The Single Electricity Market (SEM)

Appendix N

Draft Text – SEM Programme

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APPENDIX N: OPERATION OF THE MSP SOFTWARE

N.1 This Appendix N of the Code contains a description of the algorithm used to determine the values for each Trading Period h of System Marginal Price (SMPh), and the values of Market Schedule Quantity (MSQuh) for each Price Maker Generator Unit u that are included within the Ex-Ante Indicative Market Schedule, the Ex-Post Indicative Market Schedule and the Ex-Post Market Schedule.

N.1A This Appendix N further sets out the derivation of data inputs that are used within each of the MSP Software Run Types and other interim values that are used within Ex-Post Indicative Settlement

N.2 Each run of the MSP Software relates to a single Optimisation Time Horizon. Within this Code, where a run of the MSP Software is associated with a Trading Day, it means the Trading Day that is entirely within the Optimisation Time Horizon.

N.2A The following Generator Unit and Supplier Unit types are not used in any MSP Software Run Type:

1. Interconnector Error Units;
2. Netting Generator Units; and
3. Supplier Units.

PRINCIPLES UNDERLYING THE CALCULATION OF SMP

N.3 The System Marginal Price calculated in each Trading Period is set to be the marginal cost of meeting the last unit of Schedule Demand (as defined within this Appendix N) plus Uplift, taking account of all constraints and limitations used within that run of the MSP Software and bounded by the Market Price Cap (PCAP) and the Market Price Floor (PFLOOR).

N.4 Intentionally blank.

MSP SOFTWARE RUN TYPES

N.4A Ex-Ante Indicative MSP Software Runs are performed each day by the Market Operator, before the start of the relevant Trading Day, in order to determine: ex-ante indicative values of System Marginal Price; ex-ante indicative values of Market Schedule Quantity for each Generator Unit for use within the Ex-Ante Indicative Market Schedule; and to determine the Interconnector Unit Nominations.

N.4B Ex-Post Indicative MSP Software Runs are performed each day by the Market Operator, after the end of the relevant Trading Day, in order to determine indicative ex-post values of System Marginal Price and indicative ex-post values of Market Schedule Quantity for each Generator Unit that are used in Ex-Post Indicative Settlement.

N.4B1 Ex-Post MSP Software Runs are performed by the Market Operator in accordance with the Settlement Calendar, in order to determine values of System Marginal Price and values of Market Schedule Quantity for each Generator Unit that are used in Initial Settlement or in subsequent Settlement reruns. Ex-Post Indicative MSP Software Runs are not Ex-Post MSP Software Runs.

DATA INPUTS FOR THE MSP SOFTWARE

N.4C The data inputs for Ex-Ante Indicative MSP Software Runs, Ex-Post Indicative MSP Software Runs and Ex-Post MSP Software Runs differ and the inputs to each are set out below.

N.4C1 Each MSP Software Run in respect of a Trading Day will take starting conditions from the results of the Preceding MSP Run, where this is the preceding MSP Software Run of the same MSP Software Run Type. Specifically, the initial conditions for the Trading Period commencing 06:00 on the Trading Day will be taken from the results for the Trading Period commencing 05:30 on previous Trading Day produced by the Preceding MSP Run for:

1. the Unit Commitment Schedule for each Generator Unit.
2. the Market Schedule Quantity for each Generator Unit Generator Unit.
3. the level, in units of MWh, of each reservoir associated with Pumped Storage Units.

N.4D Table 1 sets out the Commercial Offer Data and Technical Offer Data and indicates whether and how it is used in each SMP Software Run Type.

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Active Export Capacity Holding	Used to set the low output limit for Interconnector Units	Not used	Not used	Submitted data
Active Import Capacity Holding	Used to set the high output limit for Interconnector Units	Not used	Not used	Submitted data
Aggregate Export Availability	Not used	Not used	Not used	Not used
Aggregate Import Availability	Not used	Not used	Not used	Not used
Aggregated Export Nomination (IUNMs)	Not used	Not used	Not used	Not used
Aggregated Import Nomination (IUNMs)	Not used	Not used	Not used	Not used
Aggregate Interconnector Ramp Rate	Used to place a limit on total ramping of Interconnector Units	Used to place a limit on total ramping of Interconnector Units	Used to place a limit on total ramping of Interconnector Units	One value used for all Trading Periods in Optimisation Time Horizon
Available Transfer Capacity (ATC)	Not used	Not used	Not used	Not used

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Block Load Cold	Used to set the high output limit for Dispatchable Units	Used to set the high output limit for Dispatchable Units	Used to set the high output limit for Dispatchable Units	One value used for all Trading Periods in Optimisation Time Horizon
Block Load Flag	Used to set the high output limit for Dispatchable Units	Used to set the high output limit for Dispatchable Units	Used to set the high output limit for Dispatchable Units	One value used for all Trading Periods in Optimisation Time Horizon
Block Load Warm	Used to set the high output limit for Dispatchable Units	Used to set the high output limit for Dispatchable Units	Used to set the high output limit for Dispatchable Units	One value used for all Trading Periods in Optimisation Time Horizon
Block Load Hot	Used to set the high output limit for Dispatchable Units	Used to set the high output limit for Dispatchable Units	Used to set the high output limit for Dispatchable Units	One value used for all Trading Periods in Optimisation Time Horizon
Deloading Breakpoint	Not used	Not used	Not used	Not used
Deloading Rate 1	Not used	Not used	Not used	Not used
Deloading Rate 2	Not used	Not used	Not used	Not used
Dispatch Instruction MW	Not used	Not used	Not used	Not used
Dispatchable Capacity	Used as the high output limit for demand side units in the UUC.	Used as the high output limit for demand side units in the UUC.	Used as the high output limit for demand side units in the UUC.	Submitted data
Droop	Not used	Not used	Not used	Not used
Dwell Time 1	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	One value used for all Trading Periods in Optimisation Time Horizon
Dwell Time 2	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	One value used for all Trading Periods in Optimisation Time Horizon
Dwell Time 3	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in	One value used for all Trading Periods in

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
			UUC.	Optimisation Time Horizon
Dwell Time Trigger Point 1	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	One value used for all Trading Periods in Optimisation Time Horizon
Dwell Time Trigger Point 2	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	One value used for all Trading Periods in Optimisation Time Horizon
Dwell Time Trigger Point 3	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	Used in the calculation of a single ramp rate for use in UUC.	One value used for all Trading Periods in Optimisation Time Horizon
Elapse Time - cold	Not used	Not used	Not used	Not used
Elapse Time - hot	Not used	Not used	Not used	Not used
Elapse Time - warm	Not used	Not used	Not used	Not used
End Forbidden Range 1	Not used	Not used	Not used	Not used
End Forbidden Range 2	Not used	Not used	Not used	Not used
Energy Limit Factor	Applied to the Energy Limit to give an energy limit for the EOOLP	Applied to the Energy Limit to give an energy limit for the EOOLP	Applied to the Energy Limit to give an energy limit for the EOOLP	Submitted data
Energy Limit MWh	The energy limit for day D of the Optimisation Horizon	The energy limit for day D of the Optimisation Horizon	The energy limit for day D of the Optimisation Horizon	Submitted data
Energy Limit Period	Sets the start and end period for the energy limit within a Trading Day	Sets the start and end period for the energy limit within a Trading Day	Sets the start and end period for the energy limit within a Trading Day	Trading Day data used.
Energy Limited Flag	Sets whether the energy limit will be applied.	Sets whether the energy limit will be applied.	Sets whether the energy limit will be applied.	Trading Day data used.
Firm Access Quantity (FAQsh)	Not used	Used in Ex Post availability calculcaiton for Trading Sites with non-firm access.	Used in Ex Post availability calculcaiton for Trading Sites with non-firm access.	One value used for all Trading Periods in Optimisation Time Horizon
Fixed Unit Load (FUL)	Not used	Not used	Not used	Not used

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
[Export Adjustment Factor]				
Forecast Availability Profile	Used to set the high output limit for Dispatchable Units. Part of single ramp rate calculation.	Not used	Not used	Trading Day data used.
Forecast Minimum Output Profile	Used for the low output limit for pumped storage units	Not used	Not used	Trading Day data used.
Forecast Minimum Stable Generation Profile	Used for the low output limit for non-interconnector and non-pumped storage units	Not used	Not used	Trading Day data used.
Fuel Type	Used simply to identify the treatment of units	Used simply to identify the treatment of units	Not used	One value used for all Trading Periods in Optimisation Time Horizon
Interconnector Export Quantity (SIEQ)	Not used	DQ used for Generation Requirement to be met by Price Makers	DQ used for Generation Requirement to be met by Price Makers	Submitted data
Interconnector Import Quantity (SIIQ)	Not used	Not used	Not used	Not used
Interconnector Export Price (SIEP)	Not used	Not used	Not used	Not used
Interconnector Import Price (SIIP)	Not used	Not used	Not used	Not used
Interconnector Ramp Rate	Used to limit the change in output between Trading Periods	Used to limit the change in output between Trading Periods	Used to limit the change in output between Trading Periods	One value used for all Trading Periods in Optimisation Time Horizon
Interconnector User Nomination	Generated by the Ex-Ante schedule	Generated by the Ex-Ante schedule	Generated by the Ex-Ante schedule	Output, not an Input
Load Forecast MW	Used to generate the load to be met by price makers in Ex-Ante	Used if metered data not available	Used if metered data not available	Submitted data
Load shedding estimate	Not used	Used for Generation Requirement to be met by Price Makers	Used for Generation Requirement to be met by Price Makers	Submitted data

