Payment Mechanic

Mathematical Calculations

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Electricity Distribution

nationalgrid

Payment Mechanic – Mathematical Calculations

DEFINITIONS AND INTERPRETATION

This document provides the detailed mathematical calculations adopted by National Grid for the calculation of payments in respect of its distribution flexibility products. It has been developed in line with the ENA Standard Agreement for flexibility Services and terms shall be defined and interpreted in accordance, unless the context otherwise requires or such terms are defined below:

"Arming Fee" has the meaning given in to it in 1.2 below;

"Arming Payment" means any payment calculated in accordance with 2.1.1 below;

"Arming Settlement Period" means each full thirty (30) minute period within an Accepted Arming Window, as described in 1.0 below;

"Availability Fee" has the meaning given in to it in 1.3(d) below; **[NOTE: THIS DEFINITION REPLACES THE DEFINITION OF AVAILABILITY FEE IN CLAUSE 1 OF THE STANDARD AGREEMENT]**

"Availability Payment" means any payment calculated in accordance with 2.2.1 below;

"Availability Settlement Period" means each full thirty (30) minute period within an Accepted Availability Window, as described in 1.2 below;

"Constraint Event Delivery Proportion" has the meaning given to it in 2.5.3 below;

"Delivery Proportion" has the meaning given to it in 2.4.2 in respect of the Company's Dynamic Services and/or the Company's Secure Services, and/or in 3.4 in respect of the Company's Restore Services below;

"Delivery Target Threshold" has the meaning given to it in 3.3;

"Event Delivery Proportion" has the meaning given to it in 2.5.3 below;

"Grace Factor" has the meaning given to it in 2.4.1;

"Monthly Delivery Proportion" has the meaning given to it in 2.5.2 below;

"Payable Overdelivery" means the % of overpayment above 100% that will be available in respect of Utilisation Payments for the Company's Restore Services as set out in 3.3;

"Payment Proportion" means the value calculated in accordance with 2.4.4 in respect of the Company's Dynamic Services and/or the Company's Secure Services, and/or in 3.6 in respect of the Company's Restore Services below;

"Penalisation Multiplier" has the meaning given to it in 2.0 in respect of the Company's Dynamic Services and/or the Company's Secure Services, and/or in Paragraph 3.5 in respect of the Company's Restore Services below;

"Reconciliation Grace Factor" has the meaning given to it in 2.5.4 below;

"Utilisation Cost" has the meaning given to it in 1.3 below;

"Utilisation Payment" means any payment in respect of the Company's Dynamic Services and/or the Company's Secure Services calculated in accordance with 2.3 of this below, and/or any payment in respect of the Company's Restore Services calculated in accordance with 3.1 below;

"Utilisation Settlement Period" means each full one (1) minute period during a Utilisation event, as described in 1.0 below, with the first Utilisation Settlement Period for the Company's Dynamic Services and/or the Company's Secure Services being the minute in which the Response Time ends, and the first Utilisation Settlement Period for the Company's Restore Services being the first full minute after despatch of Demand Response, or the issue of a Utilisation Instruction, by the Company.

1 GENERAL

1.1 For the Company's Dynamic Services, there are two primary payments: Utilisation Payments and Availability Payments. For the Company's Secure Services, there are two primary payments: Utilisation Payments and Arming Payments. For the Company's Sustain Services, there is one payment: the Utilisation Payment. For the Company's Restore Services, there is one payment: the Utilisation Payment. Utilisation Payments are made when Demand Response is Utilised. Arming Payments are paid for every Accepted Arming Window in respect of the Dispatch Group (*s*). Availability Payments are paid for every Accepted Availability Window in respect of the Dispatch Group (*s*).

1.2 Arming Payments, Availability Payments and Utilisation Payments are calculated at a different granularity called the Arming Settlement Period, the Availability Settlement Period and the Utilisation Settlement Period. The constants used to convert between MWh values and the individual time segments are (SP_u) and (SP_a), which correspond to the fraction of an hour for Utilisation, Availability and Arming. The Utilisation Settlement Period is 1 minute. The Arming Settlement Periods and Availability Settlement Periods are 30 minutes i.e.:

$$SP_u = \frac{1}{60} \text{ and } SP_a = 0.5$$

1.3 In respect of each Dispatch Group there are four constant values:

a) The Contracted Capacity ($\mathbf{CC_s}$), given in MW;

b) A Utilisation Cost ($\mathbf{UC_s}$), which is the payment per MWh delivery by the Dispatch Group during a Utilisation. The Utilisation Cost for each of the Company Dynamic Services,

