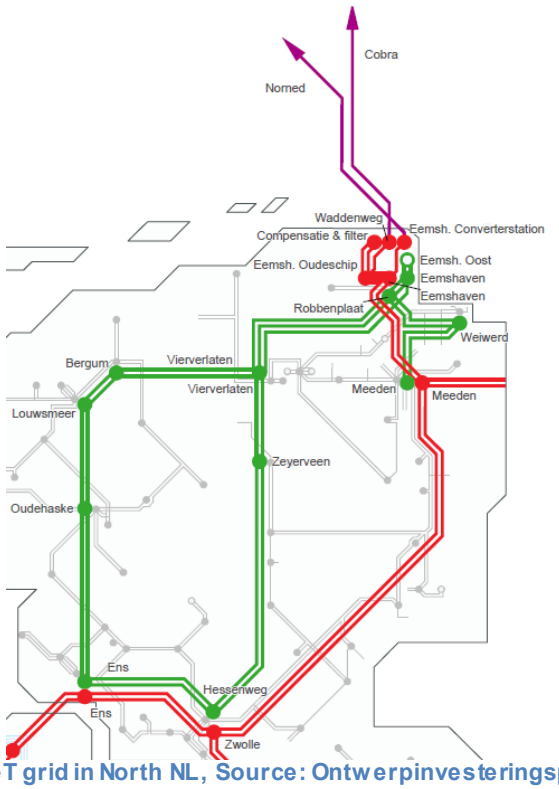


Figure 2: Part of current TenneT grid in North NL, Source: Ontwerpinvesteringsplan Net op land 2022-2031

[6] More information can be found in https://www.acm.nl/sites/default/files/documents/reactie-op-zienswijze-statkraft-op-beoordelingsverslag_0.pdf

3.2 NTC Reductions so far in 2021

In the three figures below, the NTC reductions for both interconnectors for the period Q1-Q3 2021 have been provided. In these figures, it can be seen that there were very few reductions on COBRAcable and some more on the NorNed cable. As indicated in Figure 5, the reductions on the NorNed cable were mostly triggered by Statnett or were due to an outage of the interconnector itself. Only for 209 MTUs (3.1% of the time), TenneT applied simultaneous reductions on both bidding zone borders because of limitations in the Dutch grid. Also, no reductions below a MACZT of 70% (corresponds to 490 MW) have been applied by TenneT, the reductions below a MACZT of 70% in the figures below, were applied by Energinet/Statnett.

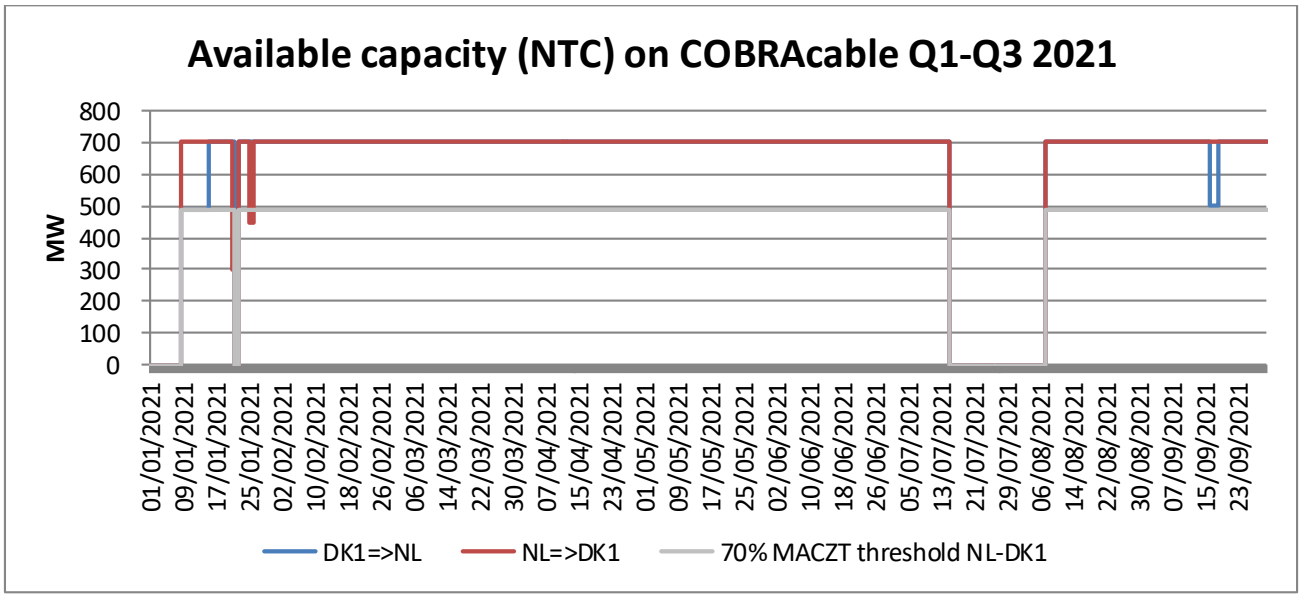


Figure 3: Available capacity (NTC) on the NL-DK1 bidding zone border, period Q1-Q3 2021

