Expert Group STORAGE
ESC Meeting – 19 March 2020

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Terms of Reference

Scope of Work and deliverables for June 2020

The objectives of Phase II of the Expert Group on Storage are:-

- Revise any relevant Articles of the Connection Network Codes (RfG, HVDC and DCC) according to the results and observations of the technical assessment from phase I.
- List and briefly assess any possible implications to other Network Codes and Guidelines that these revisions may have.
- List any possible questions to be addressed by other Network Codes / Guide Lines (market, operation).
- Include some information related to the specific case of Electric Vehicles.
- Identify the possible configurations for grid connection, and the different modes of operation.
- Asses the consequences on connection requirements.
- List any possible question to be addressed by other Network Codes / Guide Lines.

Phase 2

Scope of Work and deliverables for June 2020

Report outlining the findings of the Group

- Definitions
- Operation of storage under low frequency conditions and linkage with Emergency and Restoration Code
- Interaction with other EU Codes
- Electric Vehicles
  - E1V – Where an Electric Vehicle can only import from the System
  - E2V – Where an Electric Vehicle can import an Export to and from the System
- Updated Excel Spreadsheet of capabilities

Updates to RfG, HVDC and DCC which would include the requirements for Electric Vehicles

Topology / Approach

- *The Connection Network Codes are designed to be flexible and must cater for the various connection topologies that could exist*
- *Stand alone sites*
  - *Where a site is made up solely of Electricity Storage Modules*
- *Co-located sites*
  - *Co-located Component Site*
    - *A Site where Generation or Demand is integrated with Storage and the storage plant is dependent upon the operation of the Generation - ie the storage plant cannot be independently controlled from the generation*
  - *Co-located Independent Site*
    - *The storage module can be independently controlled from the Generation or demand*

- *All Network codes to be updated to remove the exclusions associated with Storage.*
- *The majority of changes will be made to RfG*
- *HVDC Code – Minimal changes – Storage will be included within the definition of DC Connected Power Park Modules*
- *DCC – Minimal change – there is debate that flexible load – eg heat pumps, refrigeration etc which would also include E1V's should all drop their load as system frequency falls – It is technically outside the terms of reference but there is concern that if this is not implemented now it will be a wasted opportunity.*

Classification

- *It is proposed to have the same classification for Electricity Storage Modules as Power Generating Modules – (ie Type A – D)*
- *This is especially important as it is expected numerous sites will be co-located*

Limits for thresholds for type B, C and D power-generating modules including type B, C and D electricity storage modules

Synchronous areas	Limit for maximum capacity threshold from which a power-generating module or electricity storage module is of type B	Limit for maximum capacity threshold from which a power-generating module or electricity storage module is of type C	Limit for maximum capacity threshold from which a power-generating module or electricity storage module is of type D
Continental Europe	1 MW	50 MW	75 MW
Great Britain	1 MW	50 MW	75 MW
Nordic	1,5 MW	10 MW	30 MW
Ireland and Northern Ireland	0,1 MW	5 MW	10 MW
Baltic	0,5 MW	10 MW	15 MW

Initial Definitions (1)

NOTE – The following definitions have been suggested but are subject to change

- ***Storage is treated as a subset of Generation***

- **'Electricity storage'** means the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy.

- **'Electricity storage module'** is either one or more synchronous electricity storage Unit(s) or non-synchronous electricity storage unit(s) which could also be part of a power-generating module. For the avoidance of doubt, non-controllable electricity storage equipment would not be considered to be classed as an electricity storage module or as an electricity storage unit.

- **'non-synchronous electricity storage module'** means a power park module comprising solely of one or more non-synchronous electricity storage units.

- **'non-synchronous electricity storage unit'** means a power park unit which can supply or absorb electrical energy by converting or re-converting another source of energy such that the frequency of the generated voltage is not inherently in synchronism with the frequency of the system.

