MODIFICATION PROPOSAL FORM			
Proposer *(Company)*	**Date of receipt** *(assigned by Secretariat)*	**Type of Proposal** *(delete as appropriate)*	**Modification Proposal ID** *(assigned by Secretariat)*
Aughinish Alumina Ltd	**14th April 2021**	**Standard**	**Mod_07_21**

Contact Details for Modification Proposal Originator		
Name	**Telephone number**	**Email address**
Thomas O'Sullivan		**Thomas.osullivan@augh.com**

Modification Proposal Title
DDGU (Dispatchable Demand Generation Unit)

Documents affected *(delete as appropriate)*	**Section(s) Affected**	**Version number of T&SC or AP used in Drafting**
T&SC Part A/Part B/Part C **Appendices Part A/Part B** **Glossary Part A/Part B/Part C** **Agreed Procedures Part A/Part B**		**3 Nov 2020**

Explanation of Proposed Change
(mandatory by originator)

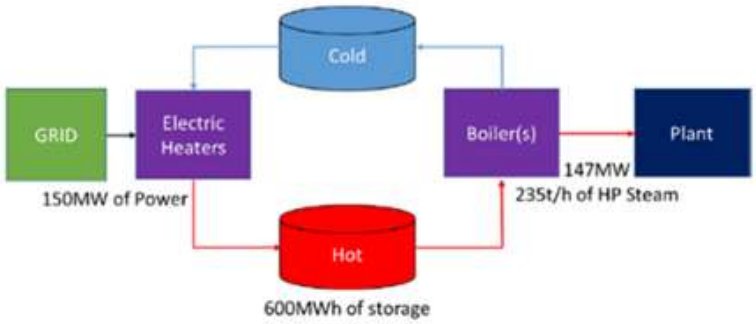
Backdrop

5.5GW of wind generation capacity on the island of Ireland
10GW of new wind generation expected by 2030
50% and 43% RES-E in Northern Ireland and Ireland respectively in 2020
12% dispatch down in 2020. The need for zero carbon system services are critical to solve dispatch down, this is a bigger issue than the SNSP level.
Need to maximise use of existing grid infrastructure.

New technology to help Ireland

Aughinish have the opportunity to install large flexible volumes of Dispatchable Demand which would be always available to TSO as a service provider. The units can be constrained-up or be constrain-down as the requirements of the electricity system change minute by minute. The units are not volume limited and can ramp up and down quickly. Initial studies and engineering by Aughinish are initially focusing on

- 25MW Electrode Boiler (22,000v), demonstration
- 75MW Electrode boilers (made up of 3 units)
- 150MW electric resistance charging of thermal storage, demonstration



Every hour these units operate will reduce imported fossil fuel and their associated carbon which would otherwise have been burned in traditional fossil fuel boilers. [For the avoidance of doubt, this modification has nothing to do with high efficient CHP. Aughinish has gas fired steam boilers running 363 days a year, which can be turned down if the TSO can dispatch-on the electric boilers to produce steam]
Aughinish can utilise cheap RES-E, which would otherwise be turned off to decarbonise our manufacturing facility.
Aughinish have a pathway to develop 600MW of DDGU by 2030 and more thereafter. By 2030 this could offset 300,000t CO_2 per year on our site alone.

Other technology which might also benefit from this proposed DDGU might include:

- 1,000MW electrolysis, for power to gas, producing hydrogen
- 2MW Industrial size heat pumps
- 0.5MW surge pumping of water reservoirs
- Battery charging
- Compressed air storage

The technical characteristic of this technology make it ideal for an island with excellent indigenous renewable generation resources. The boilers and storage can be powered up in minutes from cold. More importantly, they can be instantly disengaged from the grid to provide frequency regulation in times of high SNSP (POR and other).

These units can provide the dual purpose of 1) reducing turndown of wind generators 2) providing zero carbon frequency regulation in times of high SNSP reducing the need for traditional generation. At the same time the 99% efficient electrical heat would be directly offsetting 90% efficient fossil fuel boilers. The fossil fuel can remain in the ground indefinitely or until a later time acting as a virtual battery.