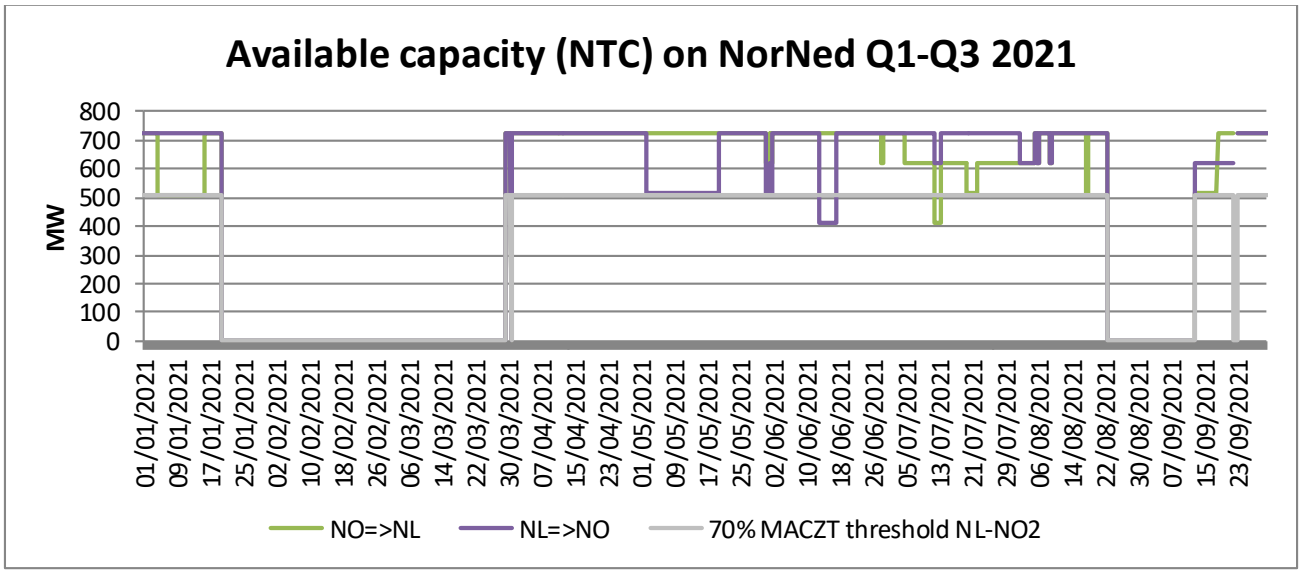
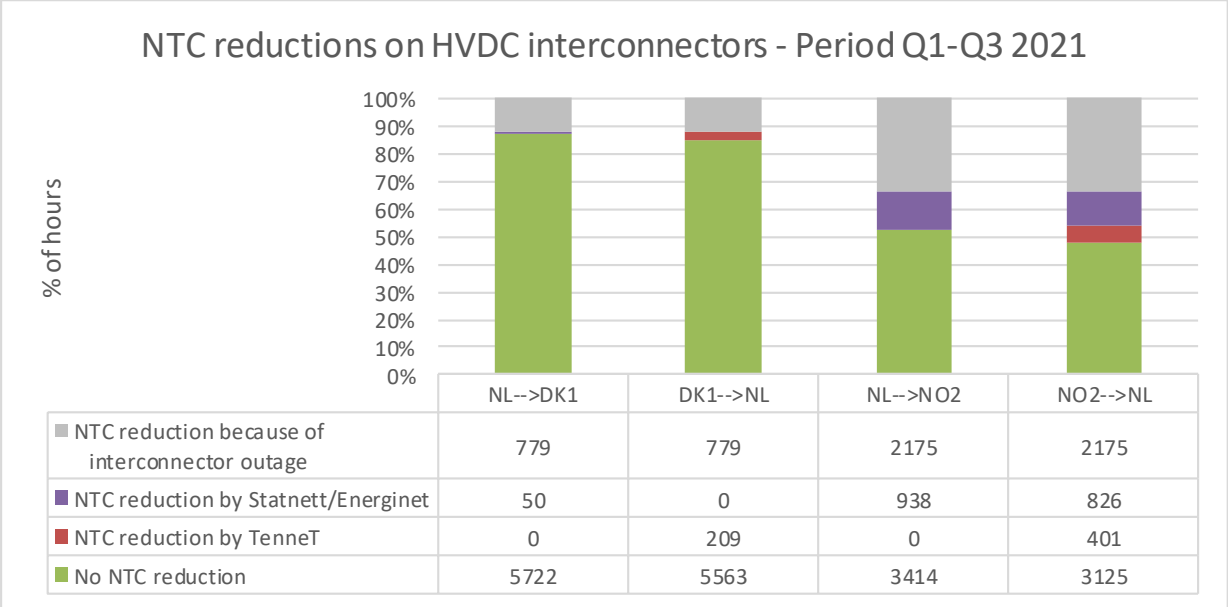


