Annex 1 to the Algorithm methodology:

Common set of requirements for the price coupling algorithm

30 January 2020

1. Requirements on functionalities and performance

1.1 General requirements.

a) For each bidding zone, the price coupling algorithm shall be able to:

(i) facilitate orders for several Market Time Units (~~hereafter referred as "~~'MTU~~s"~~'), such as 15 minutes, 30 minutes and hourly;

(ii) support the products as defined in the DA Products;

(iii) facilitate configurations with more than one NEMO for a given bidding zone or a scheduling area in accordance to the multiple NEMO arrangement as referred to in Article 45 of the CACM regulation;

(iv) support multiple scheduling areas within a bidding zone as requested by TSOs;

(v) allocate cross-zonal capacities on a bidding zone border with one or multiple TSOs on one or both sides of the concerned bidding zone border.

b) The price coupling algorithm shall aim at maximising the economic surplus for SDAC for the next trading day, consistent with time limitations, conditions and requirements established by NEMOs and TSOs.

c) The price coupling algorithm shall provide for a fair and orderly price formation in accordance with Article 3(h) of the CACM Regulation.

d) The price coupling algorithm shall support multiple bidding zones within a country and shall be scalable to cover all bidding zones eligible for participating in SDAC.

e) In case the price coupling algorithm finds solutions with equal social welfare, it shall apply deterministic rules in order to define prices and net positions for each bidding zone.

f) The price coupling algorithm shall be reliable, thus able to find a solution within the allowed time limit, including the potential to extend the calculation time in case the allowed calculation time is exceeded.

State		Owner	
~~Initial~~ Requirement deadline~~s~~	~~Future Requirements~~	TSOs	NEMOs
JAN 2021~~X~~		X	X
~~X~~EXISTING			X
~~X~~EXISTING		X	X
~~X~~EXISTING		X	
~~X~~EXISTING		X	
~~X~~EXISTING		X	X
~~X~~EXISTING			X
~~X~~EXISTING		X	X
~~X~~EXISTING		X	X
~~X~~EXISTING		X	X

g) The price coupling algorithm shall be able for each MTU to provide the net position per NEMO trading hub and the input for the calculation of the scheduled exchanges between bidding zones or scheduling areas.	~~X~~EXISTING	X	X
h) The price coupling algorithm shall be able to calculate the scheduled exchanges between bidding zones or scheduling areas.	~~X~~EXISTING	X	
i) For each bidding zone, the result from the application of the price coupling algorithm shall be one price and one net position for each MTU. For the bidding zones containing several TSOs separating their scope in different scheduling areas, the net position for each MTU shall be calculated for each scheduling area. For scheduling areas where more than one NEMO operates, the net position for each MTU shall be calculated for each NEMO trading hub.	~~X~~EXISTING	X	X
~~j) For each bidding zone, the result from application of the price coupling algorithm shall be one price and one net position for each MTU. For the bidding zones containing several TSOs separating their scope in different scheduling areas, the net position for each MTU shall be calculated for each scheduling area.~~	~~X~~EXISTING	X	
~~k)~~j) The integrity of the price coupling algorithm and the data it processes shall be properly secured from unauthorized access;	~~X~~EXISTING	X	X
1.2 Qualitative requirements with precision and price ranges			
a) The price coupling algorithm shall ensure: (i) equal treatment of orders coming from all NEMOs in accordance with Article 3(e) of the CACM Regulaiton; and (ii) provide all orders of market participants non-discriminatory access to cross zonal capacity in accordance with Article 3(j) of the CACM Regulation.	~~X~~EXISTING	X	X
b) In case of tie rules (between two or more orders) and for branching decisions (if any), deterministic rules shall be implemented. Such choices shall be logged.	~~X~~EXISTING	X	X
c) The price coupling algorithm shall allow for partial decoupling.	~~X~~EXISTING	X	X
d) The price coupling algorithm shall automatically support leap years, i.e. 366 days in a year.	~~X~~EXISTING	X	X
e) The price coupling algorithm shall support 23, 24 or 25 hours for a trading day.	~~X~~EXISTING	X	X
f) The calculation process of the price coupling algorithm, including prices and scheduled exchanges resulting from this calculation process, shall be transparent, auditable, and explainable. This requirement applies also to all deterministic rules and applied algorithm heuristics and occurrence rate of these rules and heuristics.	~~X~~EXISTING	X	X
g) The price coupling algorithm source code shall be well structured and well documented.	~~X~~EXISTING		X