Other industry

Once Aughinish demonstrate the technology it will be less risky for other industry (dairy, pharma, chemical, food, beverage, manufacturing, district heating) to follow. Combined, a fleet of electrical heaters would be equivalent to a virtual one-way interconnection (maybe 0.6GW to 1 GW by 2030) to reduce dispatch down of RES-E, help Ireland meet its RES-E targets while also decarbonising heat for industry. The distributed nature of many of these installation spread around the island means little need for new transmission infrastructure. These will allow better utilisation of the existing local grid, especially if installed in areas of high wind generation. Industry will be better future proofed from carbon leakage to countries with less ambitious climate change targets such as China. Local communities will quickly see the benefits of wind turbines in their area when their jobs are secured due to this low cost zero carbon indigenous energy.

The electrode boiler technology is tried and tested, having been developed in Norway in an era when they had excess hydro electricity. It has a 6 month lead time so can make a real difference not just to net-zero ambition for 2050 but for front loading of carbon reduction and RES-E integration by 2025 and 2030.

The components of the thermal storage project are all individually available but Aughinish intend to combine them for this innovative application in an Irish context. Lead time may run into 2 years from financial close but it offers a vision of what truly sustainable 99% efficient zero carbon heat may look like. Storage capacity can be increased independent of the charge capacity to provide meaningful time-shifting of renewable electricity usage.

If the barriers are removed it is anticipated the cost of these units is a fraction of other to mitigate dispatch down of wind turbines.

The Barriers

1. PSO Levy

Not relevant to this Code modification.
Designed to help promote RES-E but acting as a barrier to this service provision.
Levied on Max Import Capacity for large users.

2. Use of Service charges

Not relevant to this Code modification.
UoS are necessary charges to build and maintain the power infrastructure.
This technology located in areas of Constrained Wind will reduce the need for grid reinforcement.

3. Supplier charges

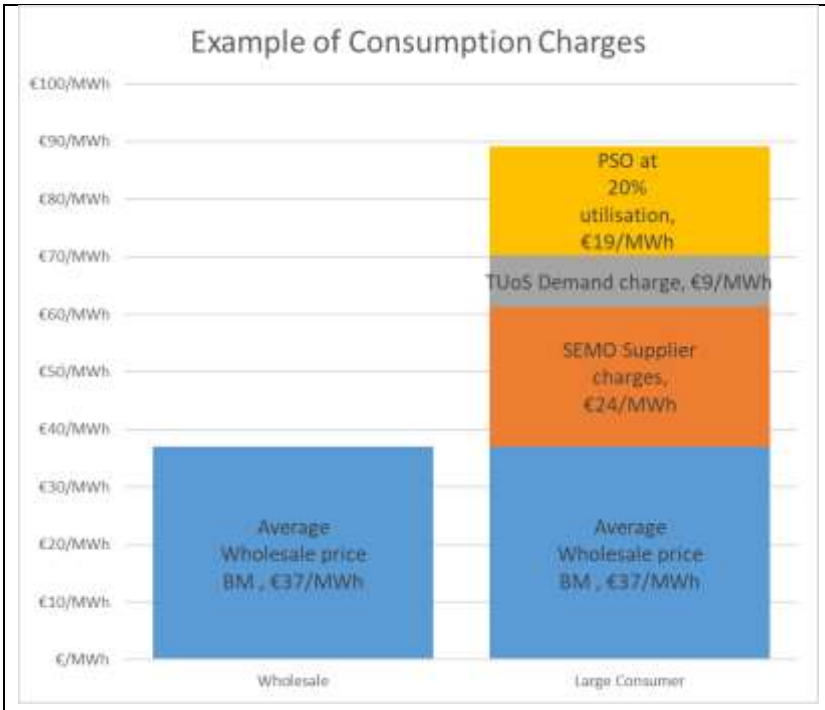
Removing this barrier is the purpose of this purposed Modification.
Suppliers pay supplier charges on top of the wholesale cost of power, these are substantially made up of two components; capacity charge and Imperfection charges.
In our proposal, Supplier pay no more and pay no less than they already do.
If these charges were to apply to the proposed Dispatchable Demand Generation Units then it would not be financially viable to install the units. The cost barrier would mean it is cheaper to burn gas in boilers than to switch to electric low carbon heat, despite the wholesale market price being below that of gas.

3.a. Capacity charge

This to ensure adequate dispatchable generation in times of peak demand and to offer Suppliers a Call Option against high wholesale prices. The Electrode boiler and Thermal storage engineered by Aughinish would never be turned on in times of peak demand, a Call Option is of zero value. Similarly the TSO would have no need to procure additional generation capacity. These units are designed to accommodate RES-E in time of ample generation, they are never envisaged to operate in times of stress.
If this proposed modification is approved existing suppliers would pay no more or no less than they already do for capacity.

