Standardised DNO Settlement Methodology

Open Networks
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DOCUMENT CONTROL

Authorities

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Version 1.0	21/08/2024	Open Networks Settlement technical working group	Final version of the standardised payment mechanics for the settlement of Flexibility Services.

TABLE OF CONTENTS

Contents

1. Introduction

About ENA

Energy Networks Association represents the companies which operate the electricity wires, gas pipes and energy system in the UK and Ireland.

We help our members meet the challenge of delivering electricity and gas to communities across the UK and Ireland safely, sustainably and reliably.

Our members include every major electricity and gas network operator in the UK and Ireland, independent operators, National Grid ESO which operates the electricity system in Great Britain and National Grid which operates the gas system in Great Britain. Our affiliate membership also includes companies with an interest in energy, including Heathrow Airport and Network Rail.

We help our members to:

- Create smart grids, ensuring our networks are prepared for more renewable generation than ever before, decentralised sources of energy, more electric vehicles and heat pumps. Learn more about our Open Networks programme.
- Create the world's first zero-carbon gas grid, by speeding up the switch from natural gas to hydrogen. Learn more about our Gas Goes Green programme.
- Innovate. We're supporting over £450m of innovation investment to support customers, connections and more.
- Be safe. We bring our industry together to improve safety and reduce workforce and public injury.
- Manage our networks. We support our members manage, create and maintain a vast array of electricity codes, standards and regulations which supports the day-to-day operation of our energy networks.

Together, the energy networks are keeping your energy flowing, supporting our economy through jobs and investment and preparing for a net zero future.

About Open Networks

Britain's energy landscape is changing, and new smart technologies are changing the way we interact with the energy system. Our Open Networks programme is transforming the way our energy networks operate. New smart technologies are challenging the traditional way we generate, consume and manage electricity, and the energy networks are making sure that these changes benefit everyone.

ENA's Open Networks programme is key to enabling the delivery of Net Zero by:

- opening local flexibility markets to demand response, renewable energy and new low-carbon technology and removing barriers to participation
- opening data to allow these flexible resources to identify the best locations to invest
- delivering efficiencies between the network companies to plan and operate secure efficient networks

We're helping transition to a smart, flexible system that connects large-scale energy generation right down to the solar panels and electric vehicles installed in homes, businesses and communities right across the country. This is often referred to as the smart grid.

The Open Networks programme has brought together the nine electricity grid operators in the UK and Ireland to work together to standardise customer experiences and align processes to make connecting to the networks as easy as possible and bring record amounts of renewable distributed energy resources, like wind and solar panels, to the local electricity grid.

The pace of change Open Networks is delivering is unprecedented in the industry, and to make sure the transformation of the networks becomes a reality, we have created three workstreams under Open Networks to progress the delivery of the smart grid.

2023 Open Networks programme Workstreams

- Network Operation
- Market Development
- Planning and Network Development

Our members and associates

Membership of Energy Networks Association is open to all owners and operators of energy networks in the UK.

- Companies which operate smaller networks or are licence holders in the islands around the UK and Ireland can be associates of ENA too. This gives them access to the expertise and knowledge available through ENA.
- Companies and organisations with an interest in the UK transmission and distribution market are now able to directly benefit from the work of ENA through associate status.

ENA members

BUUK infrastructure
Cadent Your Gas Network
electricity north west Bringing energy to your door
ESB NETWORKS
ESO
national gas
nationalgrid
Northern Gas Networks
Northern Ireland Electricity Networks
NORTHERN POWERGRID
Scottish & Southern Electricity Networks
SGN
SP Energy Networks
UK Power Networks Delivering your energy
WALES&WEST UTILITIES

ENA associates

- Chubu
- EEA
- Guernsey Electricity Ltd
- Heathrow Airport
- Jersey Electricity
- Manx Electricity Authority
- Network Rail
- TEPCO

2. Executive Summary

This document sets out the calculations to allow Distribution Network Operators (DNOs) to make payments to Flexibility Service Providers (FSPs) for the delivery of Flexibility Services. The Settlement Technical Working Group (STWG) have developed these as part of the process of standardising and alignment of the methodologies used across different DNOs.

There are two types of Flexibility Services detailed in this document: **Turnup/Turndown** and **Peak Reduction**.

3. Definition and Interpretation

This document provides the detailed mathematical calculations developed through the ENAs Open Networks Project for adoption by UK Network Operators for the calculation of payments in respect of flexibility services. It has been developed in line with the ENA Standard Agreement for flexibility Services and terms shall be defined and interpreted in accordance.