Figure 4: Available capacity (NTC) on the NL-NO2 bidding zone border, period Q1-Q3 2021



	NL-->DK1	DK1-->NL	NL-->NO2	NO2-->NL
NTC reduction because of interconnector outage	779	779	2175	2175
NTC reduction by Statnett/Energinet	50	0	938	826
NTC reduction by TenneT	0	209	0	401
No NTC reduction	5722	5563	3414	3125

Figure 5: NTC reductions on NL-DK1 and NL-NO2 bidding zone border per causer, period Q1-Q3 2021

3.3 Need for reductions expected from 2022 onwards

In December 2019, the Ministry of Economic Affairs and Climate Policy of the Netherlands has established an action plan [7] pursuant to Article 15 of the Electricity Regulation. The action plan has established a linear trajectory for the minimum capacity available for cross-zonal trade to be compliant with Article 16(8) of the Electricity Regulation, as well as what measures will be taken to comply with this linear trajectory. The major driver for increasing available capacity for cross-zonal trade is doing grid investments. Relevant grid investments are detailed in the aforementioned action plan.

Future grid investments will also relieve the need for NTC reductions on the HVDC borders in the future. The project 'Noord-West 380 kV, fase 1' will relieve the existing bottlenecks for transporting generation and import from the Eemshaven area to other parts of the Netherlands. Within this project 4 circuits of 2635 MVA between the substation Eemshaven Oudeschip 380kV and substation Vierverlaten 380kV will be realised. These circuits and the transformers in substation Vierverlaten can then be used to transport more electricity from the Eemshaven area into the 220 kV grid.

The project is already in realisation phase, and is expected to be operational per 2023[8]. An overview of the project is given in Figure 6.

[7] Action plan of the Netherlands, Implementation of Articles 14, 15 & 16 of Regulation (EU) 2019/943. The Hague, December 2019, Ministry of Economic Affairs and Climate Policy of the Netherlands. Link
[8] Ontwerpinvesteringsplan Net op land 2022-2031, Consultatiedocument 1 november 2021. Link

