nationalgrid

Stage 01: Modification Proposal

Grid Code

GC0100

Mod Title:

EU Connection Codes GB Implementation – Mod 1

What stage is this document at?

01	Modification Proposal
02	Workgroup Report
03	Code Admin Consultation
04	Draft Final Modification Report
05	Report to the Authority

Purpose of Modification:

This modification (1/4) will set out within the Grid Code the following compliance obligations in the EU Connection Codes:

1. Scope and applicability of the RfG, DCC and HVDC requirements for GB users
2. Set the x4 Type (A-D) MW banding levels for GB, as required in RfG
3. Set the GB Fast Fault Current Injection parameters, as set out in RfG
4. Set the GB Fault Ride Through requirements, as set out in RfG and HVDC

The Proposer recommends that this modification should be: assessed by a Workgroup to form the final proposals for the mod and then proceed to Workgroup Consultation.

This modification was raised on 22nd May 2017 and will be presented by the Proposer to the Panel on 30th May 2017 The Panel will consider the Proposer's recommendation and determine the appropriate route.

	High Impact: *Developers of: New generation schemes (800 Watts capacity and up), new HVDC schemes (including DC-connected Power Park Modules), and new Demand schemes; GB NETSO; Distribution Network Operators;*
	Medium Impact: *Transmission Owners (including OFTOs); Operators of existing generation, HVDC or Demand schemes considering modernisation;*
	Low Impact: *None identified*

Contents

Any Questions?

Contact:

First Last

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Timetable

The Code Administrator recommends the following timetable:

Workgroup Meeting 1	07 June 2017
Workgroup Meeting 2	July 2017
Workgroup Consultation (20 Working days)	20 July 2017
Workgroup Meeting 3 (Alternatives and vote)	September 2017
Workgroup Report presented to Panel	12 September 2017
Code Administration Consultation Report issued to the Industry (15 Working days)	14 September 2017
Draft Final Modification Report presented to Panel	10 October 2017
Panel Recommendation Vote	18 October 2017
Final Modification Report issued the Authority	27 October 2017
Implementation	13 November 2017

1 Summary

What

Full sections of the Grid Code, for example the Connection Conditions (CCs), will need to be extended to set out the new EU standards to which impacted users will need to comply with.

This will be a combination of completely new requirements inserted into the Grid Code, or adjustments/continuation of corresponding existing GB requirements to line up with equivalents in the new EU codes.

Why

Guidance from BEIS and Ofgem was to apply the new EU requirements within the existing GB regulatory frameworks. This would provide accessibility and familiarity to GB parties, as well as putting in place a robust governance route to apply the new requirements in a transparent and proportionate way.

This modification needs to be undertaken in timely manner to ensure impacted users are aware of their compliance obligations - particularly in relation to procurement of equipment, testing and operational requirements. This modification is also therefore, critical to facilitate/demonstrate Member State compliance to these three EU Network Codes.

How

With the support of the industry, we will use this modification to finalise proposals to apply the EU Connection Codes requirements, before consulting with the wider industry and submitting to Ofgem for a decision.

Previously, Grid Code and Distribution Code issue groups were formed (GC0048, GC0090, GC0091) to:
1. Comprehensively review the code to form a local interpretation of the requirements;
2. Undertake a mapping between the EU and GB codes to understand the extent for possible code changes;
3. Form proposals, which will now be taken forward as formal modifications.

2 Governance

Given the complexity and wide-ranging impact of the changes proposed in this mod, the proposer believes that self-governance or fast track governance arrangements are not appropriate in this case.

Instead, ‘Normal’ Grid Code governance processes should be followed.

3 Why Change?

This Proposal is one of a number of Proposals which seek to implement relevant provisions of a number of new EU Network Codes/Guidelines which have been introduced in order to enable progress towards a competitive and efficient internal market in electricity.