For the sole purpose of interpreting this document the following definitions are provided.

"Accepted Availability Window"	means a Committed Availability Window in respect of a Flexible Unit which is notified by the Company in the form of an award as being required by the Company for the Company's Flexibility Services;
"Availability Payment"	payment made by the Company to a Flexibility Service Provider for the period the Flexibility Service Provider was awarded an Availability Window;
"Availability Percentage"	means the calculated percentage of monthly Availability Payment due, following the application of Utilisation Performance and any applicable availability Grace Factor;
"Availability Price"	means the contracted fee £/MW/h in respect of availability;
"Availability Refinement Period"	the period defined within the flexibility service parameters where a refinement of the availability window and capacity is agreed;
"Available MW"	means the MW value the Company has awarded the FSP within an Accepted Availability Window;
"Baseline MW	means the baseline value of the Flexible Unit at the minute in question. A Demand asset is represented by a negative number with a generation asset a positive number;
The **"Company"**	means the Licensee with whom the FSP is contracted to provide flexibility services;
"Contracted Capacity"	means the target net MW of Demand Response in respect of an awarded Service Window, confirmed to the FSP at time of award or following a refinement window (if applicable for the contracted flexibility service);
"Delivered MW"	means the MW value calculated as delivered following the application of the Baseline MW to the Metered MW;
"Flexibility Service Provider" or "FSP"	an entity providing energy services to the Company;

"Flexibility Service"	means the services to be provided by the Flexibility Service Provider to the Company under contract which give the Company the ability to manage the load at a specific point of the Network at certain points in time;
"Flexible Unit"	means one or more Energy Resources that are aggregated, regarded as a single entity, and metered on a single metering output and, as such, is providing a flexibility service;
"Grace Factor"	the percentage of under delivery below 100% for which renumeration of 100% will be applied, relevant both to utilisation and availability performance at the Company's discretion;
"Metered MW"	means the actual metered MW value of the Flexible Unit at the minute in question. A Demand asset is represented by a negative number with a generation asset a positive number;
"Metered Time Period"	the time period used in the payment calculations, this will either be minute by minute or 30-minute granularity;
"Peak Reduction Service"	a flexibility service where FSPs commit to reduce their highest demand peaks during pre-contracted windows;
"Turnup/Turndown Service"	flexibility services that require FSPs to change their energy import or export behaviour during pre-scheduled windows or in response to a Utilisation Instruction;
"Utilisation Event" or "Utilisation Period"	means a utilisation request to deliver flexibility services, inclusive of a specified start and end time;
"Utilisation Instruction"	means an instruction by the Company to the FSP to deliver Flexibility Services;
"Utilisation Payment"	the amount payable by the Company to the Provider for the utilisation of any Flexibility Service;
"Utilisation Performance"	means the calculated performance per utilisation event after any factors have been applied;
"Utilisation Price"	means the contracted fee £/MWh in respect of utilisation;
"Utilised MW"	means the MW value instructed within a Utilisation Event; (Represented by a positive number for a demand reducer / generation increase asset and a negative number for a demand increase/generation reduction asset;
Performance Multiplier	the factor by which any percentage of under delivery below the grace factor will be multiplied by in order to calculate payable delivery;

The signage used in calculations differs for the different asset types with the table below showing a summary.

Table 1 – Signage used in calculations for different asset types.

Response Type	Direction	Baseline Value	Meter Readings	Dispatched Capacity
Demand	Turn Down	Negative	Negative	Positive
Demand	Turn Up	Negative	Negative	Negative
Generation	Turn Down	Positive	Positive	Negative
Generation	Turn Up	Positive	Positive	Positive

4. Payment Calculations for Turnup/Turndown Services

4.1 Availability Payments

Where the contracted Flexibility Service includes Availability, payments are applicable to the FSP in respect of Accepted Availability Windows, whereby the FSP is ready and available to supply the Utilised MW in the event of a Utilisation Instruction.

When applicable, Availability will be calculated, based on performance on a minute or 30-minute granularity. The Availability Payment due, is subject to Utilisation Performance and a Grace Factor can be applied at the Company's discretion to calculate the total Availability Percentage due.

