GC0156 Future Networks Subgroup Report

Contents

nationalgridESO

1 Executive Summary

The ESO has been directed by the Secretary of State that in accordance with Special Condition 2.2 of the National Grid Electricity System Operator's Transmission Licence, The Electricity System Restoration Standard is set at –

a. 60% of electricity demand being restored within 24 hours in all regions, and

b. 100% of electricity demand being restored within 5 days nationally.

It is an essential requirement for the NETS to have electricity system restoration capability. The ESO delivers this requirement by determining and procuring sufficient system restoration capability for the NETS on an ongoing basis.

The purpose of this direction is to require that the ESO –

a. Ensures and maintains an electricity restoration capability; and

b. Ensures and maintains the restoration timeframe.

Note: In accordance with the advice from BEIS- at GC0156 "electricity demand" will be calculated by way of the forecast of the next peak transmission demand.

Objective

The objective of this report is to cover at an appropriate level of detail the enhancements required for Transmission & Distribution Networks, Transmission Licensees, Network Operators, CUSC Parties and the ESO in the future to facilitate the ESRS particularly on:

- Resilience
- Network Design
- Operational Capability
- Protection Systems

Within the body of the report, each topic reflects the proposals, dissention and alternatives where applicable.

2 Introduction

2.1 Secretary of State Direction

The ESO has been directed by the Secretary of State that in accordance with Special Condition 2.2 of the National Grid Electricity System Operator's Transmission Licence, The Electricity System Restoration Standard is set at –

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The purpose of this direction is to require that the ESO –

a) Ensures and maintains an electricity restoration capability; and

b) Ensures and maintains the restoration timeframe.

Note: "electricity demand" will be calculated by way of the forecast of the next peak transmission demand.

2.2 GC0156 & Future Networks Subgroup

The ESO has raised Grid Code modification GC0156 to ensure that the industry is aware of what requirements are necessary to ensure and maintain an electricity restoration capability, and restoration timeframes.

This document presents the needs identified by the Future Networks Subgroup and their suggested implementation routes together with the relevant changes to Codes.

Terms of References

Purpose/Scope

To determine further future network requirements that may have implications for network operators, transmission owners, offshore transmission owners and competitively appointed transmission owners to facilitate how the industry can meet the requirements of the Electricity Supply Restoration Standard (ESRS).

Assess and accept, or modify, the recommendations in the ESRS working group report (including any unresolved ESRS WG comments) and create proposals to the GC0156 working group.

Inputs

- ESRS Future Network Workgroup Report and the associated recommendations
- Relevant codes
- An understanding of the restoration process, demand restoration requirements, service provider (volumes, geographic distribution), and how these may change in the future.

Outputs

A report, to be delivered by 20 October 2022, covering all the below aspects and including at an appropriate level of detail, the enhanced functionality required from networks in the future to facilitate the ESRS:

- Proposals from the GC0156 Future Networks subgroup to the GC0156 working group
    - Outline of any changes necessary to the Grid Code
    - Outline of any changes necessary to the Distribution Code
    - Identification of likely necessary actions and/or changes beyond the scope of GC0156
- An indication of how the above changes affect the ESO, TOs, OFTOs, CATOs, DNOs, restoration service providers, and any other users, including timescales and costs for the adoption of any proposals where this is available from subgroup members. Note – potential cost impacts will be forwarded to the Markets and Funding Mechanism Subgroup.

Provide regular progress updates to the GC0156 WG.

Propose initial draft legal text for Grid Code and Distribution Code.

Members (Update based on Nominations list)

Role	*Name*	*Organization*
Chair		NGESO
Technical secretary		NGESO
Generator rep		
TO Rep		
DNO Rep		
Other		
Etc		

Standing Agenda

1. Safety/Wellbeing/inclusion moment
2. Actions update
3. Progress/project update
4. Analysis and discussion of issues within scope
5. Decisions/actions
6. Risk/Issues for escalation to GC0156
7. AOB

Logistics

- **Cadence –**Meetings scheduled bi-weekly.
- **Duration** – 4 hours
- **Location** – Teams Meeting
- **Submissions** due and pre-read – slides/papers with clear confirmation of input/decisions needed 5 business days prior. Papers are to be read ahead of the meeting.
- **Minutes –** to be taken and circulated with the Action/Decision Log

- **Quorum –** All standing members to attend. Deputies can attend with full decision-making authority delegated.
- **Disagreement** - Proposals will be based on majority decisions. Disagreement from the proposals shall be recorded.

Note: CATOs are not yet defined in the Grid Code, hence are not referenced in the draft legal text for GC0156, however, the subgroup considered CATOs and once implemented via GC0159, the legal text will be amended to include CATOs.