- **synchronous electricity storage module'** means a synchronous power generating module which can convert and re-convert electrical energy from another source of energy such that the frequency of the generated voltage, the rotor speed and the frequency of network voltage are in a constant ratio and thus in synchronism. For the avoidance of doubt a synchronous electricity storage module could comprise of one or more synchronous electricity storage units.

- **'synchronous electricity storage unit'** means a synchronous generating unit which can supply and absorb electrical energy such that the frequency of the generated voltage, the rotor speed and the frequency of the equipment are in constant ratio and thus in synchronism with the network.

Definitions (2)

- **‘power-generating module’** means either a synchronous power-generating module, a synchronous electricity storage module, a power park module or a non-synchronous electricity storage module;

- **‘synchronous power-generating module’** means an indivisible set of installations which can convert or reconvert electrical energy from another source of energy such that the frequency of the supplied voltage, the rotor speed and the frequency of network voltage are in a constant ratio and thus in synchronism. A synchronous power generating module could comprise of one or more synchronous generating units or one or more synchronous electricity storage units;

- **‘power park module’ or ‘PPM’** means a unit or ensemble of units generating electricity or unit or an ensemble of non-synchronous electricity storage units, which is either non-synchronously connected to the network or connected through power electronics, and that also has a single connection point to a transmission system, distribution system including closed distribution system or HVDC system;

- **‘power-generating facility’** means a facility that converts primary energy into electrical energy and which consists of one or more power-generating modules connected to a network at one or more connection points, or a facility that coverts electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy and which consists of one or more electricity storage modules connected to a network at one or more connection points. A power generating facility can comprise one of more power-generating modules and/or electricity storage modules;

- **‘main generating plant’** means one or more of the principal items of equipment required to convert the primary source of energy into electricity or covert electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy;

- **‘non-controllable electricity storage equipment’** means an item of storage plant, including but not limited to a Synchronous Flywheel or Synchronous Compensation Equipment or Regenerative Braking whose active output power cannot be independently controlled.

Performance of Electricity Storage Modules under low system frequencies

Requirements of Article 15(3) of the Emergency and Restoration Code - States

3. Prior to the activation of the automatic low frequency demand disconnection scheme, each TSO and DSO identified pursuant to Article 11(4) shall foresee that energy storage units acting as load connected to its system:

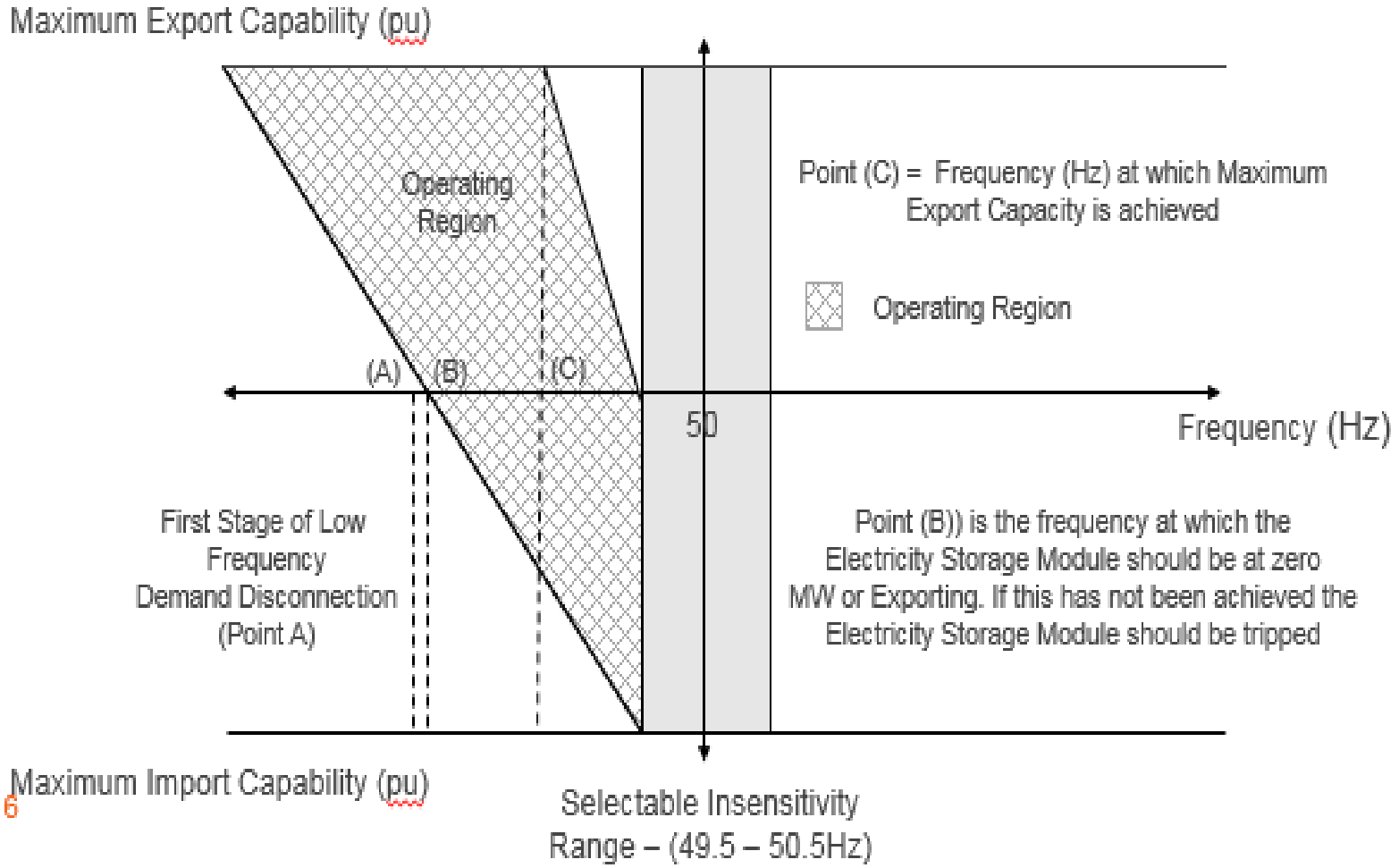
(a) automatically switch to generation mode within the time limit and at an active power set-point established by the TSO in the system defence plan; or

(b) when the energy storage unit is not capable of switching within the time limit established by the TSO in the system defence plan, automatically disconnect the energy storage unit acting as load.

Experience from Germany and GB has been used to develop a combined requirement

Consideration given to Electricity Storage Modules which import and Export and pure Demand Sites which have flexible load (eg E1V)