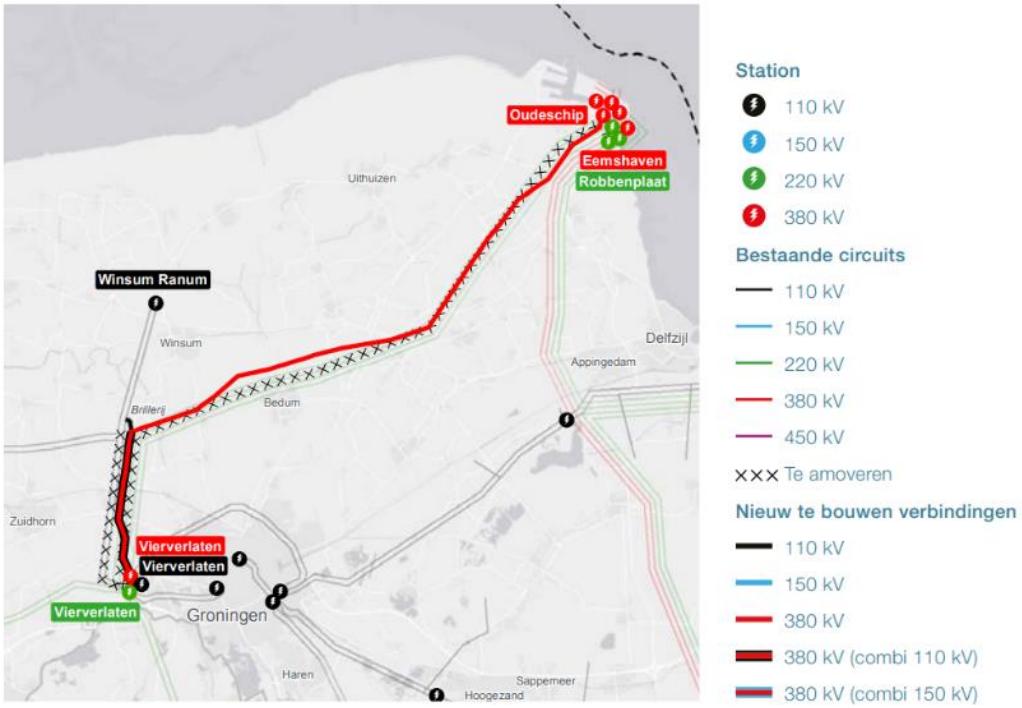


Figure 6: Scope of project Noord-West 380 kV, Source: Ontwerpinvesteringsplan Net op land 2022-2031

3.4 Overall conclusions on the expected future needs for reductions

Compared to 2020, in 2021 the need for reductions was already significantly less, both in frequency and magnitude. In the period Q1-Q3 2021, during only 209 MTUs a parallel reduction on COBRAcable and NorNed took place and no reductions below a MACZT of 70% (corresponds to 490 MW) have been applied by TenneT. Also, it is generally expected that after the realisation of the project Noord-West 380 kV, the need to apply NTC reductions on the HVDC interconnectors will decrease even further.

Together, this leads to the conclusion that any possibility of applying more accurate grid security calculations prior to the go-live of Advanced Hybrid Coupling in combination with the day-ahead capacity calculation methodology for the Hansa region, will most likely only be applied for a limited number of MTUs for only a limited period of time (2022-2023).

4. Current capacity calculation and grid security processes

As described in section 4.3 of the NL MACZT report, grid security analysis are performed by TenneT at various points in time. An overview of the different grid security analysis from week ahead (W-1) to intraday (ID) is provided in Figure 7.

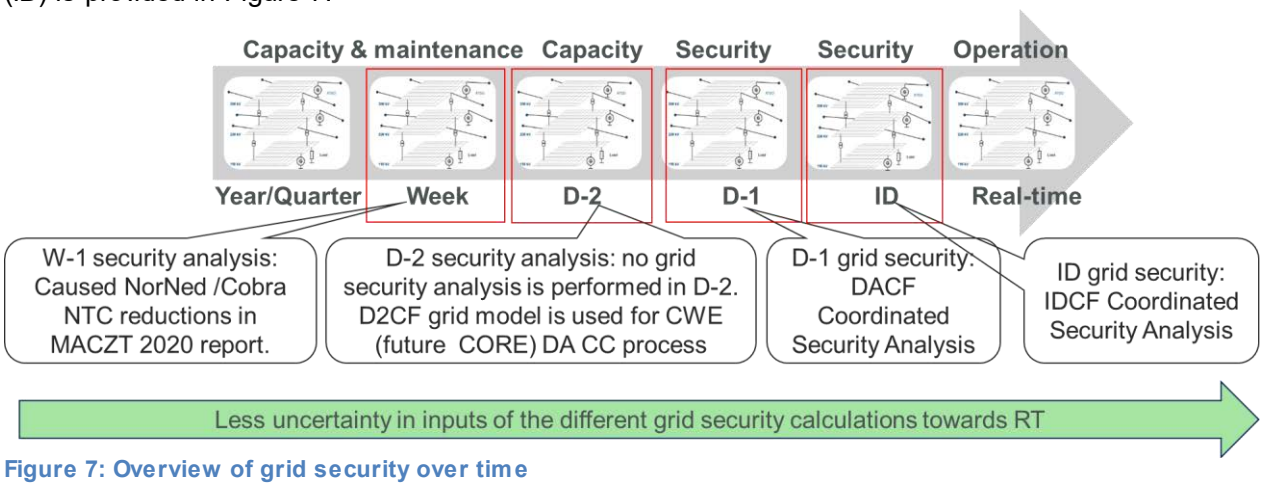


Figure 7: Overview of grid security over time

The D-1 and ID grid security analysis are part of Coordinated Security Analysis (CSA) activities, which encompass the time frames of the Day-ahead Congestion Forecast (DACF), which begins in the late afternoon of the penultimate day after market close, and the Intraday Congestion Forecast (IDCF), which begins before midnight and includes an hourly rolling forecast of all remaining hours of a calendar day[9].
The D-2 grid model, D2CF, is currently not part of a security analysis. This D2CF grid model is currently used within the CWE region in the DA CC process and will in the be used in the future with the CORE DA CC process.