the Company's Secure Services and/or the Company's Restore Services for each Zone shall be as set out in the relevant Contract Award;

c) An Arming Fee ($\mathbf{AF_s}$), which is the payment for Arming in respect of an Accepted Arming Window at a Dispatch Group (s). This is a payment per MW per hour of Arming. The Arming Fee for a CMZ shall be as set out in the relevant Contract Award;

d) An Availability Fee ($\mathbf{AC_s}$), which is the payment for Availability in respect of an Accepted Availability Window at a Dispatch Group. This is a payment per MW per hour of Availability. The Availability Fee for a CMZ shall be as set out in the relevant Contract Award.

1.4 Payments are calculated on a month-by-month basis. The calculations in this Schedule 2 determine the Utilisation Payments, the Availability Payments and the Arming Payments due to a Dispatch Group for a given month.

1.5 For the Company's Dynamic Services and the Company's Secure Services, for each month, (m), there is a list of Arming Windows or Availability Windows (as appropriate) and a list of constraint events, which are written as (AW_m) and (E_m) for Arming of the Company's Secure Services and (AP_m) and (E_m) for Availability of the Company's Dynamic Services. The top-level calculations will loop through these lists, but the bulk of the work is performed for an individual Arming Window or Availability Window and an individual constraint event.

2 THE COMPANY'S SUSTAIN SERVICES, THE COMPANY'S SECURE SERVICES AND THE COMPANY'S DYNAMIC SERVICES

2.1 THE COMPANY'S SECURE SERVICES ARMING PAYMENT

2.11.1 Arming Payments for an Accepted Arming Window are determined as the sum for all Arming Settlement Periods in that Contracted Arming Window, based on binary values for if Demand Response is Available during each Arming Settlement Period.

2.1.2 ST_{aw} and FT_{aw} are written for the start and finish time of the given Accepted Arming Window.

2.1.3 The raw Arming Payment given to a Dispatch Group for an Accepted Arming Window is as follows:

Where the Arming Fee is a payment per MW per hour:

$$AWP_{aw,s} = \left(\sum_{j=ST_{aw}}^{FT_{aw}} AF_{s,aw} \,.\, SP_{aw} \,.\, CC_s \,.\, SA_{s,j} \right)$$

Where:

$AWP_{aw,s}$ is the Arming Payment for the Dispatch Group (s) during an Accepted Arming Window (*aw*)

$\sum_{j=ST_{aw}}^{FT_{aw}}$ sums the payment for every Arming Settlement Period in the Accepted Arming Window, from start to finish time inclusive

AF_s is the Arming Fee for that Dispatch Group and Accepted Arming Window on a per MW per hour basis

SP_{aw} is the Arming Settlement Period

CC_s is the Contracted Capacity

$SA_{s,j}$ is whether Demand Response is Available for each Arming Settlement Period for the Dispatch Group within an Accepted Arming Window which is supplied as binary data into the system, based on the reporting and the conditions outlined elsewhere in the Agreement

2.2 THE COMPANY'S DYNAMIC SERVICES AVAILABILITY PAYMENT

2.2.1 Availability Payments for an Accepted Availability Window are determined as the sum for all Availability Settlement Periods in that Accepted Availability Window, based on binary values for if Demand Response is Available during each Availability Settlement Period.

2.2.2 ST_{aw} and FT_{aw} are written for the start and finish time of the given Accepted Availability Window.

1.4.2.3 The raw Availability Payment given to a Dispatch Group for an Accepted Availability Window is as follows:

Where the Availability Fee is a payment per MW per hour:

$$AP_{s,w} = (\sum_{j=ST_w}^{FT_w} AC_s \,.\, SP_a \,.\, CC_s \,.\, SA_{s,j})$$

Where:

$AP_{s,w}$ is the Availability Payment for Dispatch Group (s) during an Accepted Availability Window *(w*)

$\sum_{j=ST_w}^{FT_w}$ sums the payment for every Availability Settlement Period in the Accepted Availability Window, from start to finish time inclusive

$AC_{s,w}$ is the Availability Fee for that Dispatch Group and Accepted Availability Window on a per MW per hour basis

SP_a is the Availability Settlement Period

CC_s is the Contracted Capacity

$SA_{s,j}$ is if Demand Response is Available for each Availability Settlement Period for the dispatch Group within an Accepted Availability Window which is supplied as binary data into the system, based on the reporting and the conditions outlined elsewhere in the Agreement

2.3 UTILISATION PAYMENT

2.3.1 For a Dispatch Group (s), Utilisation Payments for the Company's Sustain Services, the Company's Dynamic Services and the Company's Secure Services are calculated per-constraint Utilisation event (e). Each constraint Utilisation event has a start time (ST_e) and a finish time (FT_e), such that $ST_e < FT_e$.