3.b. Imperfection charges.

The eelectrode boilers and thermal storage units will substantial reduce Dispatch Balancing Costs incurred by the TSO by providing zero-carbon frequency services currently provided by constraining-on fossil fuel generation. This will reduce the imperfection charge. Installing these electrical heater (electrode boilers and/or thermal storage units) will reduce the imperfection charge on all other suppliers.
It is illogical to levy this on a service provider which reduces DBCs.

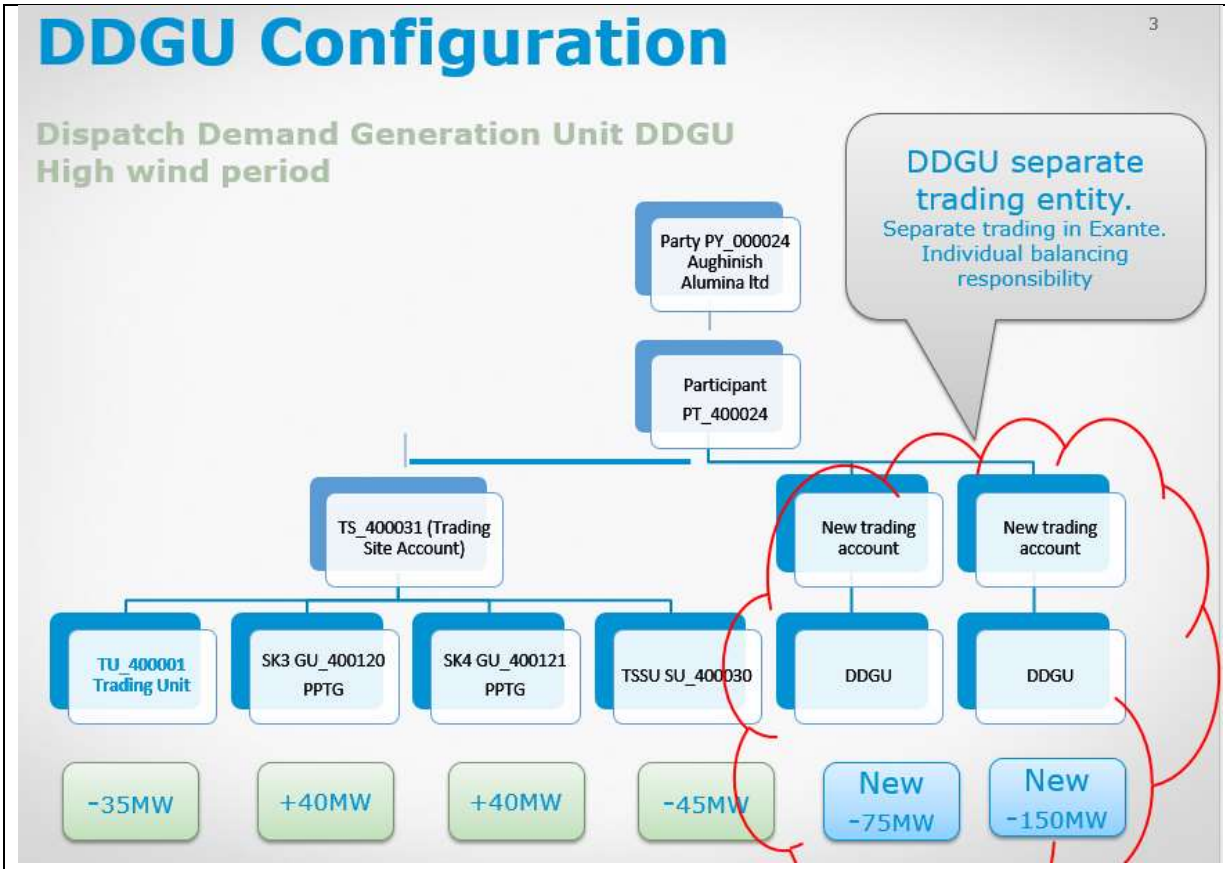


Proposed change to the Trading and Settlement Code

Create a new Generation Unit called a Dispatchable Demand [Generation] Unit.
The TSO will have full dispatch control over this unit.
It will participate like any other Unit registered to a market participant:

- Enter the Exante markets
    - DAM as the first auction, it can only offer bids to consume
    - Subsequent auction the unit can submit offers to generate and bids to consume which will suit the variabilities of renewable generation and changing system demands.
- Submit physical notifications
- Submit Commercial Offer Data and Technical Offer Data to the Balancing Market
- Follow real time dispatch instruction
- Provide Primary Operating Reserve and other services if there is a frequency event
- Be fully balance responsible

Below is an example of what the Aughinish Market interface might look like in 2025 if this modification is approved. To make the modification less complicated and to better accommodate other participants, who wish to follow this approach, it is envisaged that this is kept separate to the existing Autoproducer configuration.