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Loading Rate Cold 1	Not used	Not used	Not used	Not used
Loading Rate Cold 2	Not used	Not used	Not used	Not used
Loading Rate Cold 3	Not used	Not used	Not used	Not used
Loading Rate Hot 1	Not used	Not used	Not used	Not used
Loading Rate Hot 2	Not used	Not used	Not used	Not used
Loading Rate Hot 3	Not used	Not used	Not used	Not used
Loading Rate Warm 1	Not used	Not used	Not used	Not used
Loading Rate Warm 2	Not used	Not used	Not used	Not used
Loading Rate Warm 3	Not used	Not used	Not used	Not used
Loading Up Break Point Cold 1	Not used	Not used	Not used	Not used
Loading Up Break Point Cold 2	Not used	Not used	Not used	Not used
Loading Up Break Point Hot 1	Not used	Not used	Not used	Not used
Loading Up Break Point Hot 2	Not used	Not used	Not used	Not used
Loading Up Break Point Warm 1	Not used	Not used	Not used	Not used
Loading Up Break Point Warm 2	Not used	Not used	Not used	Not used
Market Price Cap and Floor	Used to validate PQ pairs and to amend SMPs	Used to validate PQ pairs and to amend SMPs	Used to validate PQ pairs and to amend SMPs	
Max Export Capacity	Used to calculate low output limit for Interconnector Units - MAX(ActiveExportCapacityHolding,MaxExportCapacity-submitted by Unit)	Not used	Not used	Not used
Max Import Capacity	Used to calculate high output limit for Interconnector Units - MIN(ActiveImportCapacityHolding,MaxImportCapacity-submitted by Unit)	Not used	Not used	Not used

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
MAXGEN	Provides an upper bound for Price Takers.	Not used	Not used	Not used
Maximum Down-Time	Sets a maximum time for load curtailment	Sets a maximum time for load curtailment	Sets a maximum time for load curtailment	One value used for all Trading Periods in Optimisation Time Horizon
Maximum On Time	Sets a limit for the maximum time from startup to shutdown	Sets a limit for the maximum time from startup to shutdown	Sets a limit for the maximum time from startup to shutdown	One value used for all Trading Periods in Optimisation Time Horizon
Maximum Ramp Down Rate	Used to limit the change in output between Trading Periods for Demand Side Units and Interconnector Units	Used to limit the change in output between Trading Periods for Demand Side Units and Interconnector Units	Used to limit the change in output between Trading Periods for Demand Side Units and Interconnector Units	One value used for all Trading Periods in Optimisation Time Horizon
Maximum Ramp-Up Rate	Used to limit the change in output between Trading Periods for Demand Side Units and Interconnector Units	Used to limit the change in output between Trading Periods for Demand Side Units and Interconnector Units	Used to limit the change in output between Trading Periods for Demand Side Units and Interconnector Units	One value used for all Trading Periods in Optimisation Time Horizon
Maximum Reservoir Capacity	Bounds the maximum energy in the reservoir	Bounds the maximum energy in the reservoir	Bounds the maximum energy in the reservoir	One value used for all Trading Periods in Optimisation Time Horizon
Metered Demand	Not used	Used to calculate FAQuh	Used to calculate FAQuh	Submitted data
Metered Generation	Not used	Used in Ex-Post to calculate the demand to be met by Price Makers and schedules for Price Takers	Used in Ex-Post to calculate the demand to be met by Price Makers and schedules for Price Takers	Submitted data
MINGEN	Not used	Not used	Not used	Used as MINGEN when calculating profiles
Minimum Down-Time	Sets a minimum limit on the amount of time that a unit will be off when decommitted. This	Sets a minimum limit on the amount of time that a unit will be off when decommitted.	Sets a minimum limit on the amount of time that a unit will be off when decommitted.	One value used for all Trading Periods in Optimisation Time Horizon

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
	data is static	This data is static.	This data is static.	
Minimum Export Capacity	Not used	Not used	Not used	Not used
Minimum Import Capacity	Not used	Not used	Not used	Not used
Minimum Off Time	Sets a minimum limit on the amount of time that a unit will be off when decommitted.	Sets a minimum limit on the amount of time that a unit will be off when decommitted.	Sets a minimum limit on the amount of time that a unit will be off when decommitted.	One value used for all Trading Periods in Optimisation Time Horizon
Minimum On Time	Sets a minumum limit on the amount of time that a unit will be run when started.	Sets a minumum limit on the amount of time that a unit will be run when started.	Sets a minumum limit on the amount of time that a unit will be run when started.	One value used for all Trading Periods in Optimisation Time Horizon
Minimum Reservoir Capacity	Bounds the minimum energy in the reservoir	Bounds the minimum energy in the reservoir	Bounds the minimum energy in the reservoir	One value used for all Trading Periods in Optimisation Time Horizon
Outturn Minimum Stable Generation	Not used	Used to set the high output limit for Generating Units. Also is low output limit for units at startup and shutdown. Part of single ramp rate calculation. This data can change at the trading period.	Used to set the high output limit for Generating Units. Also is low output limit for units at startup and shutdown. Part of single ramp rate calculation. This data can change at the trading period.	Submitted data
Minimum SynchronisationTime - cold	Not used	Not used	Not used	Not used
Minimum SynchronisationTime - hot	Not used	Not used	Not used	Not used
Minimum SynchronisationTime - warm	Not used	Not used	Not used	Not used
Mode of Operation	Not used	Not used	Not used	Not used
Modified Interconnector	Not used	Not used	Not used	Not used

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
User Nominations				
No Load Cost (not Int Units, PS Units, DSUs)	Is part of the production cost for a unit. Represents the cost of being on but operating at zero MW.	Is part of the production cost for a unit. Represents the cost of being on but operating at zero MW.	Is part of the production cost for a unit. Represents the cost of being on but operating at zero MW.	Trading Day data used.
Nomination Profile	Set the min and max availability for these units (scheduled at their nomination) before considering unit commitment constraints	Set the min and max availability for these units (scheduled at their nomination) before considering unit commitment constraints	Set the min and max availability for these units (scheduled at their nomination) before considering unit commitment constraints	Trading Day data used.
Non-Dispatchable Capacity	Not used	Not used	Not used	Not used
Non-Firm Access Quantity	Not used	Used in determining actual availability.	Used in determining actual availability.	One value used for all Trading Periods in Optimisation Time Horizon
Number of Run Hours	Not used	Not used	Not used	Not used
Number of Starts	Not used	Not used	Not used	Not used
Operational Reservoir Capacity	Used as the daily Max Reservoir Storage Capacity	Used as the daily Max Reservoir Storage Capacity	Used as the daily Max Reservoir Storage Capacity	One value used for all Trading Periods in Optimisation Time Horizon
PQ Pairs (prices)	Is part of the production cost for a unit. Represents the incremental cost of running at a particular MW level - set by the PQ Quantity. One set per Trading Period.	Is part of the production cost for a unit. Represents the incremental cost of running at a particular MW level - set by the PQ Quantity. One set per Trading Period.	Is part of the production cost for a unit. Represents the incremental cost of running at a particular MW level - set by the PQ Quantity. One set per Trading Period.	Trading Day data used.

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
PQ Pairs (prices)	Is part of the production cost for a unit. Represents the incremental cost of running at a particular MW level - set by the PQ Quantity. One set per Optimsation Horizon.	Is part of the production cost for a unit. Represents the incremental cost of running at a particular MW level - set by the PQ Quantity. One set per Optimsation Horizon.	Is part of the production cost for a unit. Represents the incremental cost of running at a particular MW level - set by the PQ Quantity. One set per Optimsation Horizon.	Trading Day data used.
Prior Day Reservoir Level	Not used	Not used	Not used	Not used
Priority Dispatch Flag	Used to give priority to units when a tie in terms of cost occurs.	Used to give priority to units when a tie in terms of cost occurs.	Used to give priority to units when a tie in terms of cost occurs.	One value used for all Trading Periods in Optimisation Time Horizon
Pump Storage Cycle Efficiency	Used in UUC to determine rate of change in reservoir level with pumping rate when pumping.	Used in UUC to determine rate of change in reservoir level with pumping rate when pumping.	Used in UUC to determine rate of change in reservoir level with pumping rate when pumping.	One value used for all Trading Periods in Optimisation Time Horizon
Pumped Storage Flag	Distinguishes pumped storage units for separate treatment to other units.	Distinguishes pumped storage units for separate treatment to other units.	Distinguishes pumped storage units for separate treatment to other units.	One value used for all Trading Periods in Optimisation Time Horizon
Pumping Load Capacity	Not used	Not used	Not used	Not used
PQ Pairs (Quantities)	Is part of the production cost for a unit. Represents the quantities at which prices will apply up to. One set per Trading Period.	Is part of the production cost for a unit. Represents the quantities at which prices will apply up to. One set per Trading Period.	Is part of the production cost for a unit. Represents the quantities at which prices will apply up to. One set per Trading Period.	Trading Day data used.
PQ Pairs (Quantities)	Is part of the production cost for a unit. Represents the quantities at which prices will apply up to. One set per Optimsation Horizon.	Is part of the production cost for a unit. Represents the quantities at which prices will apply up to. One set per Optimsation Horizon.	Is part of the production cost for a unit. Represents the quantities at which prices will apply up to. One set per Optimsation Horizon.	Trading Day data used.

