European Network of
Transmission System Operators
for Electricity

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ENTSO-E Cross Border Electricity Balancing Pilot Projects Public Version

2 Month Report on Pilot Project 5

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1. Introduction

This report comprises of the following general issues:

1. The main information of the pilot project;
2. The implementation of relevant targets ahead of the Network code on Electricity Balancing (NC EB);
3. An update on any specific targets of the pilot project not directly linked to NC EB, but key for the pilot project itself;
4. An update on any additional general and particular success/monitoring indicators of each pilot project, taking into account what pilots are or not under a "go live" phase;
5. Balancing products: products implemented/to be implemented at pilot project level, analysing the possibility to harmonise between different pilot projects that deal with the same type of balancing product.

The table below indicates when information has been last updated.

	Last updated
2.a Participating TSOs	April 2014
2.b Scope and goals of the pilot project	April 2014
2.c Recent achievements of the pilot project	May 2015
2.d Learning points	May 2015
2.e Specific questions	May 2015
3.a Updated project roadmap	May 2015
3.b Impact on current practice and future market design	May 2015
3.c Cross-border exchange	May 2015
3.d Pricing-Settlement	May 2015
3.e Experience from the implementation	May 2015
3.f Extensibility and cooperation	May 2015
4.a Pilot project roadmap in comparison to NC EB	May 2015
4.b Contribution to standard product definition	May 2015

2. Executive summary

a) Participating TSOs

Nordic: Fingrid, Svenska Kraftnät, Statnett, Energinet.dk
Baltic: Elering, Litgrid, AST
Germany: Tennet DE, 50 Herz , Amprion, Transnet
Poland: PSE

b) Scope and goals of the pilot project

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The aim of the pilot project is to analyse gains and ways of exchanging mFRR on the different connections in and out of the Nordic synchronous area. The gains are analysed both from increased security of supply and economic efficiency perspectives.

Three feasibility studies were carried out during 2014 in cooperation with the Baltic, the German and the Polish TSOs respectively. In all three feasibility studies possibilities and challenges regarding exchange of the product mFRR were investigated and economic benefits were analysed. The Nordic-German study also includes studies on imbalance netting and frequency stability.

The Nordic-Baltic feasibility study is a continuation of the work under the Baltic Energy Market Interconnection Plan (BEMIP). The BEMIP consists of a stepwise process to integrate the Baltic market with the Nordic market. The Nordic-Baltic study includes a throughout discussion on how the Baltic TSOs could develop the common Baltic balancing market to be compatible with the Nordic RPM and extention of Baltic – Nordic cooperation as a part of the integration process. The Nordic-Polish study is unique in the sense that it covers cooperation between a self-dispatch system and a central-dispatch system.

At the beginning of the project the Dutch TSO was invited for a feasibility study however it was agreed and decided by MSG to be postponed.

c) Recent achievements of the pilot project

- Three feasibility studies have been finalised by the end of 2014
- Meeting with Nordic NRA in December 2014
- Baltic TSOs have from January 1st 2015 implemented imbalance netting between Estonian, Latvian and Lithuanian power systems as suggested by the feasibility study on Nordic-Baltic balancing cooperation development.
- ToR for Baltic – Nordic integration has been developed and expected to be signed in May 2015 by Nordic and Baltic TSOs
- Analysis of different exchange models between Nordic and other synchronous areas has been initiated.

d) Learning points

Learnings Q1: Identify learnings that can be useful for other pilots or collaboration initiatives in general

The pilot project is in a learning phase for cooperation between CoBA's and new challenges and solutions develop as discussions are ongoing. Therefore learnings as a first step are summarised in principles below and more detailed described in part 3 and will also at the next reporting be detailed further.

Overall principles for cooperation have been developed based on learnings from the feasibility studies:

Principles related to development process of cooperation

- Different exchange models between different CoBAs is possible
- All cooperation projects shall include testing phase, implementation phase and evaluation of technical aspects and economic benefits
- Stakeholder involvement shall be ensured before implementation & thruogh the project

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- NRA approval and involvement. NRA approval processes shall be investigated beforehand.
- Principles for sharing the project costs shall be developed & agreed for each project
- Coordination between border-projects (RPM cooperation/extension projects) should be ensured

Principles related to market and trade rules, interim phase (TSO-TSO, CoBA-CoBA cooperation)