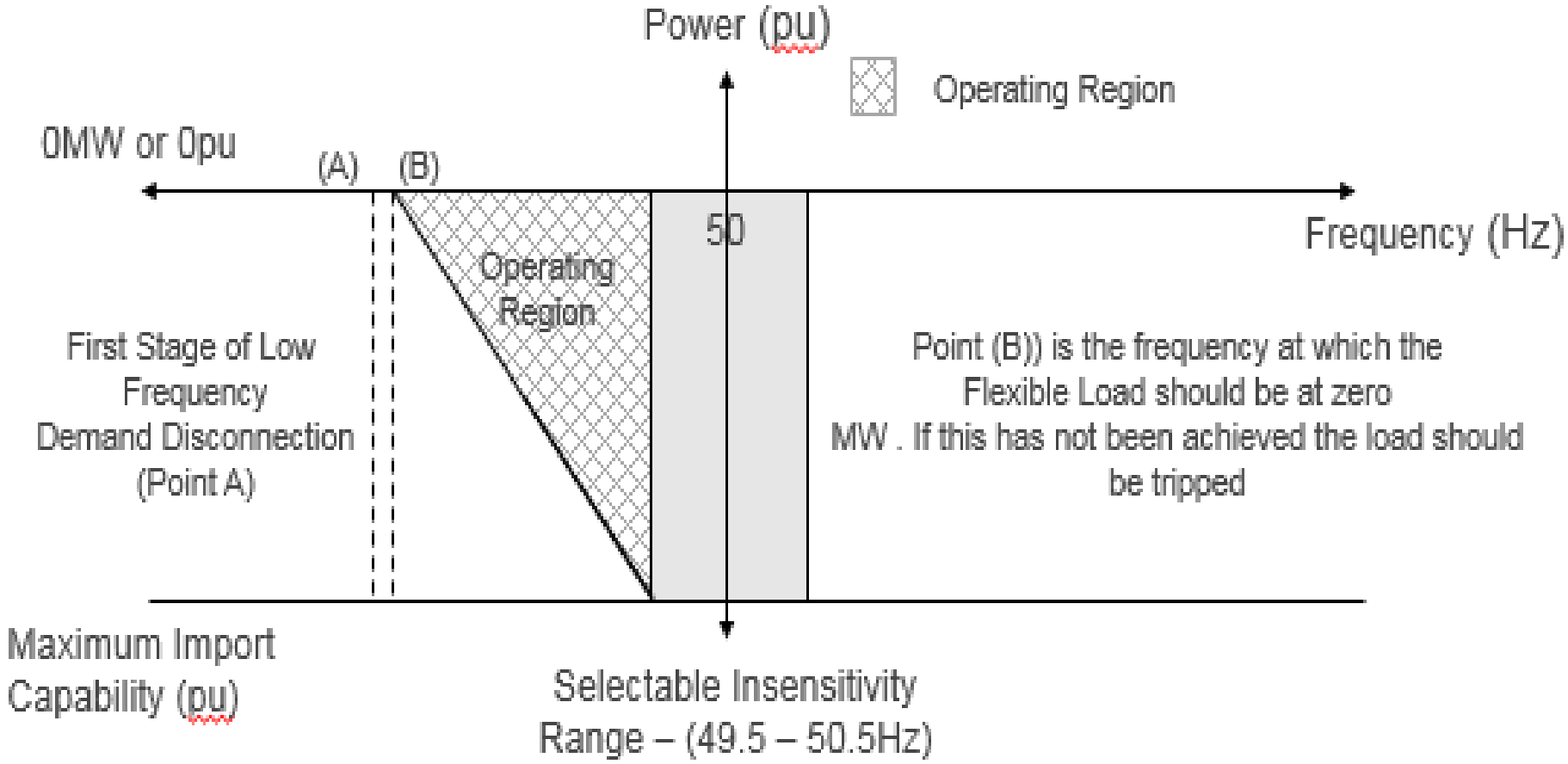
Performance of Electricity Storage Modules under low system frequencies



Performance of Electricity Storage Modules under low system frequencies – Selectable Parameters

TSO defined Parameter	Unit	Range
Insensitivity	Hz	49.5 – 50.5
Power Gradient	MW/Hz or pu/Hz	Within operating range of Figure 1
Point A - First Stage of Low Frequency Demand Disconnection	Hz	TSO defined
Point B – Frequency at which the Electricity Storage Module should be at zero MW or Exporting when capable of meeting the capability of Figure 10	Hz	TSO defined
Point C – Frequency at which Maximum Export Capability can be reached	Hz	49.6 – 49.0Hz
Frequency setting at which the Electricity Storage Module should be tripped if it is unable to meet the operating characteristic of Figure 10 within time t1.	Hz	49.8 – 48.8Hz
Time t1 – Maximum Operating time for complete characteristic	s	1 - 25
Time t2 – Initiation time from inception of frequency fall	s	0 - 5
Final Loading Point following frequency fall	MW or pu	0 – Maximum Capacity
Type A Electricity Storage Module trip setting	Hz	TSO defined

Performance of Flexible Load under low system frequencies – Out of Scope?