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Ramp DOWN Breakpoint 1	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp DOWN Breakpoint 2	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp DOWN Breakpoint 3	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp DOWN Breakpoint 4	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp DOWN Rate 1	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Ramp DOWN Rate 2	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp DOWN Rate 3	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp DOWN Rate 4	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp DOWN Rate 5	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp down rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp Up Breakpoint 1	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Ramp Up Breakpoint 2	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp Up Breakpoint 3	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp Up Breakpoint 4	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp Up Rate 1	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp Up Rate 2	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Ramp Up Rate 3	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp Up Rate 4	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Ramp Up Rate 5	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	Used to set single ramp up rate for Generating Units other than interconnectors, demand side units and pumping range of pump storage units.	One value used for all Trading Periods in Optimisation Time Horizon
Outturn Availability	Not used	Profiled to produce an actual availability for units in ex-post	Profiled to produce an actual availability for units in ex-post	Submitted data
Outturn Minimum Stable Generation	Not used	Profiled to produce a minimum stable generation profile for units in ex-post (except pump storage)	Profiled to produce a minimum stable generation profile for units in ex-post (except pump storage)	Submitted data
Outturn Minimum Output	Not used	Profiled to produce a minimum output profile for pump storage units ex post	Profiled to produce a minimum output profile for pump storage units ex post	Submitted data
Registered Capacity	Not used	Not used	Not used	One value used for all Trading Periods in

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
				Optimisation Time Horizon
Registered Firm Capacity	Not used	Used to calculate FAQ, based on MD, DQ and AP	Used to calculate FAQ, based on MD, DQ and AP	One value used for all Trading Periods in Optimisation Time Horizon
Revised Submitted Energy Limit SELut	Not used	Units can re-submit their energy limit once between gate closure and 12 hours before the end of the Trading Day. This value is used in ex-post for the energy limit. The energy limit factor will stay the same and ex-ante. If metered energy is higher over the day, that will reset the limit. If neither apply then ex ante energy limit used.	Units can re-submit their energy limit once between gate closure and 12 hours before the end of the Trading Day. This value is used in ex-post for the energy limit. The energy limit factor will stay the same and ex-ante. If metered energy is higher over the day, that will reset the limit. If neither apply then ex ante energy limit used.	Trading Day data used.
Short Term Maximisation Capacity	Not used	Not used	Not used	Not used
Short Term Maximisation Time	Not used	Not used	Not used	Not used
Shutdown Cost	Used as a "startup cost" for a demand side unit	Used as a "startup cost" for a demand side unit	Used as a "startup cost" for a demand side unit	One value used for all Trading Periods in Optimisation Time Horizon
Soak Time Cold 1	Not used	Not used	Not used	Not used
Soak Time Cold 2	Not used	Not used	Not used	Not used
Soak Time Warm 1	Not used	Not used	Not used	Not used
Soak Time Warm 2	Not used	Not used	Not used	Not used
Soak Time Hot 1	Not used	Not used	Not used	Not used
Soak Time Hot 2	Not used	Not used	Not used	Not used

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Start Forbidden Range 1	Not used	Not used	Not used	Not used
Start Forbidden Range 2	Not used	Not used	Not used	Not used
Startup Cost - Cold	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is greater than the warm duration time.	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is greater than the warm duration time.	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is greater than the warm duration time.	One value used for all Trading Periods in Optimisation Time Horizon
Startup Cost - Hot	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is less than the hot duration time.	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is less than the hot startup duration time.	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is less than the hot startup duration time.	One value used for all Trading Periods in Optimisation Time Horizon
Startup Cost - Warm	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is greater than the hot duration time but less than the warm duration time.	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is greater than the hot duration time but less than the warm duration time.	Used as part of the cost of running a unit. Applies if the unit's downtime prior to startup is greater than the hot duration time but less than the warm duration time.	One value used for all Trading Periods in Optimisation Time Horizon
Startup End Point	Not used	Not used	Not used	Not used
Startup Time - cold	Time for a unit to restart after the end of the warm duration time. Unit cannot restart until the lesser of this time and the minimum down time have elapsed.	Time for a unit to restart after the end of the warm duration time. Unit cannot restart until the lesser of this time and the minimum down time have elapsed.	Time for a unit to restart after the end of the warm duration time. Unit cannot restart until the lesser of this time and the minimum down time have elapsed.	One value used for all Trading Periods in Optimisation Time Horizon
Startup Time - hot	Time for a unit to restart before the end of the hot duration time. Unit cannot restart until the lesser of this time and the minimum down time have elapsed.	Time for a unit to restart before the end of the hot duration time. Unit cannot restart until the lesser of this time and the minimum down	Time for a unit to restart before the end of the hot duration time. Unit cannot restart until the lesser of this time and the	One value used for all Trading Periods in Optimisation Time Horizon

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
		time have elapsed.	minimum down time have elapsed.	
Startup Time - warm	Time for a unit to restart after the end of the hot duration time but before the end of the warm duration time. Unit cannot restart until the lesser of this time and the minimum down time have elapsed.	Time for a unit to restart after the end of the hot duration time but before the end of the warm duration time. Unit cannot restart until the lesser of this time and the minimum down time have elapsed.	Time for a unit to restart after the end of the hot duration time but before the end of the warm duration time. Unit cannot restart until the lesser of this time and the minimum down time have elapsed.	One value used for all Trading Periods in Optimisation Time Horizon
Target Reservoir Level	Sets a target reservoir level for the end of the Trading Day. This defines a lower limit to the reservoir level in the last period of the Trading Day.	Sets a target reservoir level for the end of the Trading Day. This defines a lower limit to the reservoir level in the last period of the Trading Day.	Sets a target reservoir level for the end of the Trading Day. This defines a lower limit to the reservoir level in the last period of the Trading Day.	Trading Day data used.
Target Reservoir Level Percent	Applied to the Target Reservoir Level to set a target reservoir level for the end of the Optimisation Time Horizon. This defines a lower limit to the reservoir level in the last period of the Optimisation Time Horizon.	Applied to the Target Reservoir Level to set a target reservoir level for the end of the Optimisation Time Horizon. This defines a lower limit to the reservoir level in the last period of the Optimisation Time Horizon.	Applied to the Target Reservoir Level to set a target reservoir level for the end of the Optimisation Time Horizon. This defines a lower limit to the reservoir level in the last period of the Optimisation Time Horizon.	Submitted data
Soak Time Trigger Point Cold 1	Not used	Not used	Not used	Not used
Soak Time Trigger Point Cold 2	Not used	Not used	Not used	Not used
Soak Time Trigger Point Hot 1	Not used	Not used	Not used	Not used

Data	Indicative Ex Ante	Indicative Ex Post	Initial Ex Post	Data Used Ending Overlap Optimis-ation Period
Soak Time Trigger Point Hot 2	Not used	Not used	Not used	Not used
Soak Time Trigger Point Warm 1	Not used	Not used	Not used	Not used
Soak Time Trigger Point Warm 2	Not used	Not used	Not used	Not used
Unit Load Scalar (ULS) [Export Adjustment Factor]	Not used	Not used	Not used	Not used
Unit Under Test End Date	Identifies whether a unit is under test and whether to use nominations for Price Makers.	Identifies whether a unit is under test and whether to use nominations for Price Makers.	Identifies whether a unit is under test and whether to use nominations for Price Makers.	Unit is considered under test for the entire Optimisation Time Horizon
Unit Under Test Start Date	Identifies whether a unit is under test and whether to use nominations for Price Makers.	Identifies whether a unit is under test and whether to use nominations for Price Makers.	Identifies whether a unit is under test and whether to use nominations for Price Makers.	Unit is considered under test for the entire Optimisation Time Horizon
Wind Forecast MW	Provides availabilities for wind units for the Optimisation Horizon. Used to set the market schedule for the price-taker wind generation unit.	Not used	Not used	Not used

Profiling of Generator Unit Technical Characteristics Data

N.4E For Ex Post Indicative MSP Software Runs and Ex Post MSP Software Runs and in accordance with paragraph 4.33A, the Market Operator shall calculate time-weighted average values of Minimum Stable Generation (MINGENuh), Availability Profile (APuh) and Minimum Output (MINOUTuh) in respect of each Generator Unit u (except Autonomous Generator Units) in each Trading Period h as follows:

1. The time-weighted average Minimum Stable Generation (MINGENuh) for Trading Period h is the sum over all Outturn Minimum Stable Generation values for Generator Unit u that apply during Trading Period h of the product of each Outturn Minimum Stable Generation value for Generator Unit u and the proportion of

the Trading Period for which that Outturn Minimum Stable Generation value applies.

2. The time-weighted average Availability Profile (APuh) for Trading Period h is the sum over all Outturn Availability values for Generator Unit u that apply during Trading Period h of the product of each Outturn Availability value for Generator Unit u and the proportion of the Trading Period for which that Outturn Availability value applies.

3. The time-weighted average Minimum Output (MINOUTuh) for Trading Period h is the sum over all Outturn Minimum Output values for Generator Unit u that apply during Trading Period h of the product of each Outturn Minimum Output value for Generator Unit u and the proportion of the Trading Period for which that Outturn Minimum Output value applies.

N.4F For Ex Ante Indicative MSP Software Run no time-weighted average values of Minimum Stable Generation (MINGENuh), Availability Profile (APuh) and Minimum Output (MINOUTuh) are required as a unique Forecast Minimum Stable Generation Profile, Forecast Availability Profile and Forecast Minimum Output Profile exist for each Trading Period h and Generator Unit u in the Optimisation Time Horizon and which is defined as follows:

1. Where Forecast Minimum Stable Generation Profile, Forecast Availability Profile and Forecast Minimum Output Profile have been submitted for each Trading Day in the Optimisation Time Horizon then the value submitted for each Trading Period in the Optimisation Time Horizon will be used in the Ex Ante Indicative MSP Software Run.

2. Where Forecast Minimum Stable Generation Profile, Forecast Availability Profile and Forecast Minimum Output Profile values are only submitted for the first Trading Day in the Optimisation Time horizon, then the values submitted for the first Trading Day will be used for the corresponding Trading Periods in the first Trading Day of the Optimisation Time Horizon, with the values for the final Trading Period of that first Trading Day being used for all Trading Periods during the Ending Optimisation Overlap Period.