- All setups shall be reciprocity (Allow for trade in both directions), non-discriminant and transparent
- Exchanged products shall be comparable and clearly defined
- Different pricing methods can be used

Principles related to market and trade rules, later stage/target model (Common European-wide or regional CoBA)

- The cooperation partner shall use marginal pricing
- The market setup and balancing pricing shall give incentives for the Balance Responsible Parties to be balanced or help the system
- Balancing principles and pricing should not negatively effect on efficient and transparent pricing between day-ahead, intraday and balancing market.
- Imbalance prices should not be regulated/price capped
- mFRR market and product definition shall be technologically neutral, allowing renewables & demand side response participation
- 3rd country (non-EU = Russia) participation to mFRR market can be enabled with non-discriminant and transparent market rules

Learnings Q2: Identify learnings that can be useful towards the NC EB implementation

The current Nordic RPM based on a CMO, marginal pricing, voluntary activation bids and combined with different national capacity auctions and smaller differences in products is example of well-functioning market based on the cooperation between four Nordic TSO's and covering two synchronous areas.

There already exists cooperation with neighbouring TSO's and the feasibility studies shows that further cooperation is beneficial but need for development of new market exchange and IT solutions to integrate with other synchronous areas and CoBA's are necessary. These issues and pre-requisites for integration will be investigated further in the continuation of the pilot project.

e) Specific questions

Potential Q1: What are the expected benefits? (quantify) Who will benefit and how are the benefits distributed (e.g. grid tariffs)?

The foreseen benefits of cooperation between Nordic and the Baltic, Polish and German balancing markets may be summarised as detailed below:

- More competition on the mFRR market and more robust market to manage deviations in supply and interconnectors. The consequence is more effective use of available mFRR resources and enhances the security of supply.

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- More efficient use of the transmission capacity to even the balancing energy prices (and conditions for the market participants) within the integrated RPM markets.
- Optimisation of the power system balancing while avoiding opposite balancing between the separate balancing areas / power systems.

It is not straightforward to quantify these benefits as price effects, change in behavior of market participants and change in congestions are uncertain factors. The characteristics of the specific design of market/exchange arrangements and the degree of harmonization will also affect what is possible to gain from extended regulation power exchange. The three feasibility studies assess the socio-economic potential in different ways.

The Nordics-Baltics study includes no in-depth quantification of benefits. The Baltic balancing markets are not very integrated today and the historical market prices and volumes would likely not be very representative to use in an assessment of benefits of future exchange after necessary harmonization and integration are achieved on the Baltic side. However, the foreseen socio-economic benefits of possible cooperation between thermal power dominant Baltic system and Nordic system with extensive hydro and nuclear resources are evident. The benefits are also reckoned as the result of the internal integration process of the Baltic electricity balancing markets.

The Nordics-Poland study makes an estimation of benefits based on historical data of first half of 2014. Activated bids, total volumes of bids and available transmission (free transmission capacity after DAM) are analysed and the estimated benefit is given by a quite broad range: 0,2 –0,6 million € in a year. This range reflects the uncertainty of available capacity on the Nordic side. The upper limit assumes that bids of all Nordic bidding areas are available and the lower limit assumes only bids of SE4 to be available. An in-between-case that often is valid would be that just bids of SE4 and DK2 are available which yields 0,3 million € in benefits. Interpreting these results we should have in mind that it is based on the prices, DAM flows and transmission capacities of a quite short period while the market situation may change radically between years and seasons. The exchange will have an impact on market prices. An assumption of 1 % decrease of price spread per MW exchange is used as assumption in the analysis as no bid curves are available. However, given that volumes in the balancing markets can be quite limited compared to for example the day-ahead market the impact can vary extensively.

The Nordics-Germany study also includes an analysis of benefits based on historical data of three different months. As opposed to the Polish study this analysis uses actual bid curves and costs of covering different demands are calculated using the bid price multiplied with the quantity of each individual bid chosen. It is analysed how much costs will be reduced if a common merit order list is established and the cheapest bids of both markets are used to cover the total demand. The demand equals actual activated volumes in one alternative, but virtually activated volumes in 200 MW steps are also considered. With the actually activated volumes as demand the results show a decrease in costs of 42% to 61 % depending on the month and direction of regulation.