High level questions:

- Is it correct that DDGU should be registered as Generation Units and not charged supplier charges, imperfections and capacity charges in particular?
- Capacity market
    - Revenue.
        - Aughinish do not see any function for DDGU in the Capacity Market. They cannot produce power. They could, in some extreme scenarios, help solve a generation catastrophic cascade event but to our recollection, this has never happened.
    - Capacity payment.
        - DDGU never consume power during peak demand, no need to procure new generation.
        - DSU never consume power during peak demand, a Reliability Option for prices over €500/MWh is of zero value to a flexible DDGU.
- How to we ensure no abuse of the DDGU? Ensure it never consumes power during peak demand?

Legal Drafting Change

*(Clearly show proposed code change using **tracked** changes, if proposer fails to identify changes, please indicate best estimate of potential changes)*

See Appendix A redline TSC

- B.7.2.2, include a new unit type "Dispatchable Demand Unit"
- B.7.2.7, define a Dispatchable Demand Unit as a Generator Unit

- D.4.2.12 DDGU Forecast Minimum Output Profile same as pumped/battery storage
- D.4.2.15 DDGU submit zero for forecast availability
- D.4.3.3 DDGU submit zero for NLC and Start-up costs
- D.4.4 Question added asking how to ensure the first PQ pair will apply from their negative min output level up to their next PQ pair?
- D.6.2.4 Net Output Function is not zero

Section E. Imbalance Pricing no change

- F.4.2 Setting of Loss Adjustment Factors
  - No change proposed, if a DDGU will reduce losses in areas of adverse TLAFs then they will benefit from the GU TLAF. Similarly, if one installs a DDGU in an area short on generation adequacy the unit will increase system losses and should suffer the GU TLAF. Open to opinions from the Code Mods Members (option to set TLAF to 1 under F.4.2.9).
- F.6.2 Calculation of Accepted Bid Quantities and Accepted Offer Quantities
  - Provision needed to ensure no bias trading in negative volumes.
    - Unit cannot profit from trading to -30MW but only able to consume -20MW
    - SEMO support need to code this
- F.6.7 Bias Quantities
  - Need to consider exclusions. It is assumed that all DDGU will exist separate to Autoproducer sites. This may make the coding easier.
- F.9.2: Uninstructed Imbalance Charges:
  - No changes proposed at this time
  - need to test the CUNIMB equations, qCR, qLIMENG
- F.11 Fixed Costs
  - Similar approach to batteries and pumped storage, where they must input a value of zero.
  - New section F.13.2.3 swapping =- Max(〖QMLF〗_uγ,0) for =- Min(〖QMLF〗_uγ,0)
- F.13.2 Exclude DDU from Texting Charge similar to interconnector error unit.
- F.20 Difference Payments
  - Assume no difference charges apply. There should be no change for Suppliers.

- G.7 Market Operator Charge
  - Assume Generator fixed charge only. There should be no change for Suppliers.

See Appendix B redline of the Appendices

- App H Table 1 Exclude DDGU from Fixed Unit Load and Unit Load Scalar

- App I: Offer Data

  Same as other GU. However question if the software can accept negative range numbers?

  No need for shutdown cost at this time.
  Table 2. Needs input from TSO. Should we introduce a new concepts for the increase in demand from a DDGU or charging a storage unit.
  -max on time
  - Synchronous Start Up Time
  - Not relevant to DDGU: block loads, deload, load, soak, dwell, restricted

- App O: Instruction Profiling Calculations
  - Few changes proposed at this time.
  - TSO to assist and maybe include battery charging. Possible changes to
    - GOOP, SYNC, PSYN, PMWO, POFF, PCOD, PISP
    - Maybe Paragraph 32 Table 9 entry for < 0 MWOF(>0):
    - Maybe Paragraph 32 Table 9 entry for < 0 MWOF(>0): For all of these MWOFs, create an equivalent for [new DI code], include DDGUs in the list in the paragraph.