As indicated in section 4.3 of the MACZT 2020 report and in Figure 7 of this document the NTC reductions applied in 2020 on NorNed & COBRAcable are based on W-1 security analysis. This because it has become apparent that in these cases operational security limits are expected to be violated due to planned outages for required maintenance or grid enforcements, or due to longer duration unexpected outages; The various foreseen non-availability (VNB) and unforeseen non-availability (ONB) in Table 4 of the MACZT 2020 report have lead that 1900 to 2650 MVA of the 5790 MVA of total generation capacity in the North of the Netherlands could be transported on internal network elements during these ONBs/VNBs.

Transmission forecasts (in Dutch: transport prognoses, or prognoses as currently described in article 13 of the Dutch grid code) from TenneT connected parties, among others, are used as input in the D-1 and ID grid security analyses. On D-1, connected parties (including DSOs) provide TenneT (in accordance with Grid Code Article 13.11(8)) with a forecast. The deadline of transmission forecasts is D-1 at 15:30. From that moment on, TenneT connected parties are allowed to deliver a change in their forecast. In accordance with

[9] https://www.tscnet.eu/services/#1527416462420-5e55d4a2-1536

the current Grid Code article 13.11(9), expected deviations from the forecast previously submitted must be made available to TenneT immediately after the change becomes known, in the case of an electricity production unit with a maximum capacity:

1. greater than 60 MW and less than 200 MW if the change is greater than 5% of the maximum capacity;
2. greater than or equal to 200 MW if the modification is greater than 10 MW.

Forecasts of the power flows through the TenneT transmission grid are used as input in the grid security analysis in the following way:

1. **Before D-1 grid security:** In this stage, transmission forecasts from connected parties are typically not yet available as the deadline is set after DA market coupling. Therefore, in this stage realised flows from (a) reference day(s) principle is used as estimate/forecast of future flows in the TenneT grid.
2. **D-1 grid security:** after Day Ahead market clearing, based on transmission forecasts from connected parties, including DSOs.
3. **IntraDay grid security:** based on any updated transmission forecasts from connected parties, including DSOs.

There are different levels of uncertainty which have to be taken into account in the grid security processes. In general, the closer the security analysis takes place to delivery, the lower the level of uncertainty. This is because closer to delivery, the quality of the data and inputs become better. In estimations (for example on the expected load/generation), performed W-1 and D-2, there is a very high uncertainty since transmission forecast are not available and possible RES or conventional generation forecast could have a very high uncertainty. Higher uncertainties result in larger reliability margins which have to be taken into account for how much capacity can be offered for cross-zonal trade.

5. Potential options to apply more accurate grid security calculations

ACM requested[10] that TenneT explores the possibilities of applying more accurate grid security calculations. As described earlier in this document TenneT carefully performs calculations related to the grid security. In section 4 and in Figure 7 the grid security analyses on different timeframes are described.
In this section these grid security analyses performed in different timeframes are listed, provided with an exploration of the possibility of having more accurate grid security calculations. This was interpreted as making the NTC reductions on NL-NO2 (NorNed) and NL-DK1 (COBRAcable) more dynamic (i.e. not apply constant NTC reductions for a longer period of time). A final evaluation of the exploration of options is included in section 6.

Week ahead grid security analysis

A potential option to make the NTC reductions on NorNed and COBRAcable more dynamic, could be to adjust the estimations that are used in the week ahead grid security assessment, i.e. the forecasts of the power flows as described in section 4. However, due to the fact that these estimations take place a week-ahead, implicitly the estimations carry a very high uncertainty as many items cannot yet be accurately forecasted at that point in time. In particular it is hard to forecast the amount of RES generation a week-ahead, but also it is not straightforward to estimate the power output of individual conventional power plants a week-ahead. The latter is in particular the case for stand-alone gas power plants, as they typically operate at the margin and have a very fluctuating output depending on prices and market conditions throughout Europe. This creates uncertainty on the flows and in addition uncertainty is created to the volume of RA needed to operate the grid within the limits for operational security during outage situations, and results in a high likelihood that forecasts week-ahead deviate a lot from the situation in real time.

D-2 grid security analysis

The D-2 grid model, D2CF, is currently not part of the grid security analysis process. This D2CF grid model is currently used within the CWE region in the DA CC process and will be used in the future with the CORE DA CC process. In estimations used in the D2CF grid model (for example on the forecasts of the power flows as described in section 4), performed D-2, there is still a very high uncertainty since transmission forecast from TenneT connected parties are not available (for a detailed description of the deadlines see section 4). An introduction of an additional grid security analysis in D-2, using the D2CF model will require a lot of effort within TenneT in terms of IT implementation.