A weakness with the Nordic-Germany analysis is that only the free capacity on the interconnector between the Nordics and Germany are taken into account and congestion between Nordic bidding areas are neglected. Nordic supply available in Germany will often be limited by congestions on the Nordic side. As seen in the Polish study this could reduce the possible gains significantly. The analysis is based on existing availability on

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the interconnectors between Germany and Nordic countries and if current limitations is changed it will effect the results.

In general the feasibility studies indicates that there is a clear potential for socio-economic benefits from integrating the Nordic market other countries/regions, however there are large uncertainties related to how large these benefits can be. Still, the analyses are valuable also for the understanding of what is affecting the benefits and at least give an idea about possible outcomes given different assumptions.

In some cases the benefits might be small in the short term but larger benefits are expected in the long term. Although the potential monetary benefit differs between the three studies the value of developing the co-operations are considered equal.

Potential Q2: Is the potential benefit of any other balancing cooperation affected by this initiative?

no

3. Detailed of the pilot project

a) Updated project roadmap

The detailed project roadmap is to be added in the Annex of this report. Deliverables of WPs and milestones in the project implementation should be shown in it. Please report and additional information to that here.

Additional information on the pilot project road map

Feasibility has been finalized end December 2014 and more detailed roadmaps for each border are been developed.

The pilot project is spilt up in three the three border projects and common Nordic umbrella project focusing on exchange models. Main focus in 2015 is analysis and design of exchange models and further understanding of IT and technical challenges.

b) Impact on current practice and future market design

Scope/influence 1: Are there side-effects on existing markets (price, liquidity, gate-closure time)?

It is expected that cooperation with the Baltics and Poland will require less compromises, if any, and thereby less changes to the Nordic RPM-market setup. Baltics is expected to develop a market design more harmonized with the Nordics, therefore few compromises in the integration. The Polish system is very different, but given a more limited cooperation between Nordic and Poland less compromises are expected.

I is likely that the Nordic TSOs together with Germany need to change existing setup and seek compromises in accordance with future final version of NC EB. Most important areas for harmonisation and compromises are on the product defintion (direct activated vs. scheduled), activation function (use of voluntary bids, gate closure and separate capacity and activation market) and settlement (15 min vs. 60 min).

Changes compared to market designs currently being analysed and developed may be required once the

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NC EB is finalised and provisions of it shall be implemented approx. in 2019 – 2020.
Scope/influence 2: Does the pilot provide for a better integration of renewable / demand-side flexibility into the market? Renewables and demand side are already part of FRR-M in participating countries. Nordic setup is working towards reduced minimum bid size and more active involvement of wind and demand side.
Incentives 1: Are there any changes to BRP incentives? (e.g. via imbalance settlement, to be balanced in day-ahead/real-time, to help restoring the system balance, to become active in day-ahead/intraday trading) No, not in current Nordic setup. Integration with German may induce changes in current Nordic set up. As a result of Baltic – Nordic balancing cooperation development, TSO – BRP imbalance pricing and settlement principles should preferably be harmonised between Baltic TSOs maintaining balance responsibility incentives in each TSO area imbalance prices should be less advantageous to BRPs than day-ahead and (in general) intraday market prices. and reflect the cost of balancing
Incentives 2: Does the pilot provide special incentives to certain BSP units (generators/load)? (Incentives for investment in new/existing technology enforced/void) No In case of Baltic power systems, expansion of balancing market to Baltic – Nordic RPM brings additional ground for evaluation whether expansion/building of flexible units may be profitable based on market based conditions, e.g. hydro pump storage power production.
Incentives 3: What are the TSO's incentives for economic efficiency? Objective for TSO's are to reduce socio economic costs while keeping the operational security within acceptable limits.
System security: Q1: Does the pilot project provide an enhancement/impairment to system security in the involved control zones? Nordic – German study gave indications of improved frequency stability, but need to be investigated further. Overall need for thorough testing before commercial operation. Extended Baltic and Nordic cooperation in electricity balancing shall have positive effect on system security through increasing system balancing options (available balancing volumes). Benefits of this for CHP dominant Baltic power systems shall especially be evident during non-heating periods of year.
Transparency Q1: What is the (additional) operational information that is provided to BSPs and BRPs in the participating systems? Not relevant at current phase
Transparency Q2: Is there a continuous evaluation and communication of quality? Not relevant at current phase

c) Cross-border exchange

The following table contains pilot project economic information about balancing markets focusing on a one year rolling window with monthly evolution of requested indexes.