Utilisation Performance is calculated as an average across the Utilisation Events within month, as detailed in section 1.2 of this document. Where a grace factor is applied to this average, the Company may pay up to 100% of availability for the month where average delivery falls within the grace factor band. For example, if the Grace Factor is defined as 5%, and Utilisation Performance is determined to be 95% then 100% of the Availability Payment is due.

If there are no utilisation events in the month then full availability is paid.

The parameters to calculate the Availability Payments are detailed below. There are two examples shown, minute by minute and 30-minute granularity. The calculations are the same in both instances however minute by minute granularity would allow the MW or price to change (if needed) on a greater granularity level than 30-minute granularity.

Table 2 – Parameters used in Availability Calculations

ID	Parameter	Description	Example 1, 1 minute granularity	Example 2, 30-minute granularity
A	Start Datetime	Start date and time of the Accepted Availability Window	01/07/23 00:00	01/07/23 00:00
B	End Datetime	End date and time of the Accepted Availability Window	01/07/23 00:01	01/07/23 00:30
C	Metered Time Period (minutes/60)	The Metered Time Period divided by sixty. In the datetime in example one the period is 1 minute so 1/60, while in example 2 the period is 30 minutes.	0.016666667	0.5
D	Availability Price £/MW/h	The contracted fee for the availability component of the service in £/MW/h	£2	£2
E	Contracted Capacity (MW)	The Available MW the service provider has been accepted to supply	5	5
F	Availability (1,0)	1 if the service was available, 0 if not available for the period	1	1
G	Grace Factor	Availability Grace Factor	5%	5%
H	Utilisation Performance	The calculated Utilisation Performance taking into account the Grace Factor in G.	85.33%	100%[1]
I	Pre-Utilisation Performance Payment £	The payment for the availability period without any performance applied Using the data above the value shown in the next columns is calculated by (C*D*E*F)	£0.17	£5.00

[1] The Utilisation performance was greater than 95% hence 100% of the Availability is being paid

J	Post-Utilisation Performance Payment	The actual Availability payment value using the applied performance %, values calculated by (C*D*E*F*H)	£0.14	£5.00

Detailed Availability Formula

The **Availability Payment** (AP_{sm}), to be made by **The Company** to the **Flexibility Service Provider** in respect of the **Accepted Availability Window(s)** in calendar month, m, for **Flexible Unit,** s, shall be calculated in accordance with the following formula: -

$$AP_{sm} = \sum_{j=1}^{j=t} AC_{sj} \times AVP_{sj} \times CC_{sj} \times SA_{sj} \times MPF_{sm}$$

t represents the number of **Metered Time Periods**

AC_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period,** j, means the **Availability Price** in £/MW/h.

AVP_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period,** j, means the **Availability Period** in minutes/60.

CC_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period,** j, means the **Contracted Capacity** in MW

SA_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period**, j, is 0 where the **Flexible Unit** is declared (or redeclared) unavailable or **The Company** deem unavailable, otherwise 1.

MPF_{sm} in respect of each **Flexible Unit**, s, and each calendar month, m, means the **Monthly Utilisation Performance Factor** and is 1 where:

a) there are no **Dispatch Events** in a month.
b) the **Monthly Utilisation Performance Factor** is not being applied by **The Company.**
c) the calculated **Monthly Utilisation Performance Factor** is **100%** or within the **Grace Factor** applied by **The Company.**

otherwise, is calculated using the formula below:

For a **Flexible Unit**, s, for each calendar month, m:

$$MPF_{sm} = \frac{1}{p} \sum_{e=1}^{e=p} \frac{1}{n} \sum_{k=1}^{k=n} Max(Min((\frac{(MM_{ek} - BM_{ek})}{DC_{ek}}),1),0)$$

BM_{ek} in respect of each **Dispatch Event**, e, and each Minute, k, BM_{ek}represents the **Baseline MW** with the signage negative for a demand unit and positive for a generation unit.

MM_{ek} in respect of each **Dispatch Event**, e, and each Minute, k, MM_{ek} represents the **Metered MW** with the signage negative for a demand unit and positive for a generation unit.

DC_{ek} in respect of each **Dispatch Event**, e, and each Minute, k, DC_{ek} represents the **Dispatched MW** with the signage positive for a demand reducing asset or a generation increase asset and the signage negative for a demand increasing asset or generation reducing asset.

n represents the number of minutes for each **Dispatch Event**

p represents the number of **Dispatch Events** in a calendar month for a **Flexible Unit**

4.2 Utilisation Payments

Utilisation payments are paid to the FSP for the energy delivered during a Utilisation Event.