3 Resilience

3.1 Transmission Network Resilience

Proposal

The transmission network, where necessary, will need to be operable remotely during a System shutdown to be able to switch sufficient equipment to achieve the restoration standard.

For the Onshore TOs and Offshore TOs it will be required to ensure that substations they own/operate can be operated in a restoration situation for up to 72 hours following a Total or Partial Shutdown. This shall involve providing mains independent back up power supplies sufficient for a minimum of 72 hours, or the provision of alternative solutions, to enable plant and primary equipment to operate without normal site supplies.

Disagreements

None

Legal Text References

CC/ECC.7.10.1 and CC/ECC.7.11.1/2

STC to follow

Alternatives

None

3.2 Transmission Network Switching Speed

Proposal

The onshore TOs / offshore TOs (including TOs HVDC networks) shall have a capability to energize all transmission substations within 24 hrs. This means there should be no transmission substation that cannot be energized, if required, within 24 hours of a restoration event, provided that there is an energised section of the transmission system to which it can be energised. In practice, the TOs will need to have the capability to perform faster switching, allowing time for other parties e.g. Network Operators to discharge their obligations.

Transmission network switching:

- Gives access to generation and demand
- Migrates away from “resilient” auxiliary supplies to normal auxiliary supplies
- Facilitate creation of a single Power Island system that can be more easily managed

Operational capability and specific network design functionality will be needed to enable this speed of energisation.

Disagreements

See below

Legal Text References

ECC.7.11.3, OC9.4.7.10, OC9.2.1 and OC9.1.1

STC to Follow

Alternatives

It was proposed to limit this requirement to “Core” substations for the operational capability to energise within 24 hours.

Priority would need to be given to the core substations referenced within the System Restoration Plan to be energised first [within 24hours, or a shorter period as required].

Core substations to be defined to allow for flexibility (for example, substations within the skeleton network, referenced in a LJRP or DRZP etc) to cater for a credible range of restoration scenarios.

3.3 Migration from Resilient Auxiliary Supplies at TO Substations to Normal Auxiliary Supplies

Proposal

Onshore TOs, OFTOs, DNOs & IDNOs need to work collaboratively to understand which circuits supply the transmission substations normal auxiliary supplies and to be able to energise these circuits as soon as reasonably possible within 72hrs hence migrating from the resilient auxiliary supplies.

This will maintain the operability of the transmission substations from (or before) 72hrs onwards by Network Operators. Where the network quickly returns to serviceability, the need of fuel for auxiliary supplies is reduced.

All new design builds and refurbishments of transmission substations should consider a standardised approach for normal auxiliary LVAC power, such as from a SGT tertiary winding such that there is no reliance on supplies from another Network Operator’s system. This would aid resilience of changing back to the normal auxiliary supply from the resilient supply.

Disagreements

None

Legal Text References

CC/ECC.7.10.4

STC for Transmission Licensees’

Alternatives

None

3.4 Distribution Resilience

Proposal

DNOs shall ensure that the distribution substations that the DNO needs to operate during an Electricity Restoration event for System Restoration purposes have 72-hour electricity supply resilience. This is supported by the planning assumption that all such distribution substations will be re-energised within 72 hours. This will ensure that there are auxiliary supplies to provide sufficient protection to facilitate the clearance of faults when the distribution system is re-energised. Where auxiliary supplies to the DNO's relevant substations are supplied from the DNO's system, this may require some limited additional parts of the DNO system to be energised early.

Critical systems e.g., Control Centres, shall have 72-hour resilience to enable the DNO to switch demand (i.e., switching demand on and potentially off) on the distribution system in accordance with a pre-established Restoration Plan that is sufficiently flexible. Such a Restoration Plan will set out a plan to restore customer supplies in a range of credible scenarios of:

1. transmission and distribution connected generation resynchronisation,
2. transmission switching; and
3. distribution switching

to restore 60% of electricity transmission system demand in 24 hours. To achieve this co-ordinated transmission and distribution switching will be required within 24 hours.

The above two items will facilitate the restoration of the remaining customer supplies within 5 days.

Disagreements

None

Legal Text References

CC/ECC.7.10.4

Alternatives

None

3.5 Distribution Operational Switching

Proposal

DNOs should have the capability to switch demand in at sufficient speed to achieve 60% electricity demand restoration in 24 hours in their respective Licence Areas. This will need to take account for the time taken by other parties to undertake their tasks e.g. TOs to energise the relevant GSPs.

DNOs should have the capability to switch demand on or off to help manage Power Island frequency throughout the duration of the restoration event.

Disagreements

None

Legal Text References

ECC 7.11.3

Alternatives

None

3.6 User Resilience

Proposal

All CUSC parties and Restoration Service Providers shall be able to operate normally once auxiliary supplies are returned from the system.