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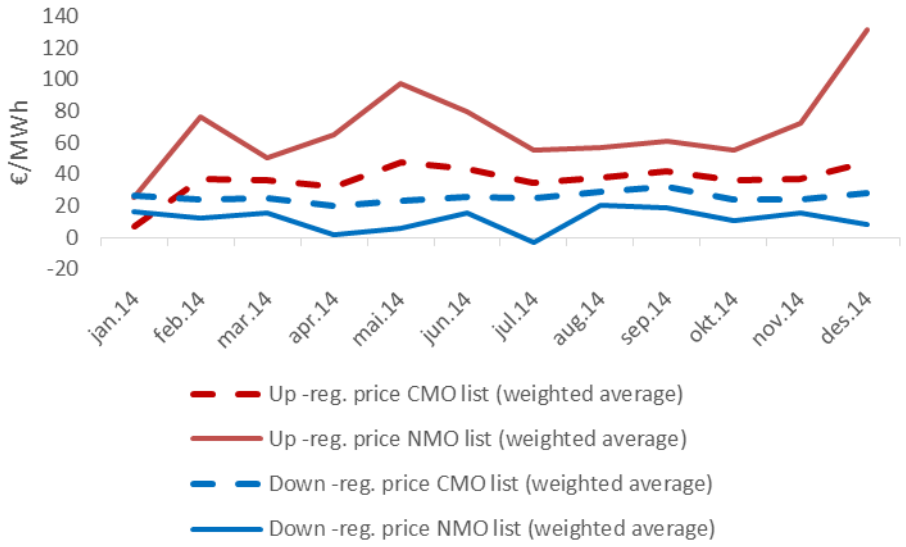

- Existing RPM marginal price in Nordic market is compared with potential national prices if no common Nordic market based on information from bids to the Nordic FRR-M market.
- The prices would have been lager/smaller without RPM – e.g. RPM reduces the price span in the Nordics.
- Socio economic gain of +50 mEuro from Jan-Dec 2014

d) Pricing – Settlement

Matching algorithm (First Come First Served or CMO through an optimisation tool or others)

Nordic RPM based on CMO and Baltic expansion expected to be integrated in existing setup.

German cooperation expected to be based on coupling on existing CMOs, eventually through new CMO as adaption of existing IT systems may be too large a challenge.

Cross border capacity management (ATC/flow based) and its interaction with intraday market and previously activated slower balancing products.

Exchange of FRR-M based on free interconnector capacity after intraday on current Nordic RPM and also expected to be methodology used in integration with other markets.

Nordic – Polish cooperation dependent on implementation of intraday coupling before FRR-M can be exchanged and IT development expected.

For Baltic cooperation analysis ongoing for use of HVDC link and need for IT adaption.

Balancing bids update process and how this update process is coordinated with previous intraday energy market and previously activated slower balancing products

Gate closure in existing Nordic RPM is 45 minutes and allow for voluntary bids. Need for harmonisation to integrate with German RPM.

Information on TSO-TSO settlement scheme

Current Nordic RPM TSO-TSO settlement is based on activation of bids to maintain power systems frequency and to cover national imbalances. If congestions occurs on cross border connections, more balancing price areas will occur.

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Principles to be applied within Baltic and in cooperation with Nordics are not yet agreed/approved.
Information on TSO-BSP settlement scheme **Not relevant**
BRP´s imbalance settlement scheme Different TSO setups, with one-price model for imbalances for consumption and two-price model for production imbalances in DK and Finland
How cross border balancing actions will be taken into account at the imbalance settlement mechanism? Exchange models to be investigated further in the project**.**
Details about imbalance settlement period at pilot project level Current Nordic RPM settelement period is 1 hour and need for harmonization with German 15 min settlement period.