Some EU Network Guidelines are still in development and these may in due course require a review of solutions developed for Codes that come into force beforehand. The full set of EU network guidelines are;

- Regulation 2015/1222 – Capacity Allocation and Congestion Management (CACM) which entered into force 14 August 2015
- Regulation 2016/1719 – Forward Capacity Allocation (FCA) which entered into force 17 October 2016
- *Regulation 2016/631 - Requirements for Generators (RfG) which entered into force 17 May 2016*
- *Regulation 2016/1388 - Demand Connection Code (DCC) which entered into force 7 September 2016*
- *Regulation 2016/1447 - High Voltage Direct Current (HVDC) which entered into force 28 September 2016*
- Transmission System Operation Guideline (TSOG) - entry into force anticipated Summer 2017
- Emergency and Restoration (E&R) Guideline - entry into force anticipated Autumn 2017

RfG, DCC and HVDC were drafted to facilitate greater connection of renewable generation; improve security of supply; and enhance competition to reduce costs for end consumers, across EU Member States.

These three codes specifically set harmonised technical standards for the connection of new equipment for generators, demand, and HVDC systems (including DC-Connected Power Park Modules respectively).

Significant work to progress GB understanding of the codes and consider the approach for implementation has been undertaken in Grid Code/Distribution Code issue groups **GC0048 (RfG); GC0090 (HVDC); GC0091 (DCC)**.

This has been widely attended, including DNOs and smaller parties. Additional stakeholder holder engagement has been undertaken to ensure the impacts of the three EU codes is understood, as well as to provide an opportunity to feed into the approach.

The majority of the technical requirements involved in Mod 1 has been consulted on, and aside from the 'RfG banding level', there is no significant concern been registered yet from industry parties.

Through proposing these modifications under Open Governance, we will finalise our proposals; and undertake a final industry consultation to confirm they are appropriate, before submitting papers to Ofgem to request a decision.

4 Code Specific Matters

Technical Skillsets

- Understanding of the GB regulatory frameworks (particularly Grid Code and Distribution Code)
- High level understanding of the EU codes and their potential impact
- Operational/technical understanding of equipment which are bound by these codes
- Where appropriate, knowledge of the obligations and operational processes of GB Network Operators and the GB National Electricity Transmission System Operator

Reference Documents

Demand Connection Code legal text:
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1388&from=EN

Requirements for Generators legal text:
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0631&from=EN

High Voltage Direct Current legal text:
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1447&qid=1494236788524&from=EN

5 Solution

1. Scope and applicability of the RfG, DCC and HVDC requirements for GB users

Requirements for Generators

- By default, the new EU requirements do not apply to existing generators.
- A 'new' user, who is therefore bound by these requirements, is any generator of 800 Watts capacity or greater, who procures their main generating equipment from two years after the RfG code entered into force onwards (17th May 2018).
- An existing generator may be bound by the new EU requirements if they undertake significant modernisation which requires their relevant system operator to adjust the terms of their connection agreement.

Demand Connection Code

- By default, the new EU requirements do not apply to existing demand users or providers of Demand Side Response.
- A 'new' user, who is therefore bound by the requirements, is any Demand User or Demand Side Response provider who procures their main equipment from two years after the RfG code entered into force onwards (7th September 2018).
- An existing Demand user may be bound by the new EU requirements if they undertake significant modernisation which requires their relevant system operator to adjust the terms of their connection agreement.

High Voltage Direct Current

- By default, the new EU requirements do not apply to existing HVDC systems or DC-Connected Power Park Modules.
- A 'new' user, who is therefore bound by the requirements, is any HVDC system or DC-Connected Power Park Module who procures their main generating equipment from two years after the RfG code entered into force onwards (28th September 2018).
- An existing generator may be bound to the new EU requirements if they undertake significant modernisation which requires the relevant system operator to adjust the terms of their connection agreement.

2. Set the Type (A-D) MW banding levels for GB, as required in RfG

Type:	A	B	C	D
Connection Voltage:	< 110kV	< 110kV	< 110kV	≥ 110kV, *or…*
Capacity:	800W – 0.99MW	1 – 9.99MW	10 - 49.99MW	≥ 50MW

3. Set the GB Fast Fault Current Injection parameter, as set out in RfG

RfG defines the requirements for Type B - Type D Power Park Modules to be capable of providing fast fault current injection.