h) The price coupling algorithm shall support negative prices for each bidding zone.	~~X~~EXISTING		X
i) The price coupling algorithm shall be able to round calculated prices and volumes according to bidding zone specific ticks and rounding rules.	~~X~~EXISTING	X	X
1.3 Performance			
a) The price coupling algorithm shall be robust and reliable and it shall be resilient to pretested data configurations such as, but not limited to, non-crossing of bids and offer curves, orders' curtailment, maximum and minimum prices, price and volume indeterminacy.	~~X~~EXISTING	X	X
b) The price coupling algorithm shall always produce a unique result, i.e. price and volume indeterminacy shall be resolved.	~~X~~EXISTING	X	X
c) The price coupling algorithm shall use reliable IT technology, e.g. reliable third party software.	~~X~~EXISTING	X	X
d) The price coupling algorithm shall be available at all times when required.	~~X~~EXISTING	X	X
e) The price coupling algorithm shall be adequatly scalable when the number of bidding zones increases. The price coupling algorithm shall cope with new markets that need to be incorporated in the price coupling, either corresponding to geographical extensions, or with additional NEMOs in existing bidding zones.	~~X~~EXISTING	X	X
f) Price taking orders are buy (respectively sell) limit orders submitted at the maximum (respectively minimum) prices. The failure to accept these price taking orders corresponds to a curtailment situation: (i) In case of over-supply, not all price taking supply orders can be accepted (ii) In case of under-supply, not all price taking demand orders can be accepted Curtailment can be partially mitigated by exporting excess energy or importing deficit energy. In case more than one bidding zones faces a curtailment situation, when the curtailment of one increase, the curtailment of the other will decrease. Per bidding zone, it should be possible to either: (i) Prevent sharing of curtailment: the local curtailments remain local; no support is received or provided to the adjacent bidding zone (ii) Share curtailment: the difference in relative (percentage) curtailment between the different bidding zones is minimized	~~X~~EXISTING	X	X

The option of sharing curtailment in point (ii) above also applies in case of an application of flow-based approach, where sharing curtailments may be at the cost of the economic surplus. The price coupling algorithm shall provide a mechanism that allows for a sharing of curtailment between bidding zones in a flow-based capacity allocation.				

2. Requirements related to cross-zonal capacities

2.1 The price coupling algorithm shall be able for each MTU to:

a) allow setting cross-zonal capacity value for each bidding zone border in accordance with the CACM Regulation in case coordinated net transmission capacity is applied;	~~X~~EXISTING		X	
b) constrain scheduled exchanges to the respective cross-zonal capacity value for each bidding zone border for each direction, in case the coordinated net transmission capacity approach is applied;	~~X~~EXISTING		X	
c) where applicable, allow TSOs setting a default value for cross-zonal capacity for each bidding zone border and for each direction in case coordinated net transmission capacity approach is applied;	~~X~~EXISTING		X	
d) constrain, where appropriate, an aggregated set of cross-zonal interconnectors with one global cross-zonal transmission capacity limit (cumulative ATC), i.e. a general boundary constraint. This constraint shall be applicable also to a predefined set of bidding zone borders in order to limit, for example, the net position of a bidding zone(s);	~~X~~EXISTING		X	
e) allow to define a positive and a negative limit to the net position for each bidding zone;	~~X~~AUG 2022		X	
f) process flow-based parameters, if provided at the defined MTU, when allocating cross-zonal capacities for each bidding zone border;	~~X~~EXISTING		X	
g) allow definition and application of the following flow-based parameters for each network element of a given bidding zone for the flow-based approach:				
(i) power transfer distribution factor (PTDF) as defined in Regulation (EU) 543/2013; and	~~X~~EXISTING		X	
(ii) available margin on critical network element as refered to in Regulation (EU) 543/2013	~~X~~EXISTING		X	
h) ensure that the PTDF matrix multiplied by the net position is less than or equal to the available margins for each critical network element;	~~X~~EXISTING		X	
i) receive the flow-based parameters as:				