e) Experience from the implementation

CBA finished for a certain process. Overall quantification of benefits from exchange have been analysed in the feasibility studies but are based on uncertain assumption, e.g. uncertainty on prices, effect of congestions.
Internal regulatory change approval, cost recognition from NRAs. Dialogue with NRA and need for approval is expected but depending on the need for change in existing Nordic RPM.
Update about on-going internal regulatory changes associated with pilot project objective. Not relevant
Reporting about contracts signed (at TSO-TSO level, for instance MoU signature between participating TSOs, at TSO – platform owner level, etc.) ToR between Nordic and Baltic expected to be signed in May 2015. German – Nordic cooperation based on ToR from feasibility study
What were the implementation costs and risks? Current Nordic RPM has limited costs and based on setup with single TSO procurement from common CMO and not a common procurement entity. No implementation projects have been decided for integration with Baltic, Germany and Poland.
Governance issues: platforms management and ownership. CMO calculation is split between Statnett and Svenska Kraftnett and each TSO has own setup for balancing need
Flow based feasibility study finished (if relevant). Not relevant
Reporting about stakeholder involvement at pilot project level (Workshops held, relevant feedback obtained from stakeholders) Common NRA meeting in December 2014 and each TSO involves market participants from own country
Cross Border capacity reservation experience Not relevant
Other comments.

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f) Extensibility and cooperation

Extensibility Q1: Identify any potential extensions of this project towards other pilots or other areas in general

The German-Nordic pilot could potentially also include NL

Nordic – Baltic pilot could potentially also include cooperation with non EU 3-rd countries (Russia, Belarus) and this is to analysed further.

Extensibility Q2: Please provide details about potential harmonisation of balancing products of the same process or justify any possible barriers

German and Nordic set up very different and need for harmonised setup and to be discussed in continuation of project. German setup based on scheduled product opposite Nordic direct activated product, further market setup is based on PAB in Germany and marginal pricing in Nordics.

Baltic TSO are likely to adopt mFRR product essentially similar to Nordics.

Poland potentially to integrate with simplified product.

Extensibility Q3: Under which conditions can the cooperation be extended? (Reciprocity for BRPs and BSPs is guaranteed, specific regulatory/legal framework required?)

Current agreement between Nordic countries has no clear description of integration of RPM markets and only allows limited exchange on borders to third party TSOs. NRAs to approve larger changes in the existing Nordic RPM

Extensibility Q4: What is the regional extensibility of the method, due to technical restrictions? (Uniformly applicable within regions of limited extension or no restrictions on extensibility)

Existing IT and communication systems in the Nordic need to be upgraded to extend RPM.

Baltic are likely to adopt essentially similar market setup as in Nordics.

Polish cooperation depends on further negotiation and takes differences in central and self dispatch into account.

German – Nordic extension is complex and further discussion necessary and possible solution is development of new CMO and IT-system

4. Contribution of Pilot Project to NC Implementation

a) Pilot project roadmap in comparison to NC EB

Where relevant explain briefly the expected or the already achieved contribution of each pilot to any of the NC milestones (A-J) listed below and also complete the timing in the corresponding table.

A. Proposal of regional implementation framework:

The NC EB requires that each TSO no later than 2020 has to be a member of a CoBA where mFRR are exchanged among TSO's. The existing Nordic market for mFRR (NOIS), does already operate a CMOL with marginal pricing and voluntary bids, and has as such already fulfilled the requirement for mFRR. Current Nordic market already covers two synchronous areas with DK1 as part of the Nordic market.

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B. Implementation of the regional integration model:

In principle the regional integration model for mFRR is already implemented in the Nordic. The pilot project is however investigating if the Baltic can be included in the existing Nordic CoBA, but this might not be possible if CoBA's is defined differently. In the case that the Baltic will be in a different CoBA, then the exchange shall be based on a CoBA – CoBA exchange, as the case would also be for Germany and Poland

C. Proposal of modification of the European integration model

See below

D. Proposal of the European implementation framework

In the time schedule set in the NC EB there is only 2 years from the regional model and until the European model has to apply. If the CoBA for mFRR are defined upfront, and as TSO's can only be member of one CoBA, then there will reduced incentive for be cooperation between CoBA's. Thus, it might be difficult to harmonise and move towards a European integration model. If TSO's could participate in more regional CoBA's for different products then a more stepwise integration into one European integration model can be achieved.

E. Proposal of common settlement rules

The settlement rules are already somewhat harmonised in the Nordic RPM, but they differ quite significantly from the German balancing market. The project will continue to analyse how harmonised the rules shall be. The initial harmonisation will depend on whether the exchange will be a CoBA-CoBA or if more TSO's will be included in the Nordic CoBA. (See question B)

F. Proposal of settlement harmonisation

The degree of needed harmonisation will continuously be analysed in the project. It is however important to have somewhat harmonised settlements rules, as say product prices will vary depending on whether the BSP has to incorporate the ramps in his price or not. If the ramps are not settled, then the BSP will have to incorporate that energy into his bid.