At the present time, the current GB Grid Code (CC.6.3.15) simply states that Generating Units and Power Park Modules should inject maximum reactive current without exceeding the transient rating of the Generating Unit or Power Park Module. RfG is far more specific in terms of its requirements and specifications and a simply translation from the current GB requirement would be insufficient to satisfy the RfG requirements.

In addition, evidence from the Future Energy Scenarios and System Operability Framework has demonstrated in recent years a significant rise in the volume of embedded generation connecting to the Distribution System. The consequence of which is the displacement of Transmission connected Generation and changes to the characteristics and performance of the System as a whole, most notably, falls in short circuit ratio, diminishing system inertia and a deterioration in the retained voltage during System faults.

Irrespective of the implementation of RfG, the growth of converter based plant and its impact on the system needs to be established and these effects have been studies as part of this work through extensive analysis.

The conclusions of this study work have indicated the following key points:-

- The amount of fault current injected is a function of the volume of Generation at a specific location
- The retained voltage during the period of the fault is a function of the amount of reactive current injected
- The speed, ramping and phase relationship of reactive current injection is fundamental to the retained voltage (a critical function of the Fault Ride Through Requirements) and hence the volume of generation that could be lost to a Transmission System fault
- A high degree of reactive current injection will result in improved retained voltage levels across the System which increases the value of Uret for fault ride through purposes and reduces the burden for Generators in respect of this requirement.
- It is better to specify a minimum requirement applicable to all plant rather than more onerous requirements applicable to larger plant

The exact performance requirements for fast fault current injection still require further refinement but at its heart two options are proposed.
Option 1 is based on a requirement using new converter control techniques were there is no delay to the injected reactive current and the output of the converter (including the phase relationship) follows that of the system under disturbed conditions.

Option 2 is based on conventional converter technology which uses a Phase Locked Loop. A small delay would be permitted and the reactive current injected would be required to remain above a defined threshold. This option would only be available for a time limited period until 1 January 2021.

Generators have the option of meeting either option though it is noted that option 2 is time limited until 1 January 2021. This is on the basis that it may take time for

developers to offer a solution for Option 1 which is enduring but offers significantly better system performance requirements that option 1.

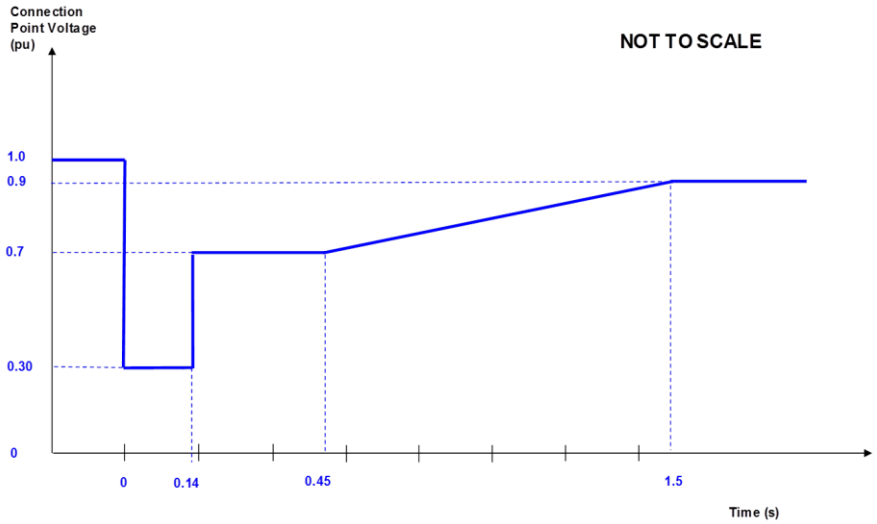
Full details of both options including legal text will be included in the consultation.