Data inputs for Ex-Post MSP Software Runs

N.5 For the purposes of Ex-Post MSP Software Runs the provisions for data inputs in paragraphs N.6 to N.13G shall apply.

N.6 Schedule Demand (expressed in MW) used in the MSP Software for any Ex-Post MSP Software Run to be met by Price Maker Generator Units in Trading Period h is calculated as follows:

1. the Actual Output (AOuh) for all Price Maker Generator Units u (for the avoidance of doubt, including Interconnector Units and Dispatch Quantities for Demand Side Units, calculated in accordance with paragraphs 4.68 and 5.76 respectively, but excluding the Interconnector Residual Capacity Unit) in Trading Period h;

2. less the summation of all reductions in Output of any Predictable Price Taker Generator Unit, calculated as the difference between:

a. the minimum of Nominated Quantity (NQuh) and the Availability Profile (APuh) of the Predictable Price Taker Generator Unit for Trading Period h; and

b. the Actual Output (AOuh) of the Predictable Price Taker Generator Unit u for Trading Period h,

with increases in Output having the opposite sign;

3. less the summation of all reductions in Output of any Variable Price Taker Generator Unit, calculated as the difference between:

a. the Availability Profile (APuh) of the Variable Price Taker Generator Unit u for Trading Period h; and

b. the Actual Output (AOuh) of the Variable Price Taker Generator Unit u for Trading Period h,

with increases in Output having the opposite sign;

4. plus an estimate of any reduction in demand in Trading Period has a consequence of Demand Control as set out in the Grid Codes;

5. plus the Dispatch Quantity (DQu'h) of each Interconnector Residual Capacity Unit u' in Trading Period h.

N.7 The value for Availability used by the MSP Software for each Generator Unit u in each Trading Period h will be the Actual Availability (AAuh) as calculated under paragraphs 4.35 to 4.36 or within Section 5 as appropriate except that for Generator Units that are Interconnector Units the Actual Availability in Trading Period h is to be set equal to the greater of zero and the Interconnector Unit's Modified Interconnector User Nomination.

N.8 Minimum Output is not used in the Ex Post MSP Software Run except as allowed for in paragraph N.9.

N.9 The value for Minimum Stable Generation used by the MSP Software for each Generator Unit u in each Trading Period h is to be set equal to the Minimum Stable Generation (MINGENuh) as calculated by the Market Operator under paragraph N.4E in accordance with paragraph 4.33A, except that:

1. for Generator Units that are Pumped Storage Units it is to be set equal to the Minimum Output (MINOUTuh) as calculated by the Market Operator under paragraph N.4E in accordance with paragraph 4.33A or within Section 5 as appropriate.

2. for Generator Units that are Interconnector Units it is to be set equal to the lesser of zero and the Interconnector Unit's Modified Interconnector User Nomination.

N.9A The value of the Energy Limit of an Energy Limited Generator Unit for the Trading Day, expressed in units of MWh, will be the greater of its cumulative Metered Generation over the Trading Day and the applicable Energy Limit, where the applicable Energy Limit is the Energy Limit contained within Technical Offer Data except where a re-submitted Energy Limit has been received from the relevant System Operator in accordance with Appendix E in which event that re-submitted Energy Limit is the applicable Energy Limit.

N.10 Intentionally blank.

N.11 Intentionally blank.

N.12 Intentionally blank.

N.13 For the avoidance of doubt, in the event that the MSP Software is re-run for use in Settlement in respect of a Trading Day, this will not trigger a re-run of the MSP Software for any subsequent Trading Day.

Data inputs for Ex-Post Indicative MSP Software Runs

N.13A For the purposes of Ex-Post Indicative MSP Software Runs the provisions for data inputs in paragraphs N.13A1 to N.13H apply.

N.13A1 For the purposes of each Ex-Post Indicative MSP Software Run, the values of Availability and Minimum Stable Generation for each Trading Period in the Optimisation Time Horizon for each Generator Unit u other than Autonomous Generator Units are as follows:

1. for each Trading Period h within the first 18 hours of the Optimisation Time Horizon, these values are to be set equal to the Actual Availability (AAuh) and Minimum Stable Generation (MINGENuh) values respectively as calculated by the Market Operator under paragraph N.4E in accordance with paragraph 4.33A except that

    a. For Generator Unit u that is a Pumped Storage unit the Minimum Stable Generation in Trading Period h is to be set equal to the Minimum Output (MINOUTuh) as calculated by the Market Operator under paragraph N.4E in accordance with paragraph 4.33A or within Section 5 as appropriate.

    b. For Generator Unit u that is an Interconnector Unit the Minimum Stable Generation in Trading Period h is to be set equal to the lesser of zero and the Interconnector Unit's Modified Interconnector User Nomination.

    c. For Generator Unit u that is an Interconnector Units the Actual Availability in Trading Period h is to be set equal to the greater of zero and the Interconnector Unit's Modified Interconnector User Nomination; and

2. for each of the remaining Trading Periods h in the Optimisation Time Horizon, these values are to be set equal to the value of Availability and Minimum Stable Generation respectively as determined in paragraph 1 for the last Trading Period h' that is within the first 18 hours of that Optimisation Time Horizon.

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N.13A2 For the Ex-Post Indicative MSP Software Run used for the purposes of Ex-Post Indicative Settlement, Schedule Demand (expressed in MW) is calculated as follows:

1. For the first 18 hours of the Optimisation Time Horizon for the relevant Trading Day, Schedule Demand to be met by Price Maker Generator Units is calculated in accordance with paragraph N.6 parts 1-5 above.

2. For the remaining hours of the Optimisation Time Horizon, Schedule Demand to be met by Price Maker Generator Units is calculated in accordance with paragraph N.15 below.

N.13E The value of the Energy Limit of an Energy Limited Generator Unit for the Trading Day, expressed in units of MWh, will be the greater of its cumulative Metered Generation, determined subject to paragraph N.13H, over the Trading Day and the applicable Energy Limit, where the applicable Energy

Limit is the Energy Limit contained within Technical Offer Data except where a re-submitted Energy Limit has been received from the relevant System Operator in accordance with Appendix E in which event that re-submitted Energy Limit is the applicable Energy Limit.

N.13F Intentionally blank

N.13G Intentionally blank

N.13H For the purposes of each Ex-Post Indicative MSP Software Run, the values of Metered Generation are determined as follows:

1. for each Trading Period within the first 18 hours of the Optimisation Time Horizon, these values are the Metered Generation values (MGuh); and

2. for each of the remaining Trading Periods in the Optimisation Time Horizon, these values are to be set equal to the relevant Metered Generation (MGuh') taken from the last Trading Period h' that is within the first 18 hours of that Optimisation Time Horizon.

Data inputs for Ex-Ante Indicative MSP Software Runs

N.14 For the purposes of Ex-Ante Indicative MSP Software Runs, the provisions for data inputs set out in paragraphs N.14A to N.21 apply.

N.14A For the purposes of each Ex-Ante Indicative MSP Software Run, the values of Availability and Minimum Stable Generation for each Trading Period h in the Optimisation Time Horizon for all Generator Units u other than Autonomous Generator Units are based on the Forecast Availability Profile and the Forecast Minimum Stable Generation Profile values respectively, which are submitted as part of Technical Offer Data, except that:

1. For Generator Units that are Pumped Storage units the Minimum Stable Generation in Trading Period h is to be set equal to the Forecast Minimum Output Profile submitted as part of Technical Offer Data.

2. For Generator Units that are Interconnector Units the Minimum Stable Generation in Trading Period h is to be set equal to the greater of the Maximum Interconnector Unit Export Capacity and the Active Interconnector Unit Export Capacity Holding. If no Active Interconnector Unit Export Capacity Holding is available then a value of zero should be used in its place.

3. For Generator Units that are Interconnector Units the Actual Availability in Trading Period h is to be set equal to the lesser of the Maximum Interconnector Unit Import Capacity and the Active Interconnector Unit Import Capacity Holding. If no Active Interconnector Unit Import Capacity Holding is available then a value of zero should be used in its place.

N.14B The Interconnector Residual Capacity Unit is not used in the Ex-Ante Indicative MSP Software Run.

N.14C Forecast Availability is not used in the Ex-Ante Indicative SMP Software for Price Taker Generator Units that are not wind units.

N.15 The values aggregated to comprise Schedule Demand (expressed in MW)] will be:

1. Forecast Demand (based on the latest Four Day Load Forecast Data that includes forecasts for the entire Optimisation Time Horizon) which is the demand at the boundary of the Transmission System, for each Trading Period in the Optimisation Time Horizon which will be net of expected generation for each Autonomous Generator Unit that is not a Wind Power Unit;

2. less Nominated Quantities (NQuh) in respect of each Predictable Price Taker Generator Unit u that is not a Wind Power Unit and each Variable Price Taker Generator Unit u that is not a Wind Power Unit in accordance with their Accepted Nomination Profiles;

3. less the forecast of Output in respect of each Variable Price Taker Generator Unit u that is a Wind Power Unit and each Autonomous Generator Unit u that is a Wind Power Unit (based on the Wind Power Unit Forecast);

N.16 Intentionally blank.

N.17 Intentionally blank.

N.18 Intentionally blank.

N.18A For the Ex Ante Indicative MSP Software Run the value of the Energy Limit of an Energy Limited Generator Unit for the Trading Day will be the Energy Limit submitted as part of its Technical Offer Data.

Clauses N.19 and N.20 have been removed. There is a lot of pre-processing of commercial and technical offer data, some of that data applies for a trading period, some for a day, and some that is submitted for day 1 is re-used on day 2. A column in the above table on source data indicates how data is treated in the Ending Optimisation Overlap Period.

N.19 Intentionally blank.

N.20 Intentionally blank.

