Explanation of terminology used in the prototype flow-based market simulations

Terminology in this document:

Term	Meaning	Example
YYYY	Year	2016
MM	Month	5
DD	Day in month	27
NP (text in bold)	Vector/array of numbers	[1, 2, 3]
·	Dot product	[1, 2] · [3, 4] = 1*3 + 2*4 = 11
NP	Net position	Net position in area SE3 is 1234 MW
PTDF	Power transfer distribution factor	The PTDF from area NO1 to CNE XX is 12 % (This assumes the power goes to the *reference node* of the PTDF matrix)
PTDF matrix	The matrix containing all PTDFs. The columns are the bidding areas, and the rows are the grid constraints.	
Reference node	All PTDFs are referenced to this node, choice of node have no impact on the resulting market capacity	Currently the node is in SE3
CNE	Critical network element or general grid constraint One or more grid components that limits the available market capacity. The CNEs form the rows of the PTDF matrix. Can be one of two types: • CBCO: the flow on a grid component (the Critical Branch) is monitored when another grid component (the Critical Outage) is disconnected. • Cut: a set of components that together form a grid constraint	
Base case	The forecast state of the power system for a single hour, including	

	forecast area net positions and flow on CNEs	
[]	Terms which include whitespace is put in brackets when used in equations	[]
Loop flow	Power flow induced on all CNE due to internal trades inside an area (when the area has a net position of zero, but also non-zero production and consumption).	
CGM	Common grid model. Contains both the base case (state of the power system), and all components that are connected in the relevant hour.	
NTC	Net transmission capacity. The current capacity calculation methodology used in the Nordics, but can also refer to a single value of such capacity.	NTC value for border SE2→SE3: 7300 MW
Area, bidding zone	These terms are used interchangeably in this document	

cnes.csv

Term	**Meaning**
Timestamp	The time for which the data is valid, hours from 0-23
cne_name	The name of the CNE
CNE names starting with "CUT_" or "CUT_2_"	The bidding zone borders. These are automatically created. "CUT_2_" means that the reference direction is opposite of the reference direction for "CUT_" Examples: CUT_SE1-SE2 CUT_2_SE1-SE2
DK1, DK2, FIN, NO1, NO2 etc.	Bidding areas (real) These columns contain the PTDFs. The values should be in the interval [-1, 1], but can be interpreted as [-100 %, 100 %]
DK1_GE, DK1_KontiSkan, NO2_Skagerrak etc.	Bidding areas (virtual) These areas contain no load or generation bids at the market coupling. Instead they represent the terminal points of the HVDC interconnectors in the PTDF matrix.
FAV (MW)	Used to represent remedial actions
FRM (MW)	Flow reliability margin. Capacity subtracted from the Fmax of each grid constraint to account for all uncertainty between the capacity calculation time frame and the operational hour
Fref	The base case flow on the CNEs

Fref'	Estimated loop flow [MW At Zero] = [Interface MW flow] - $\mathbf{NP} \cdot \mathbf{PTDF_{CNE}}$
Fmax	The technical capacity on the grid constraint, data provided by the TSOs
Number	CNE identification number
RAM (MW)	Remaining available margin [RAM (MW)] = Fmax - FAV - FRM - Fref'
max_fb_flow	Maximum flow allowed on the grid constraint by the PTDF matrix and the RAM. Calculated as the solution to an optimization problem with the net positions as variables: max($\mathbf{NP} \cdot \mathbf{PTDF_{CNE}}$) + Fref' subject to: $\mathbf{NP} \cdot \mathbf{PTDF_{CNE}}$ < fb_ram for all CNEs sum($\mathbf{NP_{Nordic}}$) = 0 sum($\mathbf{NP_{Jutland}}$) = 0 $NP_{to} + NP_{from} = 0$ for all HVDC interconnectors in [Skagerrak, KontiSkan, Storebælt, FennoSkan]
max_ntc_flow	The maximum flow allowed on the grid constraint by the NTC values for the specific hour. Calculated in the same way as max_fb_flow
min_fb_flow	Same as max_fb_flow, but solving for min() instead of max()
min_ntc_flow	Same max_ntc_flow, but solving for min() instead of max()
ntcsim_flow	The estimated flow on the grid constraint from the NTC simulation. ntc_flow = $\mathbf{NP_{NTC}} \cdot \mathbf{PTDF_{CNE}}$ + Fref'
fb_flow	Similar to the ntcsim_flow, but using the net positions from the flow based market simulations
fb_shadow_price	The shadow price of the CNEs is an output of Euphemia. The values indicate the marginal increase in total welfare if the RAM (MW) on the CNE was increased (given in €/MW) Only CNEs which actively limit the market outcome will have a non-zero shadow price
ntcsim_overload	Similar to the ntc_overload, but using the net positions from the NTC simulations
fb_overload	Similar to the ntc_overload, but using the net positions from the flow based simulations
RAM+Fref'	The available margin, referenced to zero flow instead of referenced to Fref' as the RAM (MW) RAM+Fref' = [RAM (MW)] + Fref'