[10] https://www.acm.nl/sites/default/files/documents/brief-aan-tennet-beoordelingsverslag-en-zienswijze-statkraft.pdf

D-1 grid security analysis

The D-1 grid security analysis is performed after the DA market coupling. A potential option could be to extend the D-1 grid security analysis process with a manual process to evaluate whether the intraday NTC on the NL-NO2 and NL-DK1 bidding zone border could be increased without violating (N-1) operational security limits. The potential process is illustrated in Figure 8 below.

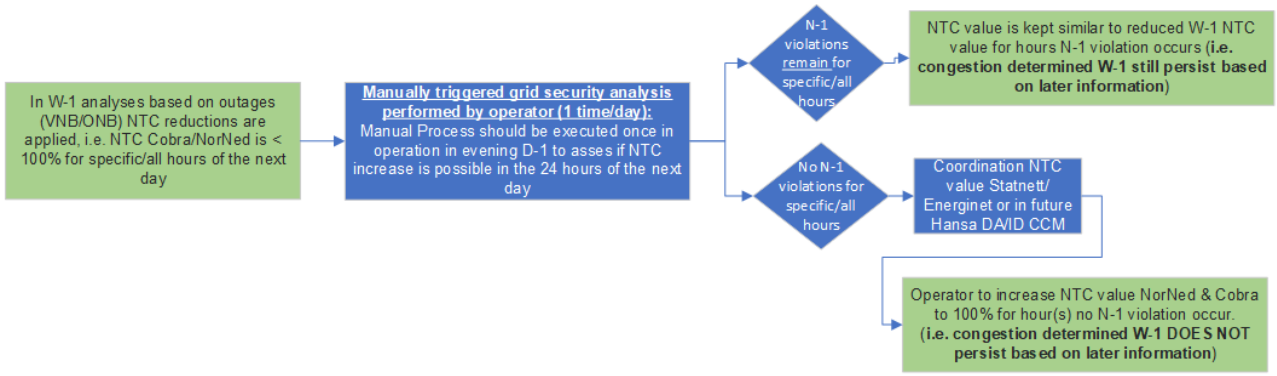


Figure 8: Potential option to extend the current D-1 grid security process with a manual process

Operators could perform this evaluation by using an additional manual grid security analysis, executed once in the late evening of D-1 for all the 24 hours of the next day. For each hour of the next day, they would then need to check whether increased NTC capacity can be provided on NL-NO2 and NL-DK1 without violating operational security limits. If for one or more hours this is the case, the NTC on NorNed & COBRAcable can be increased to a value of 100% of the NTC value of (NL-DK1) or (NL-NO2).
An increase of the NTC for intraday needs to be coordinated with Statnett and/or Energinet. Implementing a process, as depicted above, also possibly requires changes on the side of Statnett and/or Energinet as they might as well need to implement a process to evaluate a request for increase of the side of TenneT.

Until the Hansa DA/ID CCM is implemented, the existing capacity coordination process with Statnett & Energinet needs to be possibly adjusted to ensure this coordination process can be executed. Within the current coordination process Statnett and Energinet could reject an intraday request of NTC increase from TenneT, if such an increase would violate operational security limits in their areas. Therefore, even if TenneT could make additional NTC capacity available for intraday for one or more hours, it is not a given that this capacity will become available for the intraday market.

The DACF grid model, used during the D-1 grid security analysis, is based on transmission forecasts from connected parties, including Dutch DSOs. This implies that there is less uncertainty in the input in the D-1 grid security process (for example on the expected load/generation), compared to the W-1 and D-2 timeframe, as actual information has become available directly from the connected parties. However, uncertainty remains to some extent since changes based on Intraday trading are still not accounted for in the D-1 grid security analysis, and because market parties still have the possibilities to adjust their transmission forecasts based on later trade or further optimisation of their generator schedules.

Intraday (ID) grid security analysis

The ID grid security analysis is performed after the D-1 grid security analysis. As indicated in section 4 the IDCF grid model used during the ID grid security analysis, is based on transmission forecasts from connected parties, including Dutch DSOs. In principle, there is less uncertainty in the estimations used as input in the ID grid security process compared to the inputs used as input for the security processes in the D-1, D-2 and W-1 timeframe, because closer to delivery, the quality of the data and inputs become better. However, as illustrated in Figure 9 intraday trading happens mostly close to the ID cross-zonal gate closure time (60 min in advance of delivery). Therefore, the uncertainty only significantly decreases closer to delivery.