User's plant and equipment will need to shutdown safely and enter a state of preservation that will facilitate them joining a power island within a reasonable time and at a reasonable run up rate, similar to a cold start. In particular, items, such as hydrogen cooling of generator windings, will need to be maintained during the shutdown.

Disagreements

Some stakeholders are concerned about the practicalities and cost of retrospective installation of resilience measures on existing plant and equipment.

Legal Text References

CC/ECC.7.10.1 and CC/ECC.7.11.1

DPC6.7.2, DPC6.8.3, DPC7.A

Alternatives

Please see Annex below.

3.7 Network Operators & Users

Proposal

Visibility of TOs', OFTOs', DNOs' Network to the ESO. For the DNO Network this is limited to assets within the DRZ as defined in the associated DRZP and any other assets as defined in the associated LJRP.

Communication between TOs', OFTOs' and the ESO

There is a need for resilience of assets required to facilitate visibility and communication of user control points to the ESO and user control points to their sites.

There needs to be operational capability resilience to any extended loss of supply within ESO, TOs', OFTOs', DNOs' and Users' control points.

The visibility and communication requirements above are required for restoration.

Disagreements

None

Legal Text References

CC/ECC.6.4.6.3c

DPC6.7.5

STC to follow

Alternatives

None

4 Onshore TO, Offshore TO and Interconnectors

4.1 Network Design

Proposal

The network needs to be designed holistically, so that the capability of new generation connecting is matched against the transmission system.

Proposed changes to the TO's and OFTO's systems and the connection of new Users, should be designed and built to be able to operate in a restoration situation with an electrically weak network i.e., considering reactive gain, inertia, inrush and the ability to energise and operate these with limited generator capability.

These requirements partly exist within the existing frameworks for TOs, but the STC and SQSS requires further review to ensure requirements are fit for purpose. The framework needs developing/updating to ensure OFTOs have similar requirements to the onshore TOs.

Proposals for network design that may be included in the STC or SQSS (includes but are not limited to):

- *Each user connection point will have a network designed around it to be able to energise a 0MW output to sufficient demand to load the generator above SEL, with only the reactive power from that User.*
- *No Load gain between adjacent substations must be designed so that it can be energised within a restoration situation. (i.e., circuit busbars and associate reactive plant) This would include energising from Anchor Generator/ Top up services to demand, and then other CUSC Parties.*
- *Once a power island is created with RSP, Network and demand, it must be possible to energise to the next user on the network to either offer auxiliary supplies or to Synchronise Power Islands.*
- *The ability to deliver reactive compensation in steps of up to 60Mvar from a proportion of reactive equipment. Enabling utilisation of this equipment during a restoration.*
- *Compensation equipment, such as Static Compensators and SVCs should be energised and used within initial stages of a restoration.*
- *The ability to utilise Offshore Networks as part of the Restoration Process.*

Disagreements

None

Legal Text References

STC/SQSS To follow

Alternatives

None

4.2 Protection Systems

Proposal

Transmission systems owned/operated by TOs, OFTOs and Interconnectors should have the ability to change between predefined protection and control settings as required during the restoration, to align with the system strength.

For equipment and personnel safety, there needs to be the capability for protection to operate at different fault infeeds that could realistically be expected during the implementation of a LJRP or DRZP.

Disagreements

None

Legal Text References

STC to follow

Alternatives

None

4.3 Operational Capability

Proposal

Transmission systems owned/operated by TOs, OFTOs and Interconnectors should have sufficient operational capacity to energise a skeleton network across Great Britain, all substations energised by at least one transmission circuit within 24 hours. This will need to take account of the time taken by other parties undertaking their tasks, e.g. DNOs to switch to restore customer supplies.

TOs, OFTOs and Interconnectors should:

- when considering resourcing and systems, have the ability to open switches to “clear circuits” prior to energisation over the first 24 hours.
- have operational support for LJRPs/DZRPs within each Region and undertake operational planning during a restoration process.
- Have the ability to manage and expand Power Islands, including synchronising Power Islands together.

Disagreements

None

Legal Text References

OC9.1.1, OC9.2.1

STC to follow

Alternatives

The alternative is to modify the proposed requirement from all substations to core substations at the request of the TO’s. The ESO has clarified that for those substations that are not core i.e., will not have normal LV auxiliary restored, the relevant TO will need to develop how they can maintain capability during the restoration.

4.4 New Connections

Proposal

TOs, OFTOs and Interconnectors should develop solutions to meet any reactive power requirements imposed by the STC, Bilateral Connection Agreement (BCA) with Users and the Grid Code (ECC.6.3). Need to add flexibility so that reactive power is able to be provided at 0MW active power output.

There should be the ability for users (including Offshore Wind Farms) to operate in islanded mode i.e. providing reactive power at 0MW, when the transmission system is not energised / available.

There should be the ability to operate in weak transmission system conditions expected during restoration.