fb_AAF	Additional allocated flow. Shows how much of the RAM was used by the market coupling. AAF = fb_flow – Fref'

borders.csv

timestamp	See description for the same term in file fb_cnes.csv
border	The name of the border , specifying the direction as [area from] > [area to]
date	The date, YYYY-MM-DD
hour	The hour, 0-23
market	FB or NTC, specify if the results in the row belong to the FB simulation results or the NTC simulation results
missing_hour	See description for file all_cnes.csv
congestion_rent	The congestion rent on the border, corrected for the cost of losses congestion_rent = [flow on importing side] * [price difference] – [loss volume] * [price on exporting side] (in the equation above the import and export side refer to the intuitive interpretation of imports/exports, not to the use in Euphemia terminology)
flow_export_side	Flow on the "from" side, referenced in the same direction as the border name (negative values indicate imports to the "from" area)
flow_import_side	Flow on the "to" side, referenced in the same direction as the border name (negative values indicate imports to the "from" area)
loss	The losses on the border Loss = abs(flow_export_side - flow_import_side)
ntcsim_physical_flow	This value applies only to the Nordic borders in market "NTC" This is the value on the border as calculated by the PTDFs for the bidding zone border, using the net positions from the NTC simulation ntcsim_physical_flow **= $NP_{NTC\_sim} \cdot PTDF_{border}$ +** [MW At Zero]
price_difference	The price difference between the "to" area and the "from" area price_difference = price_to – price_from
price_from	Price in the "from" area
price_to	Price in the "to" area
shadowprice_capacity_down	The marginal value of capacity on the border in

	the "down" direction The down direction is the same as the direction of the border name: [area from] to [area to]
shadowprice_capacity_up	The marginal value of capacity on the border in the "up" direction, being the opposite direction of "down"
shadowprice_ramping_down	The marginal value of the ramping constraint in the "down" direction
shadowprice_ramping_up	The marginal value of the ramping constraint in the "up" direction

areas.csv

timestamp	See description for the same term in file fb_cnes.csv
area	Bidding zone name
max_net_position	Maximum bidding zone net position allowed by the PTDF matrix and RAM (MW). Calculated as the solution to an optimization problem with the net positions as variables: max(**NP** · $\mathbf{PTDF}_{area}$) where $\mathbf{PTDF}_{area}$ is a vector with only 0s, except for a 1 in the position of the bidding zone in question subject to: **NP** · $\mathbf{PTDF}_{CNE}$ < [RAM (MW)] for all grid constraints sum($\mathbf{NP}_{Nordic}$) = 0 sum($\mathbf{NP}_{Jutland}$) = 0 $NP_{to} + NP_{from} = 0$ for all HVDC interconnectors in [Skagerrak, KontiSkan, Storebælt, FennoSkan]
min_net_position	Same as max_net_position, but solving for min() instead of max()
buy_complex	Accepted buy (consumption) volume of complex bids (should be zero for all Nordic areas)
buy_curve	Accepted volume of hourly buy bids
buy_noncurve	Accepted volume of block buy bids
buy_total	Sum of accepted buy bids in the bidding zone for this hour buy_total = buy_complex + buy_curve + buy_noncurve
consumer_surplus	Consumer surplus
price	The simulated price in the bidding zone
producer_surplus	Producer surplus
sell_complex	Accepted sell (production) volume of complex bids (should be zero for all Nordic areas)
sell_curve	Accepted volume of hourly sell bids
sell_noncurve	Accepted volume of block sell bids
sell_total	sell_total = sell_complex + sell_curve + sell_noncurve
sim_net_position	The simulated net position of the area sim_net_position = sell_total – buy_total
congestion_rent	The sum of congestion rent going to this area if the congestion rent of every border is shared

	50/50 between the two bordering areas. The congestion rest is calculated from the simulated flow on the borders. In case of the Nordic AC borders this flow includes the MW At Zero.
total_surplus	Total surplus Total_surplus = consumer_surplus + producer_surplus + congestion_rent