Emergency Disconnection of Embedded Generation

Draft paper for discussion at the Grid Code Development Forum

Relevant documents

The Grid Code: BC2.9, OC6

Balancing Principles Statement: Part B Section 5 – available online at

https://www.nationalgrid.com/sites/default/files/documents/Balancing%20Principles%20Statement%20v15%20Effective%20from%201%20April%202017.pdf

CUSC: 5.2 and the associated definition

The Issue

Under Emergency Conditions, The Grid Code allows NGET to

- issue Emergency Instructions to directly connected Power Stations and embedded Large Power Stations to either change their output level or to deenergise them when it is necessary to do so.
- issue Emergency Instructions to DNOs to reduce demand or to manually disconnect demand.
- implement demand reduction on Non-Embedded Customers or manually disconnect them.
- Disconnect Network Operators and/or Non-Embedded Customers at Grid Supply Point.

However, similar provisions that allow NGET to issue Emergency Instructions to disconnect embedded Small Power Stations or embedded Medium Power Stations are subject to interpretation with the only clause that could be interpreted[1] to allow this is an example of Emergency Instructions that could be issued to DNOs (BC2.9.3.3 (e)).

BC2.9.3.3	Instructions to **Network Operators** relating to the **Operational Day** may include: (a) a requirement for **Demand** reduction and disconnection or restoration pursuant to **OC6**; (b) an instruction to effect a load transfer between **Grid Supply Points**; (c) an instruction to switch in a **System to Demand Intertrip Scheme**; (d) an instruction to split a network; (e) an instruction to disconnect an item of **Plant** or **Apparatus** from the **System**.

The Risk

Emergency Instructions are used to protect the integrity of the National Electricity Transmission System, to prevent damage to equipment, and prevent injury to public and personnel under emergency conditions.

Where these risks are caused or exacerbated by an embedded Small or Medium Power Station, NGET might not be able to issue the Emergency Instruction to prevent such risk.

[1] NGET is of the opinion that this is allowed however some parties have different views.

As the installed capacity of embedded Small, and Medium, Power Stations continue to increase, the risk that the National Electricity Transmission System, public, and personnel are exposed to will also increase.

Where the consequence of leaving the embedded Small or Medium Power Station(s) running would be deemed unacceptable or unsafe, NGET may have to contain the risk by disconnecting an entire Grid Supply Point[2]. This would lead to unnecessary loss of supply and widespread disruption.

Interim Arrangements

In order to minimise the risk, and as a part of the Connection Application process (Statements of Works) NGET agreed interim arrangements with some DNOs who have to provide the facility to accept Emergency Instructions from NGET to disconnect tranches of Small and Medium Power Stations embedded within the DNO's System. For these cases, it was agreed to use a process that is roughly similar to the process used form Manual Demand Disconnection under OC6.

These arrangements were stipulated in Appendix F of the relevant Bilateral Connection Agreements. They only apply only to the Small Power Stations and the Medium Power Stations listed in Appendix G of that Agreement.

The practical implementation and the associated processes have been agreed bilaterally between the NGET Control Room and the Control Rooms of the relevant DNOs. However, the process is more or less consistent between all DNOs.

Enduring Arrangements

In order to ensure consistency, it is necessary to modify the Grid Code such that the provisions and the processes required to allow NGET to issue Emergency Instructions to disconnect generation embedded within a User's System are clear and consistent among all DNOs.

Where necessary, change the relevant codes including CUSC, Distribution Code, BSC, to ensure that the "legality" of the process.

It will need to be agreed whether the requirements

- would apply retrospectively or only in relation to power stations connected after a certain cut-off date; and
- would apply for all embedded generation or for generation above a certain capacity (i.e. generation that is needs to provide the facility to be able to accept such instructions under RfG)

[2] In practice, this would only be effective if the GSP is exporting or if the risk is due to a specific plant or to an unidentified plant at a specific GSP. In some parties' opinion, an exporting GSP ceases to be a GSP and hence there could be a legal issue. However, if the issue raised by this paper is addressed, the risk of GSP disconnection will be reduced and hence the legal definition is not thought to be an issue at this moment.

Whereas it is desirable to ensure that the requirements apply consistently on all embedded generation, a pragmatic solution will need to recognise the ease of implementation and any legal/contractual risks that needs to be taken into account. However, it needs to be recognised that where it will have been chosen that such requirements apply only on generation connected after a certain date or above a specific capacity, there may be a need in the future to revise this position.

Utilisation of Emergency Instructions

Emergency Instructions are issued only in emergency circumstances – as determined by NGET in its reasonable opinion.

Examples of what may constitute an emergency situation are listed in BC2.9.1.2 and are further explained in the Balancing Principles Statement. Some of these situations are related to the inability of the market to provide a workable solution within the normal operating range of the plants available (BC2.9.1.2 b, c, d, and e-iii). The rest of these situations are related to incidents that are not triggered by market failure (BC2.9.1.2 a, e-i, and e-iii)

BC2.9.1.1	Examples of circumstances that may require the issue of **Emergency Instructions** include:- (a) **Events** on the **National Electricity Transmission System** or the **System** of another **User**; or (b) the need to maintain adequate **System** and **Localised NRAPM** in accordance with BC2.9.4 below; or (c) the need to maintain adequate frequency sensitive **Gensets** in accordance with BC2.9.5 below; or (d) the need to implement **Demand Control** in accordance with OC6; or (e) (i) the need to invoke the **Black Start** process or the **Re-Synchronisation of De-Synchronised Island** process in accordance with OC9; or (ii) the need to request provision of a **Maximum Generation Service**; or (iii) the need to issue an **Emergency Deenergisation Instruction** in circumstances where the condition or manner of operation of any **Transmission Plant** and/or **Apparatus** is such that it may cause damage or injury to any person or to the **National Electricity Transmission System**
Balancing Principles Statement	(a) **Events** Events on the GB Transmission System or the System of another user that lead or could potentially lead to insecure system operation and for which insufficient relevant Bid-Offers are available to restore system security. The Grid Code defines an 'Event' as: *'An unscheduled or unplanned (although it may be anticipated) occurrence on, or relating to, a **System** (including **Embedded Power Stations)** including, without limiting that general description, faults, incidents and breakdowns and adverse weather conditions being experienced'.* (b) **Demand Control** (detailed in OC6.5 to OC6.8) Operating Code No. 6 (OC6) of the Grid Code is concerned with the provisions to be made by Network Operators, and in relation to Non-Embedded Customers by us, to permit the reduction of demand in the event of insufficient active power generation being available to meet demand, or in the event of breakdown or operating problems (such as in respect of system frequency, system voltage levels or system thermal overloads) on any part of the GB Transmission System. (c) **System and Localised Negative Reserve Active Power Margin** (detailed in BC2.9.4 of the Grid Code). BC2.9.4 details the actions that we can undertake in ensuring that: - the sum of synchronised BMUs at all times are capable of reducing output sufficient to offset the loss of the largest secured demand on the system and - synchronised BMUs at all times are capable of reducing output to allow transfers to and from system constraint groups to be contained within the required limits. In both cases this action must be sustainable. **System Negative Reserve Active Power Margin** It should be noted that if the System Negative Reserve Active Power Margin (NRAPM) is not met then the resulting high frequency following the loss of the largest secured demand

would not be abated.
Where we are unable to satisfy the required System NRAPM