Disagreements

None

Legal Text References

CC/ECC.6.3.2.5.3

STC to follow

Alternatives

None

5 DNO and IDNO

5.1 Network design

Proposal

To develop a process to ensure that restoration is considered when designing the network, in partnership with TOs and ESO. This being for the initial restoration stages documented in an LJRP or DZRP, and later stages of restoration such as skeleton network and demand restoration.

DNO Network should be designed to have the:

- Ability to energise and block load, considering reactive gain between adjacent substations such that it can be energised within a restoration situation/ network arrangements.
- Ability to segregate areas of the network for LJRP and DRZPs.
- Ability to segregate block loads
- Ability to synchronise circuit breakers across the network
- Ability to manage embedded generation within a DRZs.

Disagreements

None

Legal Text References

OC9.4.7.5.1 (b)(x); OC9.4.7.5.1 (c)(xi); OC9.4.7.5.2 (a)(xii); OC9.4.7.5.2 (b)(xii); CC/ECC.6.4.6.3b

DOC9

Alternatives

None

5.2 Operation capacity

Proposal

DNOs should have the capability in operational timescale to:

- Switch their network to supply a minimum of 60% of electricity demand within 24 hours, in accordance with any agreed block loading requirements.
- Switch their network to supply 100% of electricity demand within 5 days.
- Estimate demand pick up (max and mins) associated with each block to help avoid going outside the capability of the Power Island.
- Provide support to demand balancing in a Power Island by switching on or off demand to maintain sufficient (head room / foot room between the demand and generator capability)
- Co-ordinate with an ESO led process of electricity sharing across GB, plus the DNO responding back to ESO for operations and reporting where applicable.

Disagreements

None

Legal Text References

OC9.1.1, OC9.2.1

Alternatives

None

5.3 Protection systems

Proposal

DNOs should have the capability to remotely switch between two protection and control setting groups on parts of their network referenced in a LJRP or DRZP (as required) during the restoration process.

For safe and efficient operation of the system, DNOs should have the capability for protection to operate at different fault infeeds that could realistically be expected during the implementation of a LJRP or DRZP.

Disagreements

None

Legal Text References

CC/ECC.6.2.3.7.2

DCode to follow

Alternatives

None

6 CUSC Participants

6.1 Restoration Service Providers & all CUSC Parties – Starting point recap

Proposal

Future Networks subgroup meeting 1 covered resilience requirements. In summary the agreed principles are

- ESRS will need Users to be able to operate normally once auxiliary supplies are returned from the system.
- Operational capability resilient to a total shutdown across user control points and generation.

Added for clarity:

All CUSC Parties, including existing parties, will be required to ensure that their plant and apparatus has a resilience period of up to 72 hours such that when supplies are restored their plant and apparatus shall be returned to service in an equivalent time scale that would be expected from a cold plant

Their plant and apparatus should be such that their plant can be shutdown in a safe manner in a Partial or Total Shutdown and remain in a safe state without external supplies for up to 72 hours so there is some assurance that the plant will not have to be subject to major component replacement thereafter.

Disagreements

SSE Gen remains unclear on the requirement for the 72hrs resilience. ESO responded that the requirement is as stated above. Drax also expressed concerns about retrospectively applying this level of resilience and submitted the note detailing their concerns which is included in the annex in section 9.

Legal Text References

CC/ECC.7.10.1 and CC/ECC.7.11

Alternatives

Please see Annex below.

6.2 Restoration Service Providers & CUSC Parties – Annual Data

Proposal

The ESO needs to understand the status of whether ESRS is likely to be met, and the ESO is developing a tool to aid decision making during a restoration.

Based upon the capability to be resilient and the ability of a generator to join a power island, the ESO will need the following data to be provided:

- Confirmation that installed equipment has resilience, and plant would be able to be operated.
- Design duration of the resilience at site.
- Predicted duration from the return of auxiliary supplies from the system/power island to synchronisation.

It is envisaged that this would be an annual data submission to the ESO, with provider notifications for any changes via PC – Week 24 data submission.

This requirement forms part of the Assurance activity.

Disagreements

None

Legal Text References

Assurance activity is in OC5 and System Test Plan

Alternatives

None

6.3 Other Non-CUSC Users (including those connected to DNO networks)

Proposal

There needs to be clarity on how other users will act during a restoration and the scale of this interaction with the power Island. The ESO will review the Grid Code Week 24 submissions and propose a change to Schedule 11 to ensure that for each power station (including embedded power stations) the following information is provided to the ESO:

Embedded generation and capacity installed

- G99 and G98 reconnection arrangements
- Availability of Distribution Restoration Zones and critical equipment outages to be provided by the DNO as part of OC2 data submissions.