See Appendix C redline Agreed Procedure 4

- Appendix 2 Table 9 MPR / Resource Balancing
  - 'DISPATCHABLE DEMAND (ELECTRIC)' added to fuel type
  - 'DISPATCHABLE DEMAND (ELECTRIC)' added to secondary fuel type
  - "Minimum Import Capacity" added. This is already exists or Interconnectors. Additional line added.
  - Physical notification: Deleted '~~Must be >=0 for all Generators apart from Pumped Storage Units~~'. Replaced with 'must be a number in MW'

Modification Proposal Justification

(Clearly state the reason for the Modification)

- Stepping up to the battle against climate change
  - Reduced reliance on fossil fuels
  - Utilise synergies between constant need for heat and variable electricity generation
- Reduce dispatch down of renewable power generation
- Provide system services to the TSO
- Reduce customer bills
  - Reduce Dispatch Balancing Costs (imperfection charge)
  - Reduce the investment needed to achieve 70% RES-E by 2030.
  - More uptime from existing RES.
  - Reduce cost of PSO, investors can assume a higher capacity factor.
  - Reduce need for transmission grid investment, consume the power within constrained areas and thereby reduce the Use of Service Charges.
- Sustainable indigenous decarbonisation of heat. Use Irish RES-E to decarbonise Irish Industry
- Secure job,
  - Secure existing jobs
  - Jobs remain on the Island of Ireland, avoid carbon leakage to China
  - Give competitive advantage to Irish industry
  - Initially secure jobs in rural area close to wind turbines, as more RES-E assets are built copy and paste the Aughinish demonstration.
- Improve the profile of wind turbines within their community. Secure jobs.
- Future proof the market for Green Hydrogen
- Calls in industry for direct wire capability may no longer be needed if the market has DDGU for hydrogen production from offshore giga-watt wind farms.

Code Objectives Furthered

(State the Code Objectives the Proposal furthers, see Section 1.3 of Part A and/or Section A.2.1.4 of Part B of the T&SC for Code Objectives)

List of code objectives taken from Section A.2.1.4

a. to facilitate the efficient discharge by the Market Operator of the obligations imposed upon it by its Market Operator Licences;
b. to facilitate the efficient, economic and coordinated operation, administration and development of the Single Electricity Market in a financially secure manner;
c. to facilitate the participation of electricity undertakings engaged in the generation, supply or sale of electricity in the trading arrangements under the Single Electricity Market;
d. to promote competition in the Single Electricity Market;
e. to provide transparency in the operation of the Single Electricity Market;
f. to ensure no undue discrimination between persons who are parties to the Code; and
g. to promote the short-term and long-term interests of consumers of electricity on the island of Ireland with respect to price, quality, reliability, and security of supply of electricity.

Code objectives furthered by this proposal:

B. the SEM will be more efficient and more economic if flexible dispatchable demand can be used to reduce dispatch down of renewable power generators.

C. if this proposed modification is implemented it will facilitate new participation in the SEM and will better utilise the SEM as a vector to decarbonise of the whole energy system on the island of Ireland.

D. Additional competition will be created by approving this modification. These units will help put a lower price floor on the wholesale electricity market in times of ample generation.

E. This modification proposes transparent removal of barriers and make it available to all participants and technology types.

F. No undue discrimination in created by this modification. Any technology which is willing to offer COD and be dispatched in real-time by the TSO can utilise the proposed modification.

G. the technology being suggested by Aughinish sitting behind this propose code modification will

- reduce consumer costs of electricity on the island of Ireland in the short term and in the long term.
- improve the quality, reliability and security of supply of electricity in time of high SNSP
- reduce the carbon intensity of the power grid by providing zero-carbon system services
- it will also reduce the carbon intensity of the wider energy system by incorporating the synergies with the heat sector

Implication of not implementing the Modification Proposal

(State the possible outcomes should the Modification Proposal not be implemented)

If this modification is not approved then

1

The technology proposed by Aughinish is not economic to build. Economic utalisation falls from maybe 30% to 3%. Only out-of-market supports can then make the technology viable.

Without the supplier charge barrier being removed industry will continue to burn fossil fuels for another 20 years until Hydrogen comes available, renewable generation will suffer more and more dispatch down while waiting 20 years for Hydrogen to be available at scale. Much more interconnection will be required, huge grid infrastructure will be required to bring RES-E to interconnection beach points, to demand centres and to nodal Hydrogen locations.

2

More wind turbines will need to be built to achieve 2030 targets and compensate for up to 43% dispatch down if other mitigation measures are not put in place (ref SEAI / MullanGrid study).