Utilisation will be calculated, if applicable, on a minute granularity, the payment is subject to a performance metric known as a Performance Multiplier which applies after, if applicable, a Grace Factor.

The parameters to calculate the Utilisation Payments are detailed in Table 3. Two examples are detailed a Demand turndown asset and a Generation turnup asset, note the signage used differs dependent on asset type and is shown in Table 1.

Table 3 – Parameters used in Utilisation Calculations

ID	Parameter	Description	Example 1, 1 minute granularity Demand Reducer	Example 2, 1 minute granularity Generation Increase
A	Start Datetime	Start date and time of the Utilisation Event	01/07/23 00:00	01/07/23 00:00
B	End Datetime	End date and time of the Utilisation Event	01/07/23 00:01	01/07/23 00:01
C	Dispatched Capacity (MW)	The Utilisation MW instructed.	5	5
D	Utilisation Price £/MWh	The contracted fee for the utilisation component of the service in £/MWh	£25	£25
E	Utilisation Period (minutes/60)	The duration of the Utilisation Event divided by sixty.	0.016666667	0.016666667
F	Baseline (MW)	The baseline of the asset in the minute in question.	-5	10
G	Metered (MW)	The actual Metered MW of the asset in the minute in question.	-0.712	14

H	Delivered (MW)	The actual delivered MW of the asset in the minute in question. Calculated by G-F	4.288	4
I	Delivery Percentage[2]	The actual delivery percentage in the minute in question, calculated by H/C	85.76%	80%
J	Grace Factor[3]	A utilisation Grace Factor applied to the MW delivered, if the delivered % is within this tolerance then full payment is made for the minute in question.	5%	5%
K	Performance Multiplier[4]	If the delivery % is outside the Grace Factor, then a Performance Multiplier is applied to reduce the % paid.	3	3
L	Payment Percentage	The % calculated for payment considering the Grace Factor and penalisation multiplier for the minute in question	67.28%	50%
M	Utilisation Payment (£)	The actual Utilisation Payment value for the minute in question considering the applied performance % calculated by (D*E*H*L)	£1.20	£0.83

[2] This percentage is collared at 0% and capped at the POD (payable over delivery) in the formula specified in Detailed Utilisation Formula section.
[3] In these two examples if either asset had delivered >=95% (taking the grace factor into account) then the full utilisation payment would have been made
[4] A performance Multiplier of 3 is used in these examples with a grace factor of 5%. Example 1 has a actual delivery of 85.76% this falls 9.24% (95%-85.76%) outside of the grace factor level, a multiple of 3 is applied (3 * 9.24% = 27.72%) and a payment 67.28% (95% - 27.72%) of the max amount for that minute is paid.

Detailed Utilisation Formula

The **Utilisation Payment** (UP_{sm}), made by **The Company** to the **Flexibility Service Provider** in respect of the **Utilisation Events(s)** in calendar month, m, for **Flexible Unit,** s, shall be calculated in accordance with the following formula: -

$$UP_{sm} = \sum_{j=1}^{j=t} UF_{sj} \times UVP_{sj} \times UC_{sj} \times PM_{sj}$$

t represents the number of **Metered Time Periods**

UF_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period**, j, means the **Utilisation Price** in £/MWh.

UVP_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period**, j, means the **Utilisation Period** in minutes/60.

UC_{sj} in respect of each **Flexible Unit**, s, for each **Metered Time Period**, j, means the delivered MW calculated as below:

$$MAX\left(MIN\left(\left(\frac{(MM_{sj} - BM_{sj})}{DC_{sj}}\right), POD_{sj}\right), 0\right) * |DC_{sj}|$$

BM_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period**, j, BM_{sj} represents the **Baseline MW** with the signage negative for a demand unit and positive for a generation unit.

MM_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period**, j, MM_{sj} represents the **Metered MW** with the signage negative for a demand unit and positive for a generation unit.

DC_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period**, j, DC_{sj} represents the **Utilised MW** with the signage positive for a demand reducing asset or a generation increase asset and the signage negative for a demand increasing asset or generation reducing asset.

POD_{sj} in respect of each **Flexible Unit**, s, and each **Metered Time Period**, j, POD_{sj} represents Payable Over Delivery, the percentage over delivery beyond 100% for which remuneration will be allowed. A POD value of 1 will not allow payment for any over delivery whilst a POD value of 1.1 will allow payment for up to 10% over delivery.