Performance of Flexible Load under low system frequencies - Parameters

TSO defined Parameter	Unit	Range
Insensitivity	Hz	49.5 – 50.5
Power Gradient	MW/Hz or pu/Hz	Within operating range of Figure 1
Point A - First Stage of Low Frequency Demand Disconnection	Hz	TSO defined
Point B – Frequency at which the Fleixble Load should be at zero MW	Hz	TSO defined
Frequency setting at which the Flexible Load should be tripped if it is unable to meet the operating characteristic of Figure 1 within time t1.	Hz	49.8 – 48.8Hz
Time t1 – Maximum Operating time for complete characteristic	s	1 - 25
Time t2 – Initiation time from inception of frequency fall	s	0 - 5

ACE Control and Interaction with SOGL / Interaction with other Work

ACE Control and SOGL

- ACE Control (Area Control Error)
- Need to ensure that Storage has the same requirements as Generation so as not to cause difficulties in terms of oscillations at borders and ensure consistency with Automatic Generator Control
- Correct dimensioning of parameters needs to be assessed
- Mainly believed to be an issue with Type A Power Generating Modules including Storage

Interaction with Mixed Customer Sites

- As Storage is expected to be integrated with other technologies – eg generation and demand and HVDC there is a need to feed the outcome of this work into the Mixed Customer Site Expert Group
- A Work Group member who is involved in both groups has been involved in this process

Electric Vehicles

- The scope of the Work extends to Electric Vehicles
- Significant Work completed by ACER and a report is expected imminently
- Two classes of EV's defined
  - E1V – Where an Electric Vehicle which can only import Active Power from the Network
  - E2V – Where an Electric Vehicle can both import and Export Active Power to and from the Network
- The requirements for Electric Vehicles are with respect to the connection point not the vehicle itself.
  - Approach captures small residential connections (Type A) and Larger installations Type A and above
  - Reflects behaviour of different sites – eg Car Parks at hotels, airports and railway stations where the purpose is for parking the car allowing electricity trading to be achieved as a secondary function
  - Reflects other site uses – eg equivalent to a fuel station where the purpose of the site is simply to charge the vehicle for the ongoing journey.
- EV's have been referenced in the report and as Annex's in the draft RfG. Initial requirements were included in DCC but expected to be removed.

Issues Identified / Areas requiring further work

- **Interaction with other EU Codes – SOGL/ACE Control – is there anything further to add?**
- **Treatment of Electricity Storage Modules Embedded with Demand – No change to DCC**
- **Treatment of Flexible Load under low frequency conditions - is this outside scope?**
- **Demand with Storage taking part in Demand Response Service Activities (DCC – Art 27 - 30) – No change?**
- **No change to HVDC Code**
- **Others?**

Phase 2 – Meetings and Timeline

Meetings held

- 8th November 2019 - Webinar
- 19th November 2019 – Physical Meeting – Held ENTSO-E Offices - Brussels
- 10th December 2019 - Webinar – special meeting to discuss Electric Vehicles
- 16th December 2019 – Webinar Meeting
- 28th January 2020 – Webinar Meeting
- 4th March 2020 – Physical Meeting
- 13th March 2020 - Webinar

Future Meetings

- Early April 2020 – Doodle Poll issued - waiting confirmation
- Early May 2020 – Doodle Poll issued - waiting confirmation
- June – Issue Report and draft Text

Phase 2 – Current Status / Next Stage

Good progress being made

- **RfG for storage including Electric Vehicles (V2G) – *First draft completed and sent to workgroup***
- **HVDC Code to include DC Connected Non-Synchronous Electricity Storage Modules - *First draft completed and sent to workgroup***
- **DCC to include storage forming part of a Demand Facility including Electric Vehicles (V1G) – *First draft completed and sent to workgroup***
- **First draft of the Workgroup Report – *First draft completed and sent to workgroup***
- **Updated Spreadsheet – *First Draft prepared and circulated to Workgroup***

A very successful physical meeting was held on 4th March followed by another successful webinar on 13 March. Expert Group Members are currently assessing the draft report and legal text with comments required by the end of the month.
The aims is now for Expert Group members to review the above documents and comment on the proposals to reflect best and consistent practice and make recommendations to the Steering Group

Summary

- Good progress being made
- Still a lot of work to be done
- Numerous issues have been raised –particularly with regard to flexible load
- Expert Group Members are currently assessing the draft report and legal text and due to report back at the end of March 2020
- Questions