4. Set the GB Fault Ride Through requirement, as set out in RfG

Type B Synchronous Power Generating Modules - Voltage Against Time Parameter Ranges:

Voltage parameters [pu]		Time parameters [seconds]	
U_{ret}	0.3	t_{clear}	0.14
U_{clear}	0.7	t_{rec1}	0.14
U_{rec1}	0.7	t_{rec2}	0.45
U_{rec2}	0.9	t_{rec3}	1.5

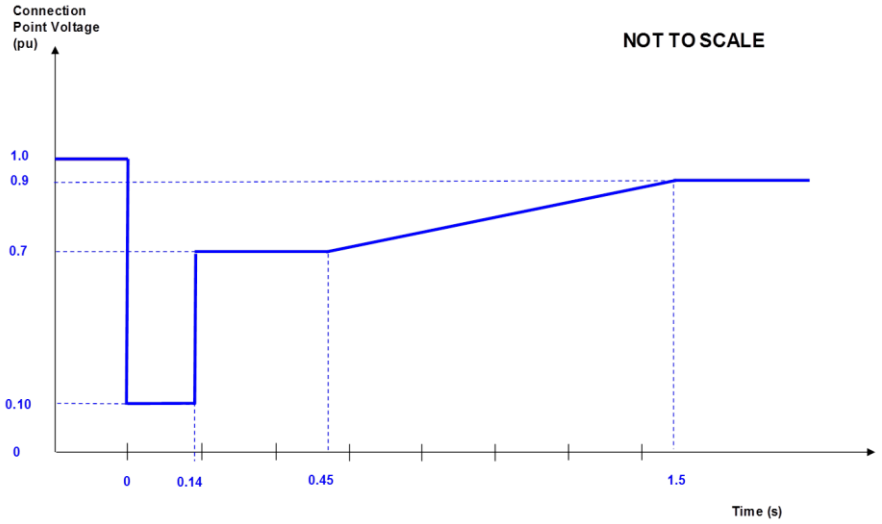
Type B Synchronous Power Generating Modules - Proposed Voltage against Time Profile:



Type C and D Synchronous Power Generating Modules Connected <110kV - Voltage Against Time Parameter Ranges:

Voltage parameters [pu]		Time parameters [seconds]	
U_{ret}	0.1	t_{clear}	0.14
U_{clear}	0.7	t_{rec1}	0.14
U_{rec1}	0.7	t_{rec2}	0.45
U_{rec2}	0.9	t_{rec3}	1.5

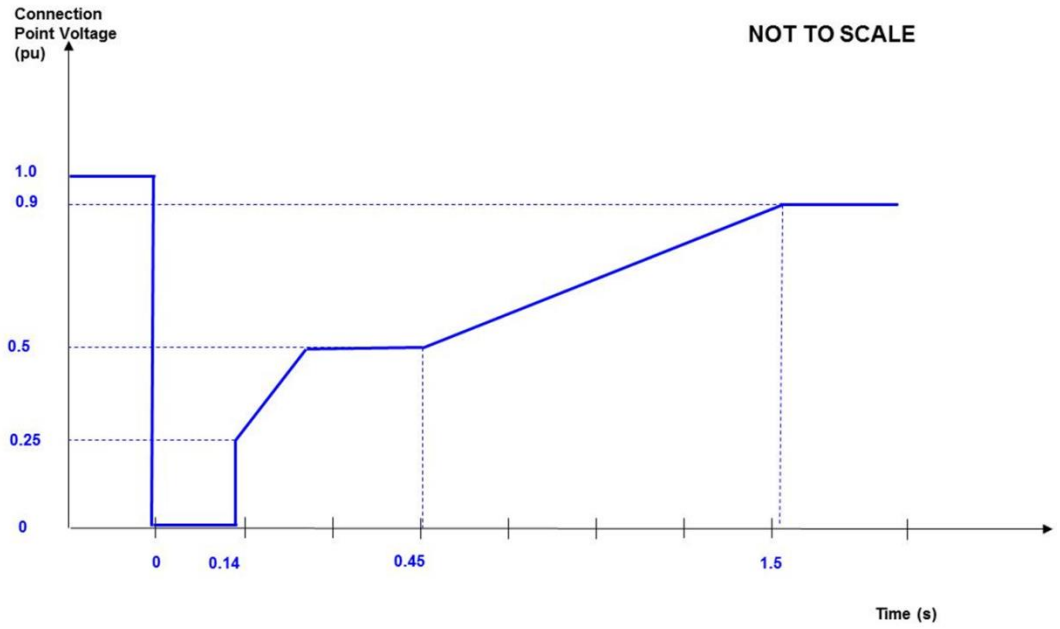
Type C and D Synchronous Power Generating Modules Connected <110kV - Proposed Voltage against Time Profile:



Type D Synchronous Power Generating Modules connected at ≥110kV - Voltage Against Time Parameters:

Voltage parameters [pu]		Time parameters [seconds]	
U_{ret}	0	t_{clear}	0.14
U_{clear}	0.25	t_{rec1}	0.25
U_{rec1}	0.5	t_{rec2}	0.45
U_{rec2}	0.9	t_{rec3}	1.5

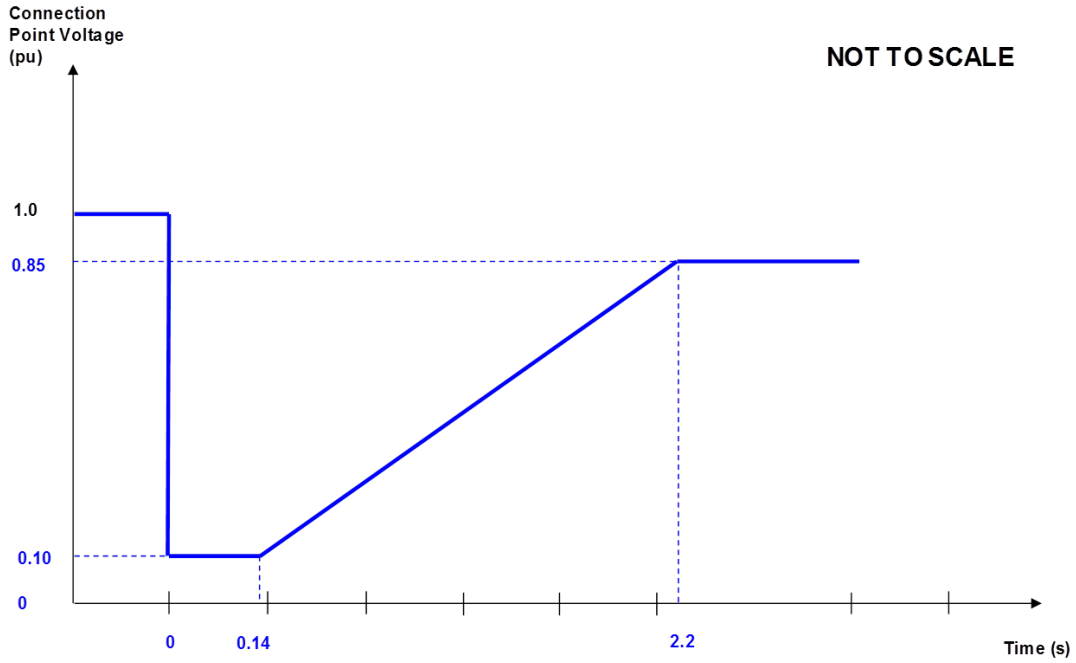
Type D Synchronous Power Generating Modules connected at ≥110kV - Proposed Voltage against Time Profile:



Type B and C, and Type D Power Park Modules connected <110kV - Voltage against Time Parameters:

Voltage parameters [pu]		Time parameters [seconds]	
U_{ret}	0.1	t_{clear}	0.14
U_{clear}	0.1	t_{rec1}	0.14
U_{rec1}	0.1	t_{rec2}	0.14
U_{rec2}	0.85	t_{rec3}	2.2