Disagreements

See below

Legal Text References

OC2 and PCA.5.7.2

Alternatives

As an alternative it would be reasonable to assume, for embedded generators connected after April 2019 that the default arrangements in EREC G99 and EREC G98 have been adopted by the Generator. Same applies for Embedded Generators caught by the requirements of G59.

7 ESO and GB System

7.1 Management of Power Islands

Proposal

The ESO initiates the restoration process to form a Power Island and also manages the synchronisation between two or more Power Islands. This is the current arrangement.

Disagreements

None

Legal Text Reference

OC9.4.7.8, OC9.4.7.9, OC9.4.7.10, OC9.4.7.11, OC9.4.7.12, OC9.5

Alternatives

None

7.2 Regions Definition

Proposal

Within the drafting of the legal text, the definition of a Restoration Region will be codified aligning with the text below.

- Restoration Region – A single or number of DNO Licence Areas combined for reporting and process efficiencies.

Disagreements

None

Legal Text Reference

G&D

Alternatives

None

7.3 LJRP and DRZP Establishment

Proposal

The ESO leads the development of LJRPs and DRZPs in cooperation with prospective restoration service providers, TOs and DNOs. The ESOs' control room uses these plans to speed up the decision-making process, avoid errors and optimise the restoration process as a whole.

- LJRP - Local Joint Restoration Plan
- DRZP - Distribution Restoration Zone Plan

A DRZP is distinct from and falls outside the provisions of a Local Joint Restoration Plan.

Disagreements

SSE Gen queries why Restoration Service Providers within LJRP have 2hrs to re-energise vs Restoration Service Providers within DRZP which have up to 8hrs to re-energise.

Legal Text Reference

OC9.4.5.1, OC9.4.5.2, OC9.4.7.5.1, OC9.4.7.5.2

DOC9.4.2; DOC9.4.2; DOC9.4.6

Alternatives

None

7.4 Electricity Sharing across regions

Proposal

To achieve the ESRS regionally there will be a need to determine electricity supplies available to each Restoration Region, and the demand connected in that Restoration Region.

During normal system operation

- Demand data will need to be collated for each Restoration Area via OC2.
- There will be a requirement codified for ESO to publish on a daily basis the 60% and 100% transmission demand forecasts that would feed into the ESRS regional restoration targets.

During a restoration event

- Current demand data will need to be collated and a forecast of demand made for each Restoration Region.
- There will be a codified requirement for the ESO to communicate the current and forecast demand required in each Restoration Region.

Disagreements

None

Legal Text Reference

OC9

OC2 To follow

Alternatives

None

8 Virtual Lead Parties (VLP)

8.1 VLP Categories

Proposal

1. VLPs who are Restoration Service Providers: These VLPs which are registered as Restoration Service Provider and their assets are providing restoration services as contracted and they would have to be capable of controlling their assets during a system shutdown remotely in accordance with the critical tools and facilities requirements as provided for in CC/ECC.7.10 and the assurance activities of CC/ECC.7.11of the draft Code.
2. VLPs who are CUSC parties: They do not have a Restoration Contract (i.e. Anchor Plant Restoration Contract or Top Up Restoration Contract) but they are CUSC Parties and would have to be capable of controlling their assets during a system shutdown remotely in accordance with the critical tools and facilities requirements as provided for in CC/ECC.7.10 and the assurance activities of CC/ECC.7.11 of the draft Code. The only exception to this would be a BM Party who has limited control point access as provided for in CC/ECC.7.9 which is a very limited set of cases.
3. VLPs who are non - CUSC parties: These VLPs are not a CUSC party or Restoration Service Provider, they are not in the BM and there is no agreement with the ESO. They have therefore, as far as GC0156 is concerned, no obligations and would not be caught by the requirements of the Grid Code or BSC.
4. The 4th type of VLP is a combination of all three/two of the above. In this case the rules above would apply depending upon how the sites are aggregated and how each VLP is registered.

9 Annex

Views on Resilience Requirements - Drax

At the GC0156 workgroup on the 18 August it was highlighted that the ESO had set out to the Future Network subgroup that are the ESO is going to propose, as part of the GC0156 solution, additional mandatory requirements on all CUSC participants generators which are not contracted to provide Anchor or Top Up services. These proposals are detailed in the minutes of the Future Network subgroup meeting of July 2022 as follows:-

> *"CUSC Participants and other Users Restoration Service Providers / all CUSC Parties All in agreement except SSE Gen that:*
>
> *• CUSC Parties will be required to ensure that their plant and apparatus has a resilience period of up to 72 hours such that when supplies are restored their plant and apparatus can be returned to service in an equivalent time scale that would be expected from a cold plant.*
>
> *• After an initial period of 72 hours their plant and apparatus should be designed such that even without supplies for a further 72 hours their plant can be shut down in a safe manner such that it does not pose a risk to plant or personnel and without supplies for extended periods there is some assurance that the plant will not have to be subject to major component replacement*
>
> *• Consider including the requirements in the codes as proposed above and for legacy CUSC Participants where it is not economic or practical to meet the 72 hours resilient requirements, such CUSC participants can request for a derogation from Ofgem."*

This note is a rough discussion of these proposals including areas which might need further thought and consideration. The initial part of the discussion goes through the normal process if a non-contracted[1] generating unit trips at the moment with the transmission system in a normal state. Then the discussion gives my initial rough view of what would happen now if a blackstart was to occur before the ESRS. Finally there are questions where I think further thought is required and more general discussion on the areas which I think need to be considered further.