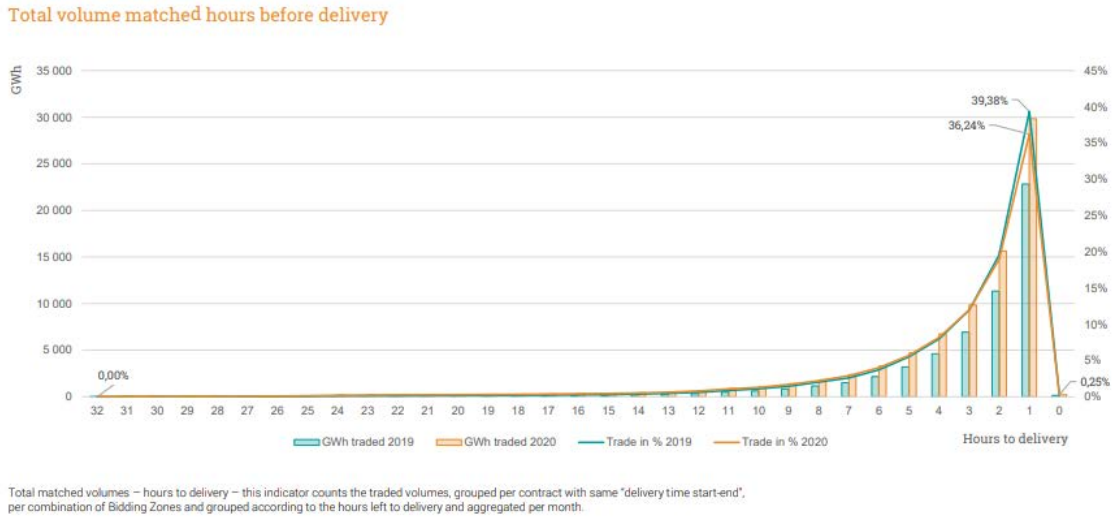


Figure 9: Single ID coupling – total matched volumes hours to delivery in 2019 and 2020 [11]

In order to deal with this uncertainty on ID, changes close to ID cross-zonal gate closure (60 min in advance of delivery)) need to be accounted for, which results in a process that needs to be performed every hour or perhaps every other hour during the day. This limited amount of time available till the time of delivery will not be enough to solve possible congestions with the use of RA (i.e. redispatch), in case N-1 overloads occur to the time of delivery.

Besides the fact that there is not enough time to apply RA (i.e. redispatch) in case a N-1 violation, it will also require extensive manual actions and coordination by the operator. For example in a similar process compared to the earlier described potential D-1 grid security analysis, which in ID then needs to be performed every hour or perhaps every other hour during the day. It is important to keep manual operations for operators to a minimum, as they need to be able to focus on the current grid situation and have the possibility to react on changing grid situations or incidents. Based on the above, the proposed process with such a manual effort is considered not feasible.

[11] CACM Annual Report 2020, page 100. source

6. Evaluation of the different options

The different options described in section 5 are evaluated in this section on the following criteria:

- Possible impact on more accurate grid security analysis (i.e. having more dynamic NTC reductions on COBRAcable & NorNed).
- Possible risk to violate operational security limits.
- Possible impact on required IT implementation effort TenneT.
- Possible impact on operational processes in control centres department.
- Possible impact on bilateral coordination with Energinet / Statnett (in future this will be done in the Hansa CCR).

A possible impact assessment is made with a distinction between: very high, high, medium, low, very low, unknown and not applicable.

Table 1: Evaluation of the different options described in section 5

Evaluation criteria	W-1 grid security analysis	D-2 grid security analysis	D-1 grid security analysis	ID grid security analysis
Possible impact on more accurate grid security analysis (i.e. having more dynamic NTC reductions on COBRAcable & NorNed).	Medium Any possibility of applying more accurate grid security calculations, will most likely only be applied for a limited number of MTUs for only a limited period of time in the period 2022-2023. In such limited occasions, dependent on the actual grid situation, and the feasibility to change estimations in the W-1 grid security assessment, a change might lead to more dynamic NTC reductions prior to DA market coupling on NorNed and COBRAcable.	Unknown Any possibility of applying more accurate grid security calculations, will most likely only be applied for a limited number of MTUs for only a limited period of time in the period 2022-2023. Based on the assessment performed it is unknown if the creation of an additional grid security analysis in D-2 would actually lead to different results compared to the W-1 grid security analysis and therefore more dynamic NTC reductions on NorNed and COBRAcable.	Medium Any possibility of applying more accurate grid security calculations, will most likely only be applied for a limited number of MTUs for only a limited period of time in the period 2022-2023. Dependent on the actual grid situation, NTC values might be increased for specific hours after DA market coupling based on a manual process executed in the evening day-ahead. This could in such case also result in more dynamic NTC reductions on COBRAcable & NorNed.	Not applicable This option is not deemed feasible to execute in the control centres department, given the amount of manual effort needed and in case N-1 violations occur in this short timeframe (i.e. one or two hours prior to delivery), it is not feasible to apply RA (i.e. redispatch).