(i) "zero balanced" meaning that the available margin on critical network elements applies from zero exchanges and that pre-existing exchanges are transmitted aside; or	~~X~~AUG 2022	X	
(ii) "not zero balanced" meaning that the available margin on critical network elements applies from pre-existing exchanges;	~~X~~EXISTING	X	
j) allow the coexistence of both flow-based and coordinated net transmission capacity approaches within the coupled regions, i.e. hybrid coupling;	~~X~~EXISTING	X	
k) allow the use of virtual bidding zones to model how the critical network elements of a CCR applying the flow-based approach are impacted by cross-zonal exchanges on HVDC interconnectors within a CCR or by cross-zonal exchanges on bidding zone borders outside the CRR that are applying the coordinated net transmission capacity approach	~~X~~EXISTING	X	
~~2.2 Multiple flow-based approaches, i.e. plain and bilaterally intuitive, may be used for different capacity calculation regions.~~	~~X~~EXISTING	~~X~~	

3. Requirements related to allocation constraints

3.1 The price coupling algorithm shall be able to:			
a) constrain the increase/decrease of scheduled exchanges over one direct current (DC) interconnector and/or a combination of DC interconnectors from a MTU to the following MTU or between the last MTU from the day before and the first MTU of the following day;	~~X~~EXISTING	X	
b) constrain the increase/decrease of scheduled exchanges over one DC interconnector and/or a combination of DC interconnectors from a MTU to the following MTU or between the last MTU from the day before and the first MTU of the following day taking into account the nominations of long term capacity allocations, i.e. physical transmission rights, where applicable. The constraint shall be handled on a single DC interconnector and multiple DC interconnectors in combination;	~~X~~AUG 2022	X	
c) constrain the increase/decrease of net positions of a single bidding zone from a MTU to the following MTU within a day or between the last MTU from the day before and the first MTU of the following day; and	~~X~~EXISTING	X	
d) incorporate losses functionality on interconnector(s) between bidding zones during capacity allocation, and activate this functionality during allocation, if requested by the owner(s) of the relevant interconnector after the approval by the relevant NRAs.	~~X~~EXISTING	X	
3.2 The price coupling algorithm shall allow to set a minimum price difference between adjacent bidding zones when a DC interconnector	~~X~~EXISTING	X	

is used for electricity exchange. For this requirement, the price coupling algorithm shall model the costs incurred for each MWh passing through a DC interconnector as a "flow tariff". The "flow tariff" shall be treated as a threshold for the price between the bidding zones connected by the DC interconnector. If the price difference between the relevant bidding zones is less than the "flow tariff", the scheduled exchange shall be set to zero. If there is a scheduled exchange, the price difference shall equal the "flow tariff", unless there is a congestion. Once the price difference exceeds the "flow tariff", the congestion income becomes positive. This functionality shall be incorporated in the price coupling algorithm and activated during allocation if requested by the owner(s) of the interconnector after approval by the relevant NRAs.			
3.3	The price coupling algorithm shall allow for adverse scheduled exchanges, i.e. scheduled exchanges from higher price bidding zone to lower price bidding zone, if this leads to an increase in overall economic surplus.	~~X~~EXISTING	X	
~~3.4~~	~~The price coupling algorithm shall enforce intuitive scheduled exchange in flow-based areas, i.e. scheduled exchange from lower price bidding zone to higher price bidding zone, where requested by the relevant party for a bidding zone border.~~	~~X~~EXISTING	~~X~~	