N.21 Intentionally blank

Use of Technical Offer Data Parameters in MSP Software

N.21A Each Price Maker Generator Unit is to be represented in the MSP Software as having a single Ramp Rate that limits the rate at which Generating Unit average MW Output can increase from one Trading Period to the next with a value determined as follows:

1. For Generator Units that are not Demand Side Units, Pumped Storage Units, or Interconnector Units the value, expressed in MW per Trading Period, equals:

$$\left(\frac{OutputRange}{RampTime + DwellTime} \right) \times 60 \times TPD$$

Where

a. OutputRange, expressed in MW, is the maximum value of Availability over the Optimisation Time Horizon less the minimum value of Minimum Stable Generation over the Optimisation Time Horizon;

b. RampTime, expressed in minutes, is the minimum time it would take that Generator Unit to increase its instantaneous Output from its Minimum Stable Generation to its Availability calculated using Ramp Up Rate 1 to Ramp Up Rate 5 (to the extent values have been provided) and Ramp Up Breakpoint 1 to Ramp Up Breakpoint 4 (to the extent that values have been provided) defined in Table 1. In determining RampTime, Ramp Up Rate i applies between a MW Output of Ramp Up Breakpoint i-1 and a MW Output of Ramp Up Breakpoint i, where if there is no defined Ramp Up Breakpoint i-1 then Ramp Up Rate i applies for all MW Output levels below Ramp Up Breakpoint i while if there is no defined Ramp Up Breakpoint i then Ramp Up Rate i applies for all MW Output levels above Ramp Up Breakpoint i-1. If there are no Ramp Up Breakpoint values provided then Ramp Up Rate 1 applies for all levels of MW Output. For the avoidance of doubt, if Ramp Up Breakpoint j is the last valid Ramp Up Breakpoint provided (for j increasing from j=1), then no Ramp Up Rate n>j+1 or Ramp Up Breakpoint n>j is to be considered in the calculation of RampTime.

c. DwellTime, expressed in minutes, is the sum of all Dwell Times corresponding to Dwell Time Triggers, between and including the units Minimum Stable Generation and its Availability; and

d. TPD is the Trading Period Duration expressed in hours.

2. For Generator Units that are Pumped Storage Units operating in generation mode the value, expressed in MW per Trading Period, equals:

$$\left(\frac{Availability}{RampTime + DwellTime} \right) \times 60 \times TPD$$

Where

a. Availability is the Availability of the Generator Unit;

b. RampTime, expressed in minutes, is the minimum time it would take that Generator Unit to increase its instantaneous Output from 0 MW to its Availability calculated using Ramp Up Rate 1 to Ramp Up Rate 5 (to the extent values have been provided) and Ramp Up Breakpoint 1 to Ramp Up Breakpoint 4 (to the extent that values have been provided) defined in Table 1 and in accordance with the methodology in Paragraph 1.b..

c. DwellTime, expressed in minutes, is the sum of all Dwell Times corresponding to Dwell Time Triggers, between and including an Output of 0 MW and the Generator Unit's Availability; and

d. TPD is the Trading Period Duration expressed in hours.

3. For Generator Units that are Pumped Storage Units operating in pumping mode, no ramp restrictions are applied.

4. For Demand Side Units the value, expressed in MW per Trading Period, is the value of Maximum Ramp-Up Rate defined in Table 1 multiplied by 60 x TPD.

5. For Interconnector Units the value, expressed in MW per Trading Period, is 99999.9 x 60 x TPD.

Where for the avoidance of doubt, Soak Times are not used in this calculation while the values of Availability and Minimum Stable Generations for each MSP Software Run Type are as defined in paragraphs N.7, N.9, N.13A1, and N.14A as applicable.

N.21B Each Price Maker Generator Unit is to be represented in the MSP Software as having a single Ramp Rate that limits the rate at which Generating Unit average MW Output can decrease from one Trading Period to the next with a value determined as follows:

1. For Generator Units that are not Demand Side Units, Pumped Storage Units, or Interconnector Units the value, expressed in MW per Trading Period, equals:

$$\left(\frac{OutputRange}{RampTime + DwellTime} \right) \times 60 \times TPD$$

Where

a. OutputRange, expressed in MW, is the maximum value of Availability over the Optimisation Time Horizon less the minimum value of Minimum;

b. RampTime, expressed in minutes, is the minimum time it would take that Generator Unit to decrease its instantaneous Output from its Availability to its Minimum Stable Generation calculated using Ramp Down Rate 1 to Ramp Down Rate 5 (to the extent values have been provided) and Ramp Down Breakpoint 1 to Ramp Down Breakpoint 4 (to the extent that values have been provided) defined in Table 1. In determining RampTime, Ramp Down Rate i applies between a MW Output of Ramp Down Breakpoint i-1 and a MW Output of Ramp Down Breakpoint i, where if there is no defined Ramp Down Breakpoint i-1 then Ramp Down Rate i applies for all MW Output levels below Ramp Down Breakpoint i while if there is no defined Ramp Down Breakpoint i then Ramp Down Rate i applies for all MW Output levels above Ramp Down Breakpoint i-1. If there are no Ramp Down Breakpoint values provided then Ramp Down Rate 1 applies for all levels of MW Output. For the avoidance of doubt, if Ramp Down Breakpoint j is the last valid Ramp Down Breakpoint provided (for j increasing from j=1), then no Ramp Down Rate n>j+1 or Ramp Down Breakpoint n>j is to be considered in the calculation of RampTime.

c. DwellTime, expressed in minutes, is the sum of all Dwell Times corresponding to Dwell Time Triggers, between and including the units Minimum Stable Generation and its Availability; and

d. TPD is the Trading Period Duration expressed in hours.

2. For Generator Units that are Pumped Storage Units operating in generation mode the value, expressed in MW per Trading Period, equals:

$$\left(\frac{Availability}{RampTime + DwellTime}\right) \times 60 \times TPD$$

Where

e. Availability is the Availability of the Generator Unit;

f. RampTime, expressed in minutes, is the minimum time it would take that Generator Unit to decrease its instantaneous Output from its Availability to 0 MW calculated using Ramp Down Rate 1 to Ramp Down Rate 5 (to the extent values have been provided) and Ramp Down Breakpoint 1 to Ramp Down Breakpoint 4 (to the extent that values have been provided) defined in Table 1 and in accordance with the methodology in Paragraph 1.b..

g. DwellTime, expressed in minutes, is the sum of all Dwell Times corresponding to Dwell Time Triggers, between and including an Output of 0 MW and the Generator Unit's Availability; and

h. TPD is the Trading Period Duration expressed in hours.

3. For Generator Units that are Pumped Storage Units operating in pumping mode, no ramp restrictions are applied.

4. For Demand Side Units the value, expressed in MW per Trading Period, is the value of Maximum Ramp-Down Rate defined in Table 1 multiplied by 60 x TPD.

5. For Interconnector Units the value, expressed in MW per Trading Period, is 99999.9 x 60 x TPD.

Where for the avoidance of doubt, Soak Times are not used in this calculation while the values of Availability and Minimum Stable Generations for each MSP Software Run Type are as defined in paragraphs N.7, N.9, N.13A1, and N.14A as applicable.

N.21C Each Interconnector is to have a single Ramp Rate, expressed in MW per Trading Period, set equal to the Aggregate Interconnector Ramp Rate that applies both for increasing and decreasing the sum of Interconnector Unit schedules. In Table 1 this is represented by the Maximum Ramp-Up Rate and the Maximum Ramp-Down Rate, these having the same value, for each Interconnector.

N.21D The value of the Energy Limit of an Energy Limited Generator Unit for the Ending Optimisation Overlap Period will be the Energy Limit applicable for the Trading Day multiplied by the factor submitted in its Technical Offer Data.

N.21E The value of the End of Day Reservoir Target for a Pumped storage Reservoir for the Ending Optimisation Overlap Period will be the End of Day Reservoir Target applicable for the Trading Day multiplied by the factor submitted with the Pumped Storage Unit Technical Offer Data.

N.21F The value of the Pumped Storage Cycle Efficiency factor for a Generator Unit that is a Pumped Storage Unit in the Ending Optimisation Overlap Period will be value applicable for the Trading Day submitted in its Technical Offer Data.

Processing of Price-Quantity pairs and Tie-Breaking in the MSP Software

N.21G Subject to paragraph N.21H, the Price Quantity Pairs are to be used in each MSP Software run as follows:

1. For an Interconnector Unit the relevant Price Quantity Pairs for each Trading Period in the Optimisation Time Horizon are to apply only over the range from the Minimum Stable Generation to the Availability in Trading Period h, where for each Trading Period h in the Optimisation Time Horizon:

    a. the price of the first Price Quantity Pair to have a quantity exceeding the Minimum Stable Generation is to apply between the Minimum Stable Generation and that quantity;

    b. the price of the last Price Quantity Pair to have a quantity less than the Availability is to apply between that quantity and the Availability;

    Where the relevant Price Quantity Pairs for Trading Period h in the Trading Day are the Price Quantity Pairs in Commercial Offer Data for that Interconnector Unit and Trading Period, as modified in accordance with paragraph N.21H, while the relevant Price Quantity Pairs for Trading Period h in the Ending Optimisation Overlap Period are the corresponding Price Quantity Pairs for that same Interconnector Unit and Trading Period h in the Trading Day.

2. For Price Maker Generator Units other than Interconnector Units and Pumped Storage Units the relevant Price Quantity Pairs for each Trading Period in the Optimisation Time Horizon are to apply only over the range from zero MW to the Availability in Trading Period h, where for each Trading Period h in the Optimisation Time Horizon:

    a. the price of the first Price Quantity Pair to have a quantity exceeding zero is to apply between zero and that Quantity;

    b. the price of the last Price Quantity Pair to have a quantity less than the Availability is to apply between that quantity and the Availability;

    Where the relevant Price Quantity Pairs for each Trading Period h in the Optimisation Time Horizon are to be the Price Quantity Pairs in Commercial Offer Data for that Generating Unit for the Trading Day, as modified in accordance with paragraph N.21H.