Possible risk to violate operational security limits	Very high Caused by the fact that estimations are used with a very high uncertainty and no transmission forecast are available W-1.	High Caused by the fact that estimations are used with a high uncertainty and that transmission forecast are not yet available at D-2.	Medium Transmission forecast are available D-1 after the deadline of 15:30, however ID changes are not yet reflected.	Very High Possibly updated transmission forecast are available close to ID gate closure, some uncertainty will remain (in case for example a process is executed once every 2 hours). However, in case N-1 violations occur in this short timeframe before delivery, it is not feasible to apply remedial actions (e.g. redispatch).
Possible impact on required IT implementation effort TenneT	High If more dynamic inputs in the W-1 grid security analysis need to be used it will possibly have a high impact on the IT implementation effort needed.	Very high No D-2 grid security analysis currently exists, since the D2CF is only currently used for the capacity calculation process in CWE (and CORE in the future). This will therefore possibly have a very high impact on the IT implementation effort needed.	Low The IT implementation effort is limited since TenneT can make use of existing processes. Some limited implementation effort might be needed.	Low The IT implementation effort is limited since TenneT can make use of existing processes. Some limited implementation effort might be needed.
Possible impact on operational processes in control centres department	Medium If more dynamic inputs in the W-1 grid security analysis need to be used this will have a limited impact on the processes executed by the outage planning coordinators. This more dynamic input can however, in case very different from the situation at the moment closer to delivery, also lead to a high impact on the real time operators and increase the impact there.	Unknown No D-2 grid security analysis currently exists, since the D2CF is only currently used for the capacity calculation process in CWE (and CORE in the future). This could possibly have an impact on the implementation effort needed, the exact impact is difficult to foresee at this point in time.	Medium In case NTC reductions are applied on NorNed/ COBRA cable based on W-1 analysis, a manual process is needed once per day by the real time operators. A possible increase of NTC could however also lead again to an impact on the real time operators, in case the grid situation changes ID compared to D-1.	Very high In case NTC reductions are applied on NorNed/ COBRA cable based on W-1 analysis, a manual process is needed 12/24 times per day performed by the real time operators, which is not feasible.
Possible impact on bilateral coordination with Energinet / Statnett (in future this will be done in the Hansa CCR)	Low If more dynamic inputs in the W-1 grid security analysis need to be used this will have a limited impact on the processes executed by the outage planning coordinators.	Medium No D-2 grid security analysis currently exists, since the D2CF is currently only used for the capacity calculation process in CWE (and CORE in the future). This might cause another coordination to happen prior to the DA market coupling.	Medium In case NTC reductions are applied on NorNed/ COBRA cable based on W-1 analysis, a manual process in the control room is needed once per day. Potentially there is impact with Energinet & Statnett as well as they might need to evaluate increase requests, which is not investigated in this evaluation.	Very high In case NTC reductions are applied on NorNed/ COBRA cable based on W-1 analysis, a manual process in the control room might be needed 12/24 times per day. Potentially there is impact with Energinet & Statnett as well as they might need to evaluate increase requests, which is not investigated in this evaluation.

7. Annex 1: List of acronyms

Abbreviation	Definition
ACM	the Dutch national regulatory Authority for Consumers and Markets
AHC	Advanced Hybrid Coupling
ATC	Available Transmission Capacity
BZ	Bidding Zone
BZB	Bidding Zone Border
CC	Capacity Calculation
CCR	Capacity Calculation Region
CNE	Critical Network Element
CNEC	Critical Network Element with contingency
D-1	Day-ahead
D-2	Two-day-ahead
D2CF	D-2 Congestion Forecast
DACF	Day-ahead Congestion Forecast
DK1	The Bidding Zone DK1 in Denmark
HVDC	High-Voltage Direct Current
ID	During the day
IDCF	Intraday Congestion Forecast
MACZT	Margin Available for Cross-Zonal Trade
MTU	Market Time Unit
NEMO	Nominated Electricity Market Operator
NL	(the Bidding Zone of) The Netherlands
NLv	A virtual bidding zone in the Netherlands, to be placed in between the Dutch Bidding Zone (NL) and the interconnectors NorNed and COBRAcable
NO2	The Bidding Zone NO2 in Norway
NTC	Net Transfer Capacity
Qx	Quarter of the year, with x denoting whether it is the first (Jan-March), second (April-June), third (July-September) or fourth (October-Decmeber) quarter of the year
RES	Renewable Energy Sources
SIDC	Single IntraDay Market Coupling
SDAC	Single Day-Ahead Market Coupling
TSO	Transmission System Operator
W-1	Week-ahead