Scenario 1 - A Trip of a Generating Unit whilst Transmission System is Operating Normally

For context I think it is firstly helpful to understand what the current arrangements and requirements are of a non-contracted Generating Unit which trips off whilst the transmission system is operating normally.

When a generator trips some protection device will probably have operated and the personnel at the Control Point will be assessing the situation and checking that the plant is shutting down correctly and safely. They have power on-site to be able to perform these tasks. They will drop the generating unit's MEL to 0MW and issue a REMIT notification, the ESO's ENCC will telephone the personnel at the Control Point to establish an initial cause and whether it is likely that a rapid restart is going to occur. In this situation the personnel at the Control Point are now not obliged to follow any instructions from the ENCC relating to this generating unit whilst the generating unit is off or

[1] That is they are not, currently, a contracted Black Start station or, in the future, based on GC0156, a contracted Anchor or Top-Up service provider.

unavailable to generate as per CC.7.9 a & ECC.7.9 a. The personnel at the Control Point shall then assess what has happened whether it is safe for them to return the plant to service and if they have the capability to do so with the resources available to them: note they may not be at the generating site. They may require additional resources to assess the situation or go to the site to carry out repairs or reset equipment and they will send them to the appropriate site, whilst revising the REMIT declaration as require. During this period it is not in the Generator's best interest to keep the generating unit out of service for any longer than required as its energy position will be out of balance and it will be costing money, if the unit is off or predicted to be off for a long period the traders will adjust PNs to get the energy position back to balanced position. Once the unit is fixed, in a timescale set by the generator, there are 2 options to return the unit to service depending on the timescale and whether the PN has been brought back to 0MW or not as follows:-

1) If the unit is returning quickly and there is still a non-zero PN then the personnel at the control point will contact the ENCC by telephone explain what they are planning to do and request permission to synchronise the unit. They will also submit a MEL which they will profile to show the unit's load increasing over time to get the unit back to the PN. Once the MEL is raised above zero or the unit starts to generate the Control Point must follow instructions from the ENCC relating to this unit; or

2) If the unit has been off for a longer period and the PN is now zero then the personnel at the Control Point shall raise the unit's MEL to its current available generation capacity and the Control Point personnel must now follow ENCC instructions relating to this unit. At this point the ENCC could issue a BOA to start the unit based on its dynamic parameters and specifically NDZ (which could be a cold start time). Otherwise the unit will be started once trading schedule a non-zero PN.

The key points are that start-up times NDZ and instructions from ENCC to start a unit, only apply from the point that the personnel at the Control Point declare that the unit is available to generate.

Scenario 2 - A Transmission System Collapse causing a Trip of a Generating Unit

When the transmission system collapses most, if not all, generating units which were in service will have been shutdown by the action of a protection device, these will be a mixture of overload, overspeed, under-voltage, over-voltage and other relays. Whilst this appears on the face of it to be similar to the generator trip described previously the personnel at the Control Point will be seeking, **without power on-site**, to do as many of the tasks as practical, such as assessing the situation and checking the plant is shutting down correctly and safely, however they may now be dealing with numerous units tripping simultaneously along with other systems shutting down. They will seek if possible to drop the generating unit's MEL to 0MW and issue a REMIT notification (if the associated reporting systems and tools along with the communication route to them externally still works). Given the ongoing situation on the wider transmission system it is highly unlikely that , not sure if the ENCC will telephone the personnel at the Control Point at this point (as they will be busy dealing with their own alarms, talking to TO and DNO control rooms and the contracted Black-start / Anchor and Top-Up service providers etc.,). Again, in this situation the personnel at the Control Point are now not obliged to follow any instructions (including emergency instructions as these are a subset of instructions) from the ENCC relating to this generating unit whilst the generating unit is off or unavailable to generate as per CC.7.9 a & ECC.7.9 a. As these generating units being discussed here do not have Blackstart Contracts (or, in the future, with GC0156, Anchor or Top-Up contracts) then the personnel at the Control Point shall then seek to assess what has happened and whether, given the lack of power on-site, it is safe to do so, noting that the generating unit will not be capable of starting at this point as there are no external power supplies to the site.