Where for the avoidance of doubt, the values of Availability and Minimum Stable Generations for each MSP Software Run Type are as defined in paragraphs N.7, N.9, N.13A1, and N.14A as applicable.

N.21H For the purpose of determining Market Schedule Quantities, Shadow Prices and System Marginal Price, if two or more Price Quantity Pairs in Commercial Offer Data for the Trading Day (for Generator Units other than Interconnector Units) or for a Trading Period (for Generator Units that are Interconnector Units) have the same price then the price for each of those Price Quantity Pairs is to be modified as follows:

1. For a Generator Unit with Priority Dispatch the price is to be reduced by a random value between zero and one, multiplied by the Tie-Breaking Adder;

2. For a Generator Unit without Priority Dispatch (including Interconnector Units) the price is to be increased by a random value between zero and one, multiplied by the Tie-Breaking Adder;

Where the Tie-Breaking Adder is to be proposed by the SMO and approved by the Regulatory Authorities.

OPERATION OF THE MSP SOFTWARE

N.22 All aspects of the MSP Software are operated for one Optimisation Time Horizon at a time. Calculated values are only required to be published for the first Trading Day within the Optimisation Time Horizon, and any calculated values that extend beyond this period (i.e. into the Ending Optimisation Overlap Period) are not published.

N.23 For each Trading Period h of the Trading Day, the MSP Software will calculate the profile of System Marginal Prices (SMPh) and the Market Schedule Quantities for each Price Maker Generator Unit as follows:

Step 1

Determine the Unit Commitment Schedule for each Price Maker Generator Unit, including for Pumped Storage Units whether or not they are pumping or generating, in each Trading Period in the Optimisation Time Horizon;

Step 2

Taking the Unit Commitment Schedule for each Price Maker Generator Unit u as an input and thereby treating Start Up Costs and No Load Costs as invariant, determine for each Trading Period h the Shadow Price (SPh) values and the Market Schedule Quantity (MSQuh) values for each Price Maker Generator Unit u in the Optimisation Time Horizon;

Step 3

Calculate the Uplift (UPLIFTh) element of System Marginal Price for each Trading Period h in the first Trading Day of the Optimisation Time Horizon, as set out in paragraphs N.25 to N.38 below; and

Step 4

Calculate System Marginal Price (SMPh) for each Trading Period h in the first Trading Day of the Optimisation Time Horizon as follows:

SMPh = Max(Market Price Floor, Min(Market Price Cap, SPh+UPLIFTh))

Where

1. SPh is the Shadow Price for Trading Period h
2. UPLIFTh is the Shadow Price for Trading Period h
3. Market Price Floor is the minimum price in the market.
4. Market Price Cap is the maximum price in the market
5. Max(a,b) means the greater of the values of a and b where a and b may be positive or negative.

6. Min(a,b) means the lesser of the values of a and b where a and b may be positive or negative.

N.23A The Unit Commitment Schedule has the following features:

1. It is formulated to determine a unit commitment schedule and energy schedule for each Price Maker Generator Unit, including Demand Side Units and Interconnector Units, so as to determine the minimum value of the mathematical function comprising the sum of:

   a. the total production cost incurred over the Optimisation Time Horizon; and

   b. the cost of violating any constraint where no feasible solution would otherwise exist as described in 4.

2. Unit Commitment constraints are formed from Technical Offer Data, where applicable, for Generator Units so as, subject to 4 and 5, to:

   a. enforcing the Maximum On-Time, being the maximum number of contiguous Trading Periods that each Generator Unit can operate relative to the Trading Period in which it starts (where that Trading Period can be in a prior Trading Day as determined by a prior SMP Software Run). For Interconnector Units this limit is set to a value which will impose no restrictions on the Market Schedule Quantity of the Generator Unit;

   b. enforcing the Minimum On-Time, being the minimum number of contiguous Trading Periods that each Generator Unit must operate relative to the Trading Period in which it starts (where that Trading Period can be in a prior Trading Day as determined by a prior SMP Software Run). For Interconnector Units this limit is set to a value which will impose no restrictions on the Market Schedule Quantity of the Generator Unit;

   c. enforcing the Minimum Off-Time, being the minimum number of contiguous Trading Periods that a Generator Unit must not operate relative to the Trading Period in which it last stopped (where that Trading Period can be in a prior Trading Day as determined by a prior SMP Software Run). For Interconnector Units this limit is set to a value which will impose no restrictions on the Market Schedule Quantity of the the Generator Unit;

   d in the case of Pumped Storage Units to set the Generator Unit to be committed in either pumping mode or generating mode when committed, where all committed Pumped Storage Units linked to the same reservoir must operate in the same mode. A Pumped Storage Unit must have a schedule of not more than 0 MW when in pumping mode and a schedule of not less than 0 MW when in generating mode. For the avoidance of doubt, a Pumped Storage Unit can simultaneously be committed, have a schedule of 0 MW, and be in either, but not both, of pumping mode or generating mode;

   e ensure that when a Generator Unit is operating that its average Output over the Trading Period is at a level not less than its Minimum Stable Generation and not greater than its Availability;

f in any Trading Period where a Generator Unit starts operating having not been operating, set its Output level to be not more than the greater of its Minimum Stable Generation and the sum of the Block Load corresponding to its Warmth State and half the single Ramp Rate for decreasing output defined in paragraph N.21A. A Block Load value of zero is to be used for Generator Units that are Pumped Storage Units or Interconnector Units;

g when a Generator Unit stops operating having been operating, set its Output level in the last Trading Period prior to it stopping to be not more than its Minimum Stable Generation plus half the single Ramp Rate for decreasing output defined in paragraph N.21B; and

where in implementing the above conditions the relevant data for the Warmth State of the Generator Unit is to be used.

3. Constraints are imposed on the scheduling of energy so as, subject to 4 and 5, to:

a schedule the sum total Output of all Price Maker Generator Units in each Trading Period so as to equal Schedule Demand in that Trading Period;

b respect ramp limits on the maximum amount by which a Generator Unit's Output can change between Trading Periods (including relative to the Generator Unit's Output from the last Trading Period of the previous Trading Day as determined by the Preceding MSP Run);

c respect ramp limits on the maximum amount by which total flow on an Interconnector can change between Trading Periods (including relative to the sum total of the Interconnector Unit flows on that Interconnector from the last Trading Period of the previous Trading Day as determined by the Preceding MSP Run);

d limit the energy scheduled from Energy Limited Generator Units on both the Trading Day and (separately) in the Ending Optimisation Overlap Period to not exceed the energy limit quantity over the relevant period;

e maintain the energy (in MWh) within each Pumped Storage Reservoir to be not less than its Minimum Reservoir Level and not more than its Maximum Reservoir Level;

f maintain the energy (in MWh) within each Pumped Storage Reservoir to respect Pumped Storage Reservoir Target Levels, which define a Minimum Reservoir Level, for each of the final Trading Period of the Trading Day and a different limit for the final Trading Period of the Optimisation Time Horizon;

g reflect the relationship whereby the generation of each 1 MWh from a Generator Unit that is a Pumped Storage Unit in generating mode lowers its associated reservoir by 1 MWh while the pumping of each 1 MWh from a Generator Unit that is a Pumped Storage Unit in pumping mode raises the associated reservoir by a number of MWh equal to the Pumped Storage Cycle Efficiency factor applicable to the Optimisation Time Horizon for that Pumped Storage Unit.

4. The SMP Software includes variables which allow constraint limits to be violated at a high cost if no feasible solution would otherwise exist. The costs associated with such variables are to be proposed by the SMO and approved by the Regulatory Authorities.

5. The SMP Software may modify conflicting input data to resolve the conflict in accordance with paragraph N.41. .

6. No Transmission Loss Adjustment Factors (TLAFs) are considered or applied in determining the Unit Commitment Schedule.

N.23B The Economic Dispatch has the following features:

1. It is formulated to determine Market Schedule Quantities (expressed in MW) for each Price Maker Generator Unit, including Demand Side Units and Interconnector Units, and shadow prices for each Trading Period, so as to determine the minimum value of the mathematical function comprising the sum of:

   a. the sum over all Trading Periods in the Optimisation Time Horizon and all Generator Unit price-quantity pairs of the product of the price of the price-quantity pair applicable in that Trading Period and the energy scheduled from that price-quantity pair for that Trading Period.

   b. the cost of violating any constraint where no feasible solution would otherwise exist as described in 3.

2. Constraints based on the Unit Commitment solution are imposed on Market Schedule Quantities so as, subject to 4 and 5, to:

   a. set Generator Units to a Market Schedule Quantity of 0 MW in Trading Periods where the Generator Unit is not operating.

   b. set Pumped Storage Units that are operating to have an Output not less than 0 MW if the Pumped Storage Unit is committed and in generating mode.

   c. set Pumped Storage Units that are operating to have an Output not more than 0 MW if the Pumped Storage Unit is committed and in pumping mode.

   d. ensure that when a Generator Unit is operating that its Output is at a level not less than its Minimum Stable Generation and not greater than its Availability;

   f in a Trading Period where a Generator Unit starts operating, ensure that its Output is not greater than the maximum Output level allowed for that Trading Period in the unit commitment schedule; and

   g in a Trading Period where a Generator Unit stops operating, ensure that its Output is not greater than the maximum Output level allowed for that Trading Period in the unit commitment.