PM_{sj} in respect of each **Flexible Unit**, s, for each **Metered Time Period**, j, means **Performance Multiplier** calculated using the formula below:

$$PM_{sj} = IF(Delivery\% \geq (1 - GraceFactor), 1, MAX\left(0, (1 - GraceFactor) - \left((1 - GraceFactor - Delivery\%) * (Mutiplier\% * 100)\right)\right))$$

Delivery% in respect of each **Flexible Unit**, s, for each **Metered Time Period**, j, means the actual MW delivered divided by the dispatched MW expressed as a percentage.

GraceFactor: in respect of each **Flexible Unit**, s, for each **Metered Time Period**, j, represents the percentage of under delivery below 100% for which renumeration of 100% will be applied.

Multiplier%: in respect of each **Flexible Unit**, s, for each **Metered Time Period**, j, represents a multiplier applied to under delivery expressed as a percentage.

5. Payment Calculations for Peak Reduction Services

5.1 Utilisation Calculations

Flexibility providers commit to reduce their highest demand peaks during pre-contracted windows. Payments are for utilisation only.

Detailed Utilisation Formula

The **Utilisation Payment** (SP_{sm}), made by **The Company** to the **Flexibility Service Provider** in respect of a calendar month, m, for **Flexible Unit,** s, shall be calculated in accordance with the following formula: -

$$SP_{sm} = CC_s \times UF_s \times H_{sm} \times PM_{sm}$$

CC_s in respect of each **Flexible Unit**, s, means the **Contracted Capacity** in MW.

H_{sm} in respect of each **Flexible Unit**, s, and month, m, means the number of service hours awarded in the month in hours.

UF_s in respect of each **Flexible Unit**, s, means the Utilisation Fee in £/MW/h

PM_{sm} in respect of each **Flexible Unit**, s, for each **Month**, m, means **Performance Multiplier** calculated using the formula below:

$$PM_{sm} = IF(Delivery\% \geq (1 - GraceFactor), 1, MAX\left(0, (1 - GraceFactor) - \left((1 - GraceFactor - Delivery\%) * (Multiplier\% * 100)\right)\right))$$

GraceFactor: in respect of each **Flexible Unit**, s, for each month, represents the percentage of under delivery below 100% for which renumeration of 100% will be applied.

Multiplier%: in respect of each **Flexible Unit**, s, for each **month,** j, represents a multiplier applied to under delivery expressed as a percentage.

Delivery% in respect of each **Flexible Unit**, s, and month, m, is calculated as below:

$$Delivery\% = \frac{\left(\left(Min\left(MM_{sj}, MM_{s,j+1}, \ldots, MM_{s,j+n}\right)\right) - \left(Min\left(BM_{sj}, BM_{s,j+1}, \ldots, BM_{s,j+n}\right)\right)\right)}{CC_{sm}}$$

BM_{sj} in respect of each **Flexible Unit**, s, and each **Settlement Period**, j, BM_{sj} represents the **Baseline MW** with the signage negative for a demand unit and positive for a generation unit.

MM_{sj} in respect of each **Flexible Unit**, s, and each **Settlement Period**, j, MM_{sj} represents the **Metered MW** with the signage negative for a demand unit and positive for a generation unit.

CC_{sm} in respect of each **Flexible Unit**, s, and each **Month**, m, CC_{sm} represents the **Contracted MW** with the signage positive for a demand reducing asset or a generation increase asset and the signage negative for a demand increasing asset or generation reducing asset.