3

Consumer prices will increase.

- Increased imperfection charge,
- Increased UoS charge,
- Increased PSO charge. (more turbines will need to be build and investor costs will increase due to higher levels of dispatch down)

4

The carbon intensity of the electricity system will be higher unnecessarily, as fossil fuel must run generators are constrained on for service provision which displaces RES-E.

5

Carbon intensity of industrial heat will be higher than is necessary

6

Jobs will be lost unnecessarily from the island of Ireland due to carbon leakage. Other decarbonisation technology are cost prohibitive. Other countries can burn cheap coal unabated. For example, China has the biggest growing Alumina manufacturing industry in the world and its carbon intensity is multiples of that produced in Ireland.

7
RES-E targets for 2030 will be harder to achieve

8
Negative prices will be more prevalent in the SEM

9
When hydrogen does come available this modification will have to be delivered to facilitate it anyway.

Working Group *(State if Working Group considered necessary to develop proposal)*	**Impacts** *(Indicate the impacts on systems, resources, processes and/or procedures; also indicate impacts on any other Market Code such as Capacity Market Code, Grid Code, Exchange Rules etc.)*

Please return this form to Secretariat by email to balancingmodifications@sem-o.com

Notes on completing Modification Proposal Form:

1. **If a person submits a Modification Proposal on behalf of another person, that person who proposes the material of the change should be identified on the Modification Proposal Form as the Modification Proposal Originator.**
2. **Any person raising a Modification Proposal shall ensure that their proposal is clear and substantiated with the appropriate detail including the way in which it furthers the Code Objectives to enable it to be fully considered by the Modifications Committee.**
3. **Each Modification Proposal will include a draft text of the proposed Modification to the Code unless, if raising a Provisional Modification Proposal whereby legal drafting text is not imperative.**
4. **For the purposes of this Modification Proposal Form, the following terms shall have the following meanings:**

Agreed Procedure(s):	**means the detailed procedures to be followed by Parties in performing their obligations and functions under the Code as listed in either Part A or Part B Appendix D "List of Agreed Procedures". The Proposer will need to specify whether the Agreed Procedure to modify refers to Part A, Part B or both.**
T&SC / Code:	**means the Trading and Settlement Code for the Single Electricity Market. The Proposer will also need to specify whether all Part A, Part B, Part C of the Code or a subset of these, are affected by the proposed Modification;**
Modification Proposal:	**means the proposal to modify the Code as set out in the attached form**
Derivative Work:	**means any text or work which incorporates or contains all or part of the Modification Proposal or any adaptation, abridgement, expansion or other modification of the Modification Proposal**

The terms "Market Operator", "Modifications Committee" and "Regulatory Authorities" shall have the meanings assigned to those terms in the Code.

In consideration for the right to submit, and have the Modification Proposal assessed in accordance with the terms of Section 2 of Part A or Chapter B of Part B of the Code (and Part A Agreed Procedure 12 or Part B Agreed Procedure 12) , which I have read and understand, I agree as follows:

1. **I hereby grant a worldwide, perpetual, royalty-free, non-exclusive licence:**

   1.1 **to the Market Operator and the Regulatory Authorities to publish and/or distribute the Modification Proposal for free and unrestricted access;**

   1.2 **to the Regulatory Authorities, the Modifications Committee and each member of the Modifications Committee to amend, adapt, combine, abridge, expand or otherwise modify the Modification Proposal at their sole discretion for the purpose of developing the Modification Proposal in accordance with the Code;**

   1.3 **to the Market Operator and the Regulatory Authorities to incorporate the Modification Proposal into the Code;**

   1.4 **to all Parties to the Code and the Regulatory Authorities to use, reproduce and distribute the Modification Proposal, whether as part of the Code or otherwise, for any purpose arising out of or in connection with the Code.**

2. **The licences set out in clause 1 shall equally apply to any Derivative Works.**

3. **I hereby waive in favour of the Parties to the Code and the Regulatory Authorities any and all moral rights I may have arising out of or in connection with the Modification Proposal or any Derivative Works.**

4. **I hereby warrant that, except where expressly indicated otherwise, I am the owner of the copyright and any other intellectual property and proprietary rights in the Modification Proposal and, where not the owner, I have the requisite permissions to grant the rights set out in this form.**

5. **I hereby acknowledge that the Modification Proposal may be rejected by the Modifications Committee and/or the Regulatory Authorities and that there is no guarantee that my Modification Proposal will be incorporated into the Code.**