3. Constraints are imposed on the Market Schedule Quantities so as, subject to 4 and 5, to:

   a schedule the total Output of Price Maker Generator Units in each Trading Period so as to equal Schedule Demand in that Trading Period;

b respect ramp limits on the maximum amount by which a Generator Unit's Output can change between Trading Periods (including relative to the Generator Unit's Output from the last Trading Period of the previous Trading Day as determined by the Preceding MSP Run);

c respect ramp limits on the maximum amount by which total flow on an Interconnector can change between Trading Periods (including relative to the sum total of the Interconnector Unit flows on that Interconnector from the last Trading Period of the previous Trading Day as determined by the Preceding MSP Run);

d limit the energy scheduled from Energy Limited Generator Units on both the Trading Day and (separately) in the Ending Optimisation Overlap Period to not exceed the energy limit quantity over the relevant period;

e maintain the energy (in MWh) within each Pumped Storage Reservoir to be not less than its Minimum Reservoir Level and not more than its Maximum Reservoir Level;

f maintain the energy (in MWh) within each Pumped Storage Reservoir to respect Pumped Storage Reservoir Target Levels, which define a Minimum Reservoir Level, for each of the final Trading Period of the Trading Day and a different limit for the final Trading Period of the Optimisation Time Horizon;

g reflect the relationship whereby the generation of each 1 MWh from a Generator Unit that is a Pumped Storage Unit in generating mode lowers its associated reservoir by 1 MWh while the pumping of each 1 MWh from a Generator Unit that is a Pumped Storage Unit in pumping mode raises the associated reservoir by a number of MWh equal to the Pumped Storage Cycle Efficiency factor applicable to the Optimisation Time Horizon for that Pumped Storage Unit.

4. The SMP Software includes variables which allow constraint limits to be violated at a high cost if no feasible solution would otherwise exist. The costs associated with such variables are to be proposed by the SMO and approved by the Regulatory Authorities.

5. The SMP Software may modify conflicting input data to resolve the conflict in accordance with paragraph N.41. .

6. The SMP Software must determine a Shadow Price (SPh) for each Trading Period in the Optimisation Time Horizon that:

a. is not to exceed the lesser of the Market Price Cap and the €/MWh rate of increase in the minimum value of the mathematical function defined in paragraph 1 that would occur were Schedule Demand in that Trading Period increased by an infinitesimally small amount while obeying all Economic Dispatch limitations on the Market Schedule Quantities;

b. is not to be less than greater of the Market Price Floor and the €/MWh rate of decrease in the minimum value of the mathematical function defined in paragraph 1 that would occur were Schedule Demand in that Trading Period decreased by an infinitesimally small amount while obeying all Economic Dispatch limitations on the Market Schedule Quantities;

7. No Transmission Loss Adjustment Factors (TLAFs) are considered or applied in determining the Economic Dispatch.

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N.24A The calculation of Uplift in this Appendix is based only on data associated with relevant Generating Units, where the set of relevant Generating Units includes all Generating Units except:

7. Autonomous Generating Units
8. Generating Units that are Price Takers
9. Interconnector Units;
10. Interconnector Error Units;
11. Pumped Storage Units;
12. Netting Generator Units; and
13. Supplier Units.

CALCULATION OF UPLIFT

N.25 Within this Appendix N and not elsewhere, the following terms apply:

1. subscript k denotes a Contiguous Operation Period;
2. TPCOUNTt is the number of Trading Periods that are within the first Trading Day t of the Optimisation Time Horizon;
3. UKSTARTuk is the sequential number of the Trading Period (where 1 is the first Trading Period in the Optimisation Time Horizon) in which the Contiguous Operation Period k for Generator Unit u commences, provided that the Contiguous Operation Period starts within the first Trading Day of the Optimisation Time Horizon, such that $1 \leq UKSTARTuk \leq TPCOUNTt$; if the Contiguous Operation Period does not commence within the first Trading Day t of the Optimisation Time Horizon under consideration then UKSTARTuk is neither defined nor required;
4. UKSTOPuk is the sequential number of the Trading Period (where 1 is the first Trading Period in the Optimisation Time Horizon) in which the Contiguous Operation Period ends, or, if the Contiguous Operation Period does not end during the Optimisation Time Horizon the last Trading Period in the Optimisation Time Horizon; if the Contiguous Operation Period does not commence within or prior to the Optimisation Time Horizon under consideration then UKSTOPuk is neither defined nor required;
5. STCukht is the Start Cost incurred for Contiguous Operation Period k for Generator Unit u that is allocated to Trading Period h within that part of Contiguous Operation Period k in the first Trading Day t of the relevant Optimisation Time Horizon;
6. CFCRukt is the Carried Forward Cost Recovery for Generator Unit u in Contiguous Operation Period k from the first Trading Day t to the next;
7. CRukt is the Cost of Running for each Price Maker Generator Unit u in that part of Contiguous Operation Period k which falls in the first Trading Day t of the relevant Optimisation Time Horizon;

8. MINUPLh is the value of INUPLh for Trading Period h that solves the problem described in Step 1 of paragraph N.37 for Trading Day t;

9. REVMINt is the minimum value of energy payments to relevant Generator Units in Trading Day t that satisfies the relevant constraints, as calculated in paragraph N.37 below.

Procedure to calculate Cost Recovery values

N.26 The procedure to calculate the Cost of Running to be used as the basis for cost recovery is set out below. Each of these calculations is made independently for each Optimisation Time Horizon.

N.27 Paragraphs N.29 to N.35 apply exclusively to the relevant Generator Units as defined in paragraph N.24A.

N.28 The calculation of the Cost of Running (CRukt) for each Generator Unit u which is not a relevant Generator Unit as defined in paragraph N.24A is set out in paragraph N.36, and values of Carried Forward Cost Recovery (CFCRukt) and Start Cost (STCukt) for these other Generator Units are neither calculated nor required.

Calculating start costs to be carried forward

Unit starts and stops within the first Trading Day or started in the previous Trading Day

N.29 For an Optimisation Time Horizon, all values of Carried Forward Cost Recovery (CFCRukt) for Generator Units u in Contiguous Operation Period k other than those which start within the first Trading Day and then continue to the second Trading Day of the relevant Optimisation Time Horizon are equal to zero.

Unit starts in the first Trading Day and continues into the Second Trading Day

N.30 For an Optimisation Time Horizon, when a Contiguous Operation Period starts within the first Trading Day and continues beyond the end of that Trading Day, a portion of the Start Up Costs will be allocated to the Trading Day in which the Contiguous Operation Period began and the remainder will be allocated to the next Trading Day, as follows. For each relevant Generator Unit u, for each Contiguous Operation Period k that starts within the first Trading Day of the relevant Optimisation Time Horizon and continues to the second Trading Day within that Optimisation Time Horizon, values of Carried Forward Cost Recovery (CFCRukt) from the first Trading Day t to the next shall be as follows:

$$CFCRukt = MSCuk \times \left(\frac{UKSTOPuk - TPCOUNTt}{UKSTOPuk - UKSTARTuk + 1} \right)$$

Where

1. MSCuk is the Market Start Up Cost for Generator Unit u applicable to Contiguous Operation Period k.

2. TPCOUNTt, UKSTARTuk and UKSTOPuk are as defined in paragraph N.25 above

Calculating start costs to be recovered within each Trading Period

Unit starts and stops in the first Trading Day

N.31 For each relevant Generator Unit u and for each Trading Period h within each Contiguous Operation Period k that both starts and ends within the first Trading Day t of the relevant Optimisation Time Horizon, values of Start Cost (STCukht) are calculated as follows:

For Trading Period h between UKSTARTuk and UKSTOPuk inclusive:

$$STCukht = MSCuk \times \left(\frac{SPh \times MSQuh \times TPD}{\sum_{h=UKSTARTuk}^{UKSTOPuk} (SPh \times MSQuh \times TPD)} \right)$$

Otherwise STCukht = 0.

Where

1. MSCuk is defined as in paragraph N.30 above.
2. SPh is the Shadow Price in Trading Period h determined by the MSP Software.
3. MSQuh is the Market Schedule Quantity in Trading Period h for Generator Unit u determined by the MSP Software
4. TPD is the Trading Period Duration expressed in hours
5. UKSTARTuk and UKSTOPuk are as defined in paragraph N.25 above.
6. $\sum_{h=UKSTARTuk}^{UKSTOPuk}$ is a summation over all Trading Periods h between UKSTARTuk and UKSTOPuk inclusive.

Unit starts in the first Trading Day and continues to the second Trading Day

N.32 For each relevant Generator Unit u, for each Contiguous Operation Period k that starts within the first Trading Day t of the relevant Optimisation Time Horizon and continues to the second Trading Day of that Optimisation Time Horizon, values of Start Cost (STCukht) to be recovered for each Trading Period h within that part of Contiguous Operation Period k in Trading Day t are calculated as follows:

For Trading Period h between UKSTARTuk and TPCOUNTt inclusive:

$$STCukht = \left(MSCuk - CFCRukt\right) \times \left(\frac{SPh \times MSQuh \times TPD}{\sum_{h=UKSTARTuk}^{TPCOUNTt} \left(SPh \times MSQuh \times TPD\right)} \right)$$

Otherwise STCukht = 0.

Where

1. MSCuk and CFCRukt are defined as in paragraph N.30 above.
2. SPh is the Shadow Price in Trading Period h determined by the MSP Software.
3. MSQuh is the Market Schedule Quantity in Trading Period h for Generator Unit u determined by the MSP Software
4. TPD is the Trading Period Duration expressed in hours
5. UKSTARTuk and TPCOUNTt are as defined in paragraph N.25 above.
6. $\sum_{h=UKSTARTuk}^{TPCOUNTt}$ is a summation over all Trading Periods h between UKSTARTuk and TPCOUNTt inclusive.