n represents the number of dispatched settlement periods

6. Appendices

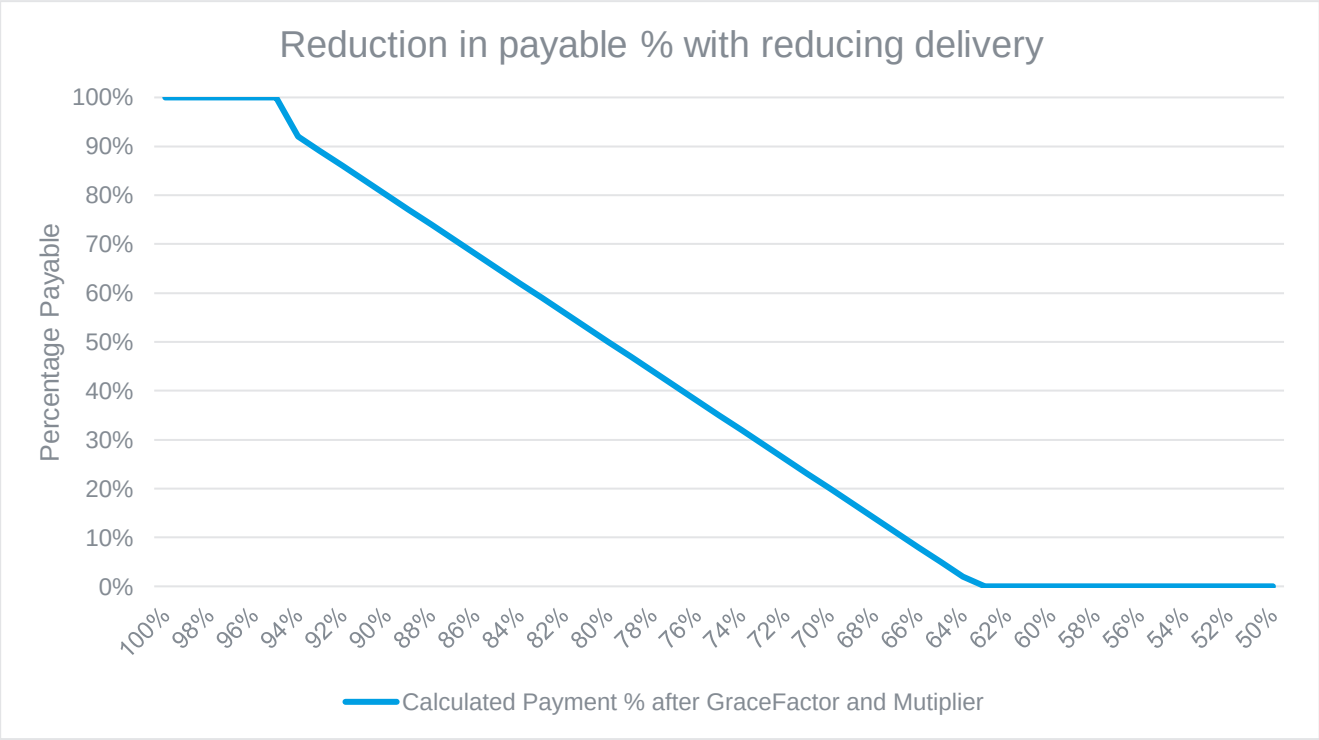
Table 4 – Impact on payment with changing delivery percentage (Turnup/Turndown Service)

The table below shows the impact on Utilisation Payments when there is less than 100% delivery. The table shows a Grace Factor of 5% and a Performance Multiplier of 3 and as can be seen (final column) the payable delivery tapers away to zero once the delivery percentage hits 63%.

Delivery %	Grace Factor	Performance Multiplier	Calculated Payment % after Grace Factor and Multiplier
100%	5%	3	100%
99%	5%	3	100%
98%	5%	3	100%
97%	5%	3	100%
96%	5%	3	100%
95%	5%	3	100%
94%	5%	3	92%
93%	5%	3	89%
92%	5%	3	86%
91%	5%	3	83%
90%	5%	3	80%
89%	5%	3	77%
88%	5%	3	74%
87%	5%	3	71%
86%	5%	3	68%
85%	5%	3	65%
84%	5%	3	62%
83%	5%	3	59%
82%	5%	3	56%
81%	5%	3	53%
80%	5%	3	50%
79%	5%	3	47%
78%	5%	3	44%
77%	5%	3	41%
76%	5%	3	38%

Delivery %	Grace Factor	Performance Multiplier	Calculated Payment % after Grace Factor and Multiplier
75%	5%	3	35%
74%	5%	3	32%
73%	5%	3	29%
72%	5%	3	26%
71%	5%	3	23%
70%	5%	3	20%
69%	5%	3	17%
68%	5%	3	14%
67%	5%	3	11%
66%	5%	3	8%
65%	5%	3	5%
64%	5%	3	2%
63%	5%	3	0%
62%	5%	3	0%
61%	5%	3	0%
60%	5%	3	0%
59%	5%	3	0%
58%	5%	3	0%
57%	5%	3	0%
56%	5%	3	0%
55%	5%	3	0%
54%	5%	3	0%
53%	5%	3	0%
52%	5%	3	0%
51%	5%	3	0%
50%	5%	3	0%

Chart 1 – Indicative Visual representation Impact on payment with changing delivery percentage (Turnup/Turndown)



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