2.3.2 The Utilisation Payment for a Dispatch Group (s) per constraint Utilisation event *(e)* is calculated as follows:

$$U_{s,e} = \sum_{j=ST_e}^{FT_e} CC_s \,.\, UC_s \,.\, SP_u \,.\, PP(CC_s, AD_{s,j})$$

Where:

$U_{s,e}$ is the Utilisation Payment for Dispatch Group (s) during each constraint Utilisation event (e)

$\sum_{j=ST_e}^{FT_e}$ sum of the Utilisation Settlement Periods during the constraint Utilisation event,

CC_s	Contracted Capacity
UC_s	Utilisation Cost
SP_u	Utilisation Settlement Period of the Dispatch Group, as defined above
$AD_{s,j}$	is the actual, metered MW delivery of the Dispatch Group (s) for each Utilisation Settlement Period during the constraint Utilisation event (j). In the payment calculations, there is no difference between Generator Sites and Demand reduction Sites, since this value is the 'reported to grid' value
PP	is the Payment Proportion and works out what fraction of the full price is due to the Dispatch Group for every Utilisation Settlement Period based on the Contracted Capacity and the actual delivery.

2.4 PAYMENT PROPORTION

2.4.1 A margin of error, known as the Grace Factor (GF) is allowed in respect of under-delivery of the Contracted Capacity (CC) at a Dispatch Group. Delivery of equal to or greater than the required level of Contracted Capacity less the applicable Grace Factor is awarded the full Utilisation Payment. A deduction from the full payment will be made for delivery of less than the required level of Contracted Capacity less the applicable Grace Factor.

2.4.2 The Delivery Proportion ($DP_{s,j}$) is defined as the ratio of actual MW delivery to Contracted Capacity. This ratio is a value that represents a percentage and rounded to two significant figures to ensure it represents a whole percentage.

2.4.3 The Grace Factor determines the acceptable under-delivery for a Dispatch Group. For every % point under that level, called the Penalisation Multiplier, (PM) of the full payment is deducted. Over-delivery is capped, and paid at Contracted Capacity.

2.4.4 Thus, the Payment Proportion is a value between 0 and 1 (or 0 and 100%). The calculation contains two separate cases:

1) $if\ DP_{s,j} \geq (1 - GF\ ), PP_{s,j} = 1$

2) $if\ DP_{s,j} < (1 - GF\ ), PP_{s,j} = Max(0,\ 1 - GF\ - PM\ .[1 - GF\ - DP_{s,j}])$

2.5 MONTHLY RECONCILIATION

2.5.1 In addition to the above, the Arming Payments and Availability Payments for a Dispatch Group are subject to a monthly reconciliation based on the Dispatch Group's individual Utilisation performance over the month.

2.5.2 This is calculated as follows: the Monthly Delivery Proportion ($MDP_{s,m}$) for a Dispatch Group for a given month is;

$$MDP_{s,m} = \frac{\sum_{e\ \epsilon\ Em} Min(1, EP_{s,e})}{\#E_m}$$

i.e. the capped proportion of average deliveries in a given month.

Where:

$e\ \epsilon\ E_m$	is the Delivery Proportion during each and every constraint Utilisation event in the set of constraint Utilisation events for the month (m)
$\#E_m$	is the number of constraint Utilisation events in the month
$Min(1, EP_{s,e}\ )$	caps the Delivery Proportion during each and every constraint Utilisation event at 100%, even if the Dispatch Group over-delivers

This Constraint Event Delivery Proportion $EP_{s,e}$ for a Dispatch Group and a Utilisation event is defined below.

2.5.3 In order to define the Constraint Event Delivery Proportion, we first need the Event Delivery Proportion (*EDP*). For each individual constraint Utilisation event the total, uncapped Delivery Proportions for each Utilisation Settlement Period are summed.

$$EDP_{s,e} = (\sum_{j=ST_e}^{FT_e} = DP_{s,j}) / (FT_e - ST_e + 1)$$

2.5.3 As such, the Delivery Proportion for each Utilisation Settlement Period of the constraint Utilisation event is calculated. It is important to note that this is uncapped. This does not apply across constraint Utilisation events in the month, as shown in the $MDP_{s,m}$ calculation.