G. Proposal of standard products definition

In the already existing common Nordic market for mFRR, the learning is that it's possible to have similar products in the same CMOL. The products does not need to be fully harmonised, but shall only comply with a minimum set of requirements.

H. Proposal of standard products pricing

Marginal pricing is the preferred choice and as already in place, bids activated for other purposes than balancing shall however not be price setting and can be settled with pay as bid.

I. Proposal of standard products algorithms

To be analysed in continuation of the project

J. Proposal for common settlement rules of intended exchanges of energy associated to the Frequency Containment Process

Not relevant

Other expected contributions? (if yes, explain contribution and indicate both NC road map and pilot project road map)

Not relevant

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The timing of the pilot project in relation to the NC EB implementation schedule (A-J), should be completed where applicable. Note: EIF is estimated in Q4 2015.

Describe current or expected mismatches of pilot project with respect to the NC EB. Currently no mismatches, but dependent on definition of CoBA's
Describe the reasons behind these mismatches. Cooperation with Baltic, Germany and Poland dependent on definition of CoBA and possibility to exchange one or more products
Describe (if feasible) forecasted date to overcome mismatches.

Manual FRR Partial contribution	A	B	C	D	E	F	G	H	I	J
Deadline from NC EB (EiF+)	2 y	4 y	4 y	5 y	2 y	3 y	1 y	1 y	1 y	
Pilot Project 5	Partly completed	Partly completed	June 2015	Decem-ber 2015	June 2015	Decem-ber 2015	June 2015	June 2015	December 2015	

b) Contribution to standard product definition

The table below provides details about the technical characteristics of the standard product that is already being exchanged in the Nordic NOIS. Especially the integration with Germany will require product harmonisation, as the German balancing market operate with scheduled products, and has an ISP period of only 15 min, compared to 60 min in the Nordic. Depending whether the exchange with Germany will be a CoBA-CoBA exchange, or we will form a specific CoBA for a specific products, there will be different requirements for product harmonisation. The explanation of the terms used is given in the Annex of this report.

Request time	Full volume has to be delivered within 15 min from the activation signal is received. Faster products are allowed, but not slower products. There is no requirement on start of the ramping period. You can in principle wait 10 min and do nothing, and then ramp to full volume during 5 min, and still comply with the requirements.
Preparation period	
Ramping period	
Minimum and Maximum bid size	Min 10 MW and max not directly specified (expected to be changed to 5 MW)
Minimum and Maximum delivery period	No minimum (other than given by deactivation), but typically not less than 30 min. Maximum is period from start of ramping until end of hour.
Deactivation period	Not regulated in any agreement but typically less than 15 min

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Scheduled activated or direct activated (when applicable)	Direct activated is applied in the Nordic, the Germans has also scheduled products
Divisibility: only divisible bids or divisible/indivisible conditions allowed?	Divisible (A bid is allowed to be indivisible for technical reasons. If needed TSO can mark the indivisible bid as unavailable.)
Upward/downward (specify if there is symmetry at product characteristics for upward/downward); if not, fulfil 2 tables: one for upward product, the other one for downward product	Upward and downward are procured separately, the products have however similar characteristics
Validity period of the bid (next hour, ...)	Gate closure is 45 minutes before delivery hour and the bids are valid during the whole delivery hour

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Appendix 1. Project road map Summary

Timelines below are illustrations and preliminary. “question mark” indicates decision gates

Indicative timeline Polish – Nordic cooperation

	2013				2014				2015				2016				2017				2018				2019			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Design Phase														?														
IT implementation																		?										
Testing																						?						
Go-Live																												
Monitoring																												

Indicative time line for Nordic – Baltic cooperation . Project has two phases, with phase 1 focusing on extended cooperation and phase 2 on combining CMO

	2014				2015				2016				2017				2018				2019			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Design Phase 1 (HVDC link)							?																	
Design phase 2 (combined CMO)												?												
IT implementation, phase 1																								
IT impl. phase 2																								
Testing phase 1												?												
Testing phase 2																?								
Go-Live																								
Monitoring																								

Indicative timeline for Nordic - German cooperation

	2013				2014				2015				2016				2017				2018				2019			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Design Phase														?														
IT implementation																		?										
Testing																						?						
Go-Live																												
Monitoring																												

Appendix 2. Standard product characteristics