Given that the whole site will have shutdown and probably not in a controlled manner the requirement for additional staff resource to assess the situation or go to the site to safely carry out (where practical, given the lack of power supplies on-site) repairs or reset equipment will be higher and there are now potentially multiple sites that will require such site visits. This is a much bigger problem than the situation discussed in Scenario 1 as (i) there will not be power on-site and (ii) even for a single site there will be much more equipment needing attention.

The personnel at the Control Point will now have to seek, if possible, to contact the additional resources off-site, however it is likely at this stage the only arrangements in place, at the moment, will be via the telephone/mobile telephone network which probably will not work. [Question for each site who will they need to contact are they just staff who are off-duty or do they need to contact contractors for certain activities]. Assuming eventually resources get to some sites they can then start to assess the situation which will be worse than just a simple generating unit trip under Scenario 1 as various auxiliary processes will, in the absence of power, have just stopped in the condition which they happen to be in at the point power supplies were lost. Whilst non-return valves may stop reverse flow, (powered) motor driven actuators are unlikely to have closed valves and these systems need to be fully assessed. The personnel can seek to safely start to reset and fixed issues but there are limits to what they can do as the site will not have any external power supplies.

At some point the ENCC with seek to contact the personnel at the Control Point, via the Control Telephony, to say they are about to energise the transmission line up to the site. However, depending on the time lag between the system shutting down and this call from the ENCC, those members of staff would be operating in a cold dark control room with limited (if any) sustenance and, depending on local circumstances, may not have been replaced in term of shift cover (as the next shift may have difficulty getting to-site). [Question how will the personnel at the Control Point decide what is the best location to send their resources to as it might be they have been sent to the site the ENCC is about to energise but the resources could have been sent to another site]. Once external power is available at the site the Control Point and the personnel on-site will then seek to safely start to re-energise the site and whilst some of these systems may be part of the normal unit start-up procedure (like with Scenario 1) there are systems on-site which might be very rarely shutdown or started and not part of any normal (Scenario 1) process, i.e. CW systems and the demineralisation plant. Also given the demineralisation plant will have been out of service there will have been no topping up of reserve feed water stocks which will now only have levels dependent on what was happening before and site evaporation rates, it is not unheard of for units returning to service with delayed or long start-up time at the moment to run out of feed water. Similarly, all motors and other electrical devices on site may also have tripped requiring reset.

Whilst in theory it is possible to remotely reset protection devices I think a large number of these devices will still need an operator to visit the site in person and go to each of the relay locations and safely reset it. Even if you assume the Control Point is able to remotely reset the relays, you then get into Company procedures and practices relating to the safe operation of protection devices and will the Control Point be allowed to reset the relays given that these are unlikely to be spurious trips. I imagine that Companies will require someone, in person, to assess the safety situation on the ground and decide that the plant and apparatus is not damaged and safe to be returned to service.

Eventually, some time after external power supplies are restored, the site will get to its normal starting position (that is as per Scenario 1) and I think using the standard start up times from this point onwards is a sensible approach but there needs to be an additional time added prior to this, which is an estimate of the time from site energisation (after a system shutdown – Scenario 2 – situation) to a generating unit being available to start as per it's normal dynamic parameters, that is akin to Scenario 1. Whilst this new time to be ready to start normally to might be added as a standard week 24 data item it might need more regular updates to highlight any site issues.

Now that the unit is fixed, in a timescale set by the generator, then the personnel at the Control Point shall safely raise the generating unit's MEL to its current available generation capacity and the Control Point personnel must now follow ENCC instructions relating to this unit. Presumably at this point the ENCC will issue an emergency instruction to start the unit based on its dynamic parameters and specifically NDZ (which could be a cold start time).

Again, the key points are that start-up times NDZ and instructions from ENCC to start a unit, only apply from the point that the personnel at the Control Point declare that the unit is available to safely generate. This is the same as the Scenario 1 example as I cannot see any additional existing rules which apply to non-blackstart providers during a blackstart.

Even once one of the generating unit gets to the point of being available to return to service, after a loss of power supplies, there then is the issue of control once the generating unit synchronises. Is the generating unit capable of safely operating in speed sensitive mode and are the personnel at the Control Point able to do this or will governor control need to be done locally at the governor panel (these are not blackstart service providers so this functionality might not have been enabled). Similarly, will the staff on-site understand how this works as they will probably never have used (BAU) the governor in this control mode? Also will there be an agreement with the ESO as to what instruction are being given? I can see chaos and confusion as everything in BC2 refers to target frequency and load control operation but the governors need to be in speed control. Manufactures are clear that load control is <u>not</u> suitable for island operation and even have automatic change-over arrangements which could quite quickly cause operators to either not be able to control the plant or understand what is happening, this situation could be execrated by the ESO also not understanding and sticking to target frequency instructions. In an island everyone needs to be in frequency sensitive using speed control, and not load control with a frequency influence which is the way most plants operate BAU now. The ESO needs to explain (well ahead of time) what instruction will be given to the sites; i.e. will they be giving load instructions or frequency instructions; also these instruction need to be similar to current MVAr instructions in that a site makes an adjustment to match the required instruction, but once the generating unit is in this condition it then lets the load and frequency drift and does no corrections until the next instruction as other sites will be affecting its load and speed. (Before some says this is LJRP detail the Grid Code says as soon as a second unit joins the island the LJRP ends).