2.5.4 When calculating the Constraint Event Delivery Proportion, the Event Delivery Proportions are also given a grace factor, called the Reconciliation Grace Factor (RGF). Thus the Constraint Event Delivery Proportion is:

$1)\ if\ 1 \leq EDP_{s,e} + RGF < 1 + RGF, EP_{s,e} = 1$

$2)\ otherwise\ EP_{s,e} = EDP_{s,e}$

2.6 MONTHLY ARMING WINDOW AND AVAILABILITY WINDOW PAYMENTS

The monthly Arming Payment and Availability Payment for a Dispatch Group for a given month is calculated as follows:

$$AP_{s,m} = (\sum_{w \epsilon\ M} AP_{s,w}) \,.\, MDP_{s,m}$$

That is, the total Arming Payments and Availability Payments due for the Dispatch Group for the month multiplied by the Constraint Event Delivery Proportion.

2.7 MONTHLY UTILISATION PAYMENTS

Similarly, the monthly Utilisation Payments due for a given Dispatch Group in a month is calculated as the sum of the individual Utilisation Payments:

$$UP_{s,m} = (\sum_{e \epsilon\ M} UP_{s,e})$$

3 THE COMPANY'S RESTORE SERVICES

3.1 UTILISATION PAYMENT

3.1.1 For a Dispatch Group (s), Utilisation Payments for the Company's Restore Services are calculated per-constraint Utilisation event (e). Each constraint Utilisation event has a start time (ST_e) and a finish time (FT_e), such that $ST_e < FT_e$.

3.1.2 The Utilisation Payment for a Dispatch Group (s) per constraint Utilisation event *(e)* is calculated as follows:

$$U_{s,e} = \sum_{j=ST_e}^{FT_e} CC_s \,.\, UC_s \,.\, SP_u \,.\, PP\ \ (CC_s, AD_{s,j})$$

Where:

$U_{s,e}$	is the Utilisation Payment for Dispatch Group (s) during each constraint Utilisation event (ce)
$\sum_{j=ST_e}^{FT_e}$	sum of the Utilisation Settlement Periods during the constraint Utilisation event
CC_s	Contracted Capacity,
UC_s	Utilisation Cost,
SP_u	Utilisation Settlement Period of the Dispatch Group, as defined above.
PP	is the Payment Proportion and works out what fraction of the full price is due to the Dispatch Group for every Utilisation Settlement Period based on the Contracted Capacity and the actual delivery.
$AD_{s,j}$	is the actual, metered MW delivery of the Dispatch Group (s) for each Utilisation Settlement Period during the constraint Utilisation event j. In the payment calculations, there is no difference between Generator Sites and Demand reduction Sites, since this value is the 'reported to grid' value

3.2 PAYMENT PROPORTION

3.3 Delivery of the Contracted Capacity at a Dispatch Group of equal to or greater than the target delivery threshold set out in 1.7 (the Delivery Target Threshold (DTT)) is awarded the Utilisation Payment "at rate" (i.e. the payment % will equate to the delivery %), provided that delivery over the required level of Contracted Capacity will be paid up to a maximum Payable Over-delivery (PO) of the Contracted Capacity. A deduction from full payment of will be made based on the rules below for delivery of less than the Delivery Target Threshold of Contracted Capacity.

3.4 The Delivery Proportion $(DP_{s,j})$ is defined as the ratio of actual MW delivery to Contracted Capacity. This ratio is a value that represents a percentage and is rounded to two significant figures to ensure it represents a whole percentage.

35 The Delivery Target Threshold (DTT) determines the acceptable under-delivery for a Dispatch Group. For every % point under that level, a fixed proportion, called the Penalisation Multiplier,(PM) of the full payment is deducted.

36 Thus, the Payment Proportion is a value between 0 and 1+PO (or 0 and 100%+PO%). The calculation contains three cases:

1) $if\ DP_{s,j} \geq (1 - DTT)\ and\ DP_{s,j} \leq 1 + PO,\ PP_{s,j} = DP_{s,j}$

2) $if\ DP_{s,j} < (1 - DTT),\ PP_{s,j} = Max\left(0,\ 1 - DTT - PM.\left[1 - DTT - DP_{s,j}\right]\right)$

3) $if\ DP_{s,j} > 1 + PO,\ PP_{s,j} = 1 + PO$

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