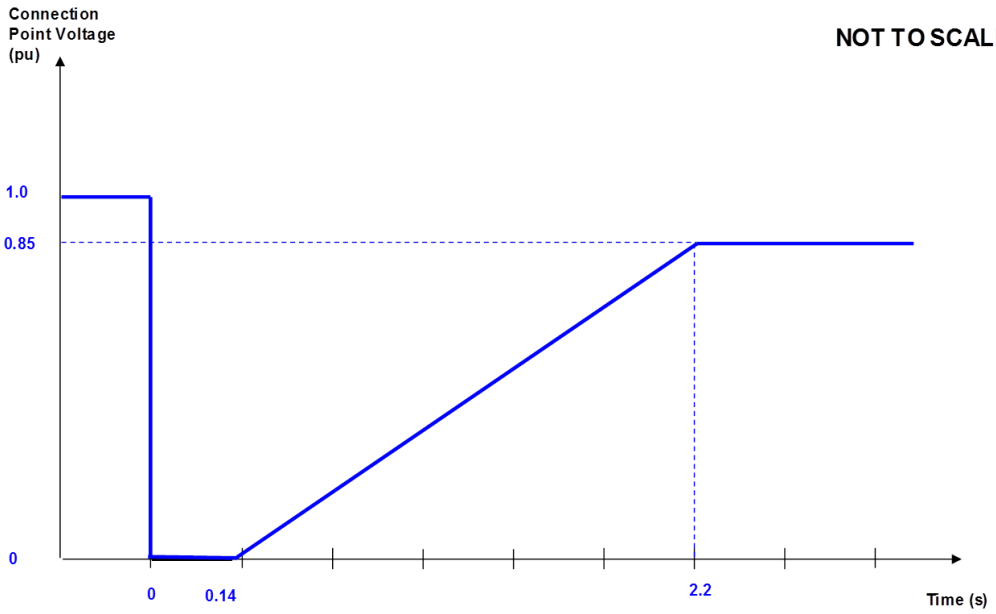
Type B and C, and Type D Power Park Modules connected <110kV - Proposed Voltage against Time Profile:



Type D Power Park Modules connected ≥110kV - Proposed Voltage against Time Parameters:

Voltage parameters [pu]		Time parameters [seconds]	
U_{ret}	0	t_{clear}	0.14
U_{clear}	0	t_{rec1}	0.14
U_{rec1}	0	t_{rec2}	0.14
U_{rec2}	0.85	t_{rec3}	2.2

Proposed Voltage against Time Profile:



HVDC Systems and DC-Connected PPMs

The requirements for DC Converters connected to the Main Interconnected AC Transmission System will be derived from the RfG settings. Workgroup discussion will be required in respect of setting the requirements for remote-end HVDC Converters and DC-Connected Power Park Modules.

6 Impacts and Other Considerations

i. *The Grid Code and Distribution Code will bear the primary impact of the EU Connection Code mods. Some consequential changes are anticipated in the STC code especially from HVDC (primarily Section K - Technical, Design And Operational Criteria And Performance Requirements For Offshore Transmission Systems)*

ii. *The Transmission/Distributions connections and compliance processes will need to be slightly altered to ensure they accommodate the new EU requirements as set out in the modified Grid Code and Distribution Codes.*

iii. *No system changes are anticipated as a result of implementing the EU Connection Codes*

Does this modification impact a Significant Code Review (SCR) or other significant industry change projects, if so, how?

The EU Network Code implementation is being undertaken as a significant programme of work within the GB industry. This mod forms part of that programme, but is not part of an on-going SCR.

Consumer Impacts

This modification facilitates the implementation of consistent technical standards across the EU for the connection of new Generation, Demand or HVDC equipment.

7 Relevant Objectives

Impact of the modification on the Relevant Objectives:	
Relevant Objective	**Identified impact**
To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity	**Positive**
To facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity)	**Positive**
Subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole	**Positive**
To efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency; and	**Positive**
To promote efficiency in the implementation and administration of the Grid Code arrangements	**Neutral**

The EU Connection Codes derive from the Third Energy Package legislation which is focused on delivering security of supply; supporting the connection of new renewable plant; and increasing competition to lower end consumer costs. It therefore directly supports the first three Grid Code objectives.

Furthermore, this modification is to ensure GB compliance of EU legislation in a timely manner, which positively supports the fourth Grid Code applicable objective.

8 Implementation

This modification must be in place to ensure the requirements of the EU Connection Codes are set out in the GB codes *by* two years from the respective Entry Into Force dates (set out earlier in this paper).

It is therefore crucial that this work is concluded swiftly to allow the industry the maximum amount of time to consider what they need to do to arrange compliance.

9 Legal Text

Not yet agreed

10 Recommendations

Panel is asked to:

- Approval ‘normal’ code governance procedures be used
- Refer this proposal to a Workgroup for continuing the formation of proposals