Unit started in the previous Trading Day

N.33 For each relevant Generator Unit u, for each Contiguous Operation Period k that starts in Trading Day (t-1) immediately before the first Trading Day t of the relevant Optimisation Time Horizon and continues to the first Trading Day t in that Optimisation Time Horizon, values of Start Cost (STCukht) to be recovered for each Trading Period h within that part of Contiguous Operation Period k which falls within Trading Day t are calculated as follows:

$$STCukt = CFCRuk(t-1)$$

For Trading Period h between one and the lesser of UKSTOPuk and TPCOUNTt inclusive:

$$STCukht = CFCRuk(t-1) \times \left(\frac{SPh \times MSQuh \times TPD}{\sum_{h=1}^{Min(UKSTOPuk, TPCOUNTt)} \left(SPh \times MSQuh \times TPD\right)} \right)$$

Otherwise STCukht = 0.

Where

1. CFCRuk(t-1) has the same definition as CFCRukt as defined in paragraph N.30 except that CFCRuk(t-1) is the value determined for the last start k of relevant Generator Unit u in Trading Day t-1 immediately prior to Trading Day t.

2. MSUCuk is defined as in paragraph N.30 above.

3. SPh is the Shadow Price in Trading Period h determined by the MSP Software.

4. MSQuh is the Market Schedule Quantity in Trading Period h for Generator Unit u determined by the MSP Software

5. TPD is the Trading Period Duration expressed in hours

6. UKSTOPuk and TPCOUNTt are as defined in paragraph N.25 above.

7. $\sum_{h=1}^{Min(UKSTOPuk,TPCOUNTt)}$ is a summation over all Trading Periods h between one and the lesser of UKSTOPuk and TPCOUNTt inclusive.

Unit started before the previous Trading Day

N.34 For an Optimisation Time Horizon, all values of Start Cost (STCukht) for Generator Units in Contiguous Operation Periods k that start earlier than one Trading Day before the start of the relevant Optimisation Time Horizon are equal to zero.

Cost of running

N.35 The Cost of Running (CRukht) for each Price Maker Generator Unit u for Trading Period h in that part of Contiguous Operation Period k which falls in the first Trading Day t of the relevant Optimisation Time Horizon is calculated as follows:

$$CRukt = \sum_{h=UKSTARTuk}^{Min(UKSTOPuk,TPCOUNTt)} \left(\left(BC(MSQuh) + MNLCuh \right) \times TPD + STCukht \right)$$

Where

1. BC(MSQuh) is sum over all Price-Quantity pairs for Generator Unit u in Trading Period h of the average megawatt quantity scheduled from that Price-Quantity Pair multiplied by the price associated with that Price-Quantity Pair. Price-Quantity Pairs are assumed to be scheduled in increasing order of bid price with the sum total quantities scheduled equalling MSQuh.

2. MSQuh is the Market Schedule Quantity in Trading Period h for Generator Unit u determined by the MSP Software

3. MNLCuh is the Market No Load Cost for Generator Unit u, expressed as cost per hour, incurred in Trading Period h

4. TPD is the Trading Period Duration expressed in hours

5. STCukht is as defined in paragraphs N.31 to N.34 as applicable.

6. UKSTARTuk, UKSTOPuk and TPCOUNTt are as defined in paragraph N.25 above.

7. $\sum_{h=UKSTARTuk}^{Min(UKSTOPuk,TPCOUNTt)}$ is the summation over all Trading Periods h between UKSTARTuk and the lesser of UKSTOPuk and TPCOUNTt.

N.36 All values of Cost of Running (CRukt) for each Generator Unit that is not a relevant Generator Unit as defined in paragraph N.24A are equal to zero.

Procedure to calculate Minimum Revenue value

N.37 The Minimum Revenue (REVMINt) for the Trading Day is used to define a constraint on the derivation of Uplift values (UPLIFTh), and is calculated as follows. For each Optimisation Time Horizon, the procedure to calculate the Minimum Revenue (REVMINt) for the first Trading Day t in that Optimisation Time Horizon is set out below, where within this procedure, the following meanings apply:

1. REVMINt is the value defined in Step 2 of this paragraph N.37.
2. INUPLh is a variable describing the potential values of Uplift for each Trading Period h that satisfy the relevant constraints.
3. OINUPLh is Optimised Initial Uplift for each Trading Period .
4. SPh is the Shadow Price in Trading Period h determined by the MSP Software.
5. MSQuh is the Market Schedule Quantity in Trading Period h for Generator Unit u determined by the MSP Software
6. TPD is the Trading Period Duration expressed in hours
7. CRukt is the Cost of Running for Generator Unit u in that part of Contiguous Operation Period k which falls in the first Trading Day t of the relevant Optimisation Time Horizon. The general form of CRukt is as given in paragraph N.35.
8. $\sum_{u}$ is a sum over all Pricing Making Generator Units u excluding Pumped Storage Units and Interconnector Units.
9. $\sum_{hink}$ is a sum over each Trading Period h in Trading Day t
10. $\sum_{hink}$ is a sum over each Trading Period h in that part of Contiguous Operation Period k within Trading Day t

The procedure is as follows:

Step 1

Determine the set of values INUPLh for each Trading Period h in Trading Day d which give the minimum value of

$$\sum_{u}\sum_{hint}\left((INUPLh + SPh)\times MSQuh \times TPD\right),$$

Subject to that set of values of INUPLh satisfying the following constraints:

1. $\sum_{hink}\left(\left(INUPLh + SPh\right)\times MSQuh \times TPD\right) - CRukt \geq 0$ for each Price Maker Generator Unit u, excluding Pumped Storage Units and Interconnector Units, for those Trading Periods h in that part of Contiguous Operation Period k that falls, partly or wholly, within the relevant Trading Day t ; and
2. $INUPLh \geq 0$ for all Trading Periods h in Trading Day t.

Let OINUPLh for each Trading Period h be the values of INUPLh that solve the above problem.

Step 2

Using the set of Optimised Initial Uplift (OINUPLh) values from Step 1 above, the minimum value of energy payments (REVMINt) to relevant Generator Units u in Trading Day t is calculated as follows:

$$REVMINt = \sum_{u} \sum_{h in k} \left((OINUPLh + SPh) \times MSQuh \times TPD \right)$$

Procedure to calculate final Uplift values

N.38 For each Optimisation Time Horizon, the final part of the procedure to calculate the Uplift values (UPLIFTh) for the first Trading Day t in that Optimisation Time Horizon is set out below, where within this procedure, the following meanings apply:

3. UPLIFTh is the value of Uplift for Trading Period h
4. REVMINt is defined as in paragraph N.37 above.
5. SPh is the Shadow Price in Trading Period h determined by the MSP Software.
6. MSQuh is the Market Schedule Quantity in Trading Period h for Generator Unit u determined by the MSP Software
7. TPD is the Trading Period Duration expressed in hours
8. CRukt is the Cost of Running for Generator Unit u in that part of Contiguous Operation Period k which falls in the first Trading Day t of the relevant Optimisation Time Horizon. The general form of CRukt is as given in paragraph N.35.
9. α is the Uplift Alpha value used in the determination of Uplift to encourage the minimisation of the overall cost to the market of all the Uplift terms over the Trading Day t. It has a value of not less than zero;
10. β is the Uplift Beta value used in the determination of Uplift to discourage large values of Uplift in any one Trading Period within Trading Day t. It has a value of not less than zero and is set by the Regulatory Authorities;
11. δ is the Uplift Delta value used in the determination of Uplift to restrict the overall increase in the cost to the market due to Uplift over the Trading Day t. It has a value of not less than zero and is set by the Regulatory Authorities;
12. $\sum_{hint}$ is a sum over each Trading Period h in Trading Day t

The procedure is as follows:

Minimise:

$$\alpha \times \left[\sum_{hint} \left(\left(UPLIFTh + SPh \right) \times \sum_{u} \left(MSQuh \times TPD \right) \right) \right] + \beta \times \left[\sum_{hint} \left(UPLIFTh \right)^2 \right]$$

by selecting values of UPLIFTh for each Trading Period h in the relevant Trading Day t,

Subject to the following constraints:

1. $\sum_{hink} \left[\left(UPLIFTh + SPh \right) \times MSQuh \times TPD \right] \geq CRukt$ for each Price Maker Generator Unit u excluding Pumped Storage Units and Interconnector Units for that part of Contiguous Operation Period k that falls within the relevant Trading Day t ;
2. $UPLIFTh \geq 0$ for all Trading Periods h in Trading Day t; and
3. $\sum_{u} \sum_{hint} \left(\left(UPLIFTh + SPh \right) \times MSQuh \times TPD \right) \leq \left(1 + \delta \right) \times REVMINt$

N.39 Intentionally blank

RESULTS OF THE MSP SOFTWARE

N.40 The results produced by the MSP Software are for each Trading Period h of the Trading Day that are to be made available for other market processes are:

1. the Market Schedule Quantity in MW for each Generator Unit;
2. the SMP price for that Trading Period ;
3. Interconnector User Nominations (for Ex Ante Indicative SMP Software Runs);

N.41 If Technical Capabilities applying to a Generator Unit within a run of the MSP Software are internally inconsistent so as to allow no possible solution for that Generator Unit, then the MSP Software may disregard one or more Technical Capability limits as required to allow a solution to be found for that Generator Unit subject to the limits that:

1. the Generator Unit is not scheduled to operate at a level in excess of the greatest availability implied by any of the inconsistent Technical Capability limits, or zero where no such limit can be implied;
2. the Generator Unit is not scheduled to operate at a level less than the lowest level implied by the lowest allowable level implied by any of the inconsistent Technical Capability limits, or zero where no such limit can be implied;
3. the Generator Unit does not operator for a period of time beyond the greatest operating time limit implied by any of the inconsistent Technical Capability limits; and
4. if Availability less than its Minimum Stable Generation then Availability is reset to equal Minimum Stable Generation;