Finally, assuming there are now generating units operating island networks which will be demand dominated how will the communications between the ESO, non-contracted Generator's Control Point and Distribution Control Point work?

General Comments

Whilst I can understand the benefits to the ESO if all generating units are capable of being brought on quicky after a system blackout, as a general comment all plant will not technically be able to achieve this as, for example, currently in GB no nuclear sites will be able to return to service within this period (unlike, for example, similar plant in Belgium), and other plants may be dependent on the position of available fuel such as hydro, gas, wind etc., (or are they now going to have to hold reserve, and if so, who is going to pay for that reserve?). Then there are staff resource issues and location issues, whilst Control Points can operate plant under normal condition if there is an issue now-a-days some Control Points need to call in additional staff resources if there are more serious issues as they may not be actually located at the generating site, and even when they are they still might need to call people out – such people may well include external contractors, whose availability in a National Power Outage situation cannot be assured on personnel safety and other grounds.

It would be more helpful if there was a more detailed plan from the ESO on how the restoration process is going to work which could then be assessed to see what generation availability profile is actually required to meet the ESRS. This can then be compared with what generators believe is currently available, then what could be made available relatively cheaply and then decide what requirements are needed. It does not seem reasonable to insist that all non-contracted parties need to provide the 72 hours resilience the ESO is proposing without even looking at whether it is possible or practical at each site or what the costs are, without fully assessing the need and then telling Users they then need to apply for a derogation (the legal status of which is currently unclear).

I am also not sure it is right for the workgroup just to place action on OFGEM to decide if generators are unable to comply with the new requirements without doing any assessment of what is physically possible, what can be done at a cost and more importantly what is actually required? It is obvious that, currently, GB nuclear sites cannot comply with the 72 hours[2] due to xenon poisoning, similarly is it possible for other sites to actually hold 72 hours of processed water or raw water with processing capabilities and other issues.

There then is the question that currently the LJRPs only apply to contracted Blackstart provider sites (which, in the future, with GC0156, will become Anchor and Top-Up service providers) and as soon as any other generation site connects the LJRP ends, does there need to be a “site specific area energisation and start plan” for all non-contracted power stations, interconnectors and other providers of restoration services or even just these identified as being part of the system restoration. This plan would identify what and when the site requires to restart also what other services in the area are required to keep the site functioning and how these are also going to be restored. My initial thoughts on areas which need further consideration for a site restart plan are listed below but are also good starting assessment for sites to identify what they are currently capable of achieving if they were to restart the site from dead today.

What other services do sites need:-

i) How much power is needed to energise the site, operate all the auxiliaries and restart the plant and apparatus?
ii) Are there off-site communications between the control point and the generating unit?
iii) Is the site self-contained and only has electricity supplies to the single site or are there other locations which need power from other external supply points i.e. for hydros is power required at dams and intakes, gas sites with remote gas take-offs/ pressure reduction stations, remote CW pump houses, etc
iv) Does the site need a mains water supply to generate electricity and will the water supply be available with no external off-site power in the local area? Typically how much raw

[2] However, in order to avoid discrimination, will the ESO be including nuclear plant within this new proposed 72 hours obligation for non-contracted generators?

water is stored and how much processed demineralized water is held on-site also will the water treatment plant operate without external power. How long can the site run at low load without an external water supply, also assuming there is power to the demineralized plant how long can low load be maintained, also what load is typically required to recirculate water and in this condition how long can the site run at normal leakage rates without external water supplies?

v) Does the site have a required a minimum electrical system strength or fault level before the generators can be connected?

vi) Is the current site staffing level capable of autonomously restarting the plant and apparatus once re-energising the site occurs? Or does the Control Point need to call out additional staff or do they need to call in contractors?

vii) What are the current hold capacities of other stocks required on site?

viii) What fuel stocks are held on-site and how long could the site run once the site is re-started with no fuel delivery? Coal, biomass, oil, gas, hydro (water), wind, battery and pump-storage (water).

ix) What (if any) is the current level of site back-up fuel supplies and duration?

x) From power being made available at site what is the sites current estimate to get into a position that normal NDZ applies?

Notes on GC0156
retrospective applicati