4. Requirements related to balance constraints

4.1	For overall balance of all bidding zones, the price coupling algorithm shall ensure that the sum of unrounded net positions and transmission losses, where applicable, of all bidding zones shall be zero.	~~X~~EXISTING	X	
4.2	For overall balance of a bidding zone, the price coupling algorithm shall ensure for each bidding zone the sum of unrounded net position and transmission losses, where applicable, shall be equal to the sum of import and export of this bidding zone resulting from the day ahead capacity allocation.	~~X~~EXISTING	X	

5. Requirements on algorithm output and deadlines for the delivery of SDAC results

5.1 Regarding the prices for each MTU the output of the price coupling algorithm shall be:

a)	rounded and unrounded price in Euros for each bidding zone;	~~X~~EXISTING	X	X
b)	shadow prices of critical network elements as needed for flow-based capacity allocation; and	~~X~~EXISTING	X	

c) regional reference prices, in a network in which the cross-zonal capacity constraints are relaxed, e.g. Nordic region.	~~X~~EXISTING	X	X
5.2 Regarding the quantities for each relevant MTU, the output of the price coupling algorithm shall be:			
a) rounded and unrounded net position for each bidding zone, which is defined as the difference between accepted supply and demand orders within a bidding zone, where rounding shall follow the rounding rules defined for each bidding zone;	~~X~~EXISTING	X	X
b) where there are multiple NEMOs within a bidding zone and scheduling area, the rounded and unrounded net position for each NEMO trading hub in a bidding zone;	~~X~~EXISTING	X	X
c) the information which enables the execution status of orders to be determined;	~~X~~EXISTING		X
d) number and volume of accepted block orders for each bidding zone and paradoxically rejected orders, if any;	~~X~~EXISTING		X
e) scheduled exchanges into and out of individual relevant DC network elements (difference in scheduled exchanges in/out reflecting losses where applicable);	~~X~~EXISTING	X	
f) scheduled exchanges on relevant bidding zone borders (scheduled exchanges in/out reflecting losses where applicable);	~~X~~EXISTING	X	
g) scheduled exchanges on relevant scheduling area borders (scheduled exchanges in/out reflecting losses where applicable);	~~X~~EXISTING	X	
h) available margin on critical network elements or the remaining allowable scheduled exchange on the network element in case of flow-based approach.	~~X~~AUG 2022	X	
5.3 For each relevant MTU the price coupling algorithm shall provide scheduled exchanges resulting from day ahead market coupling in the form of:			
a) bilateral and multilateral scheduled exchanges between scheduling areas;	~~X~~EXISTING	X	
b) bilateral and multilateral scheduled exchanges between bidding zones; and	~~X~~EXISTING	X	
c) bilateral and multilateral scheduled exchanges between NEMO trading hubs;	~~X~~EXISTING	X	X
and pursuant to the methodology for calculating scheduled exchanges. This is to support the scheduled exchanges calculation and/or multi-NEMO arrangements function.			
5.4 Regarding the calculation results, the output of the price coupling algorithm shall be:			
a) the overall economic surplus and economic surplus for each bidding zone; and	~~X~~EXISTING	X	X

b) the output necessary for monitoring in accordance with Article 82(2) and (4) of the CACM Regulation.	~~X~~EXISTING	X	X
5.5 The price coupling algorithm shall provide NEMOs and TSOs with information necessary to comply with the monitoring pursuant to Regulation (EU) 1227/2011, where such information can be obtained only from the price coupling algorithm.	~~X~~EXISTING	X	X
5.6 The price coupling algorithm shall be able to implement a change of bidding zone configurations following the change control procedure referred to in Article 9 of the Algorithm methodology.	~~X~~EXISTING	X	
5.7 The price coupling algorithm shall be capable of finding results normally within the time limit that is established in the operational procedure referred to in Article 4(15) of the Algorithm methodology.	~~X~~EXISTING	X	X
5.8 The price coupling algorithm shall be able to deliver the volume of matched orders and not-matched orders of each NEMO for bidding zones or scheduling areas if requested by the relevant TSOs.	~~X~~EXISTING	X	

6. Currency

6.1 The price coupling algorithm shall for SDAC only accept matching in Euro, i.e. all input and output currency data shall be in Euros. This should not prevent local currency orders and settlements.	~~X~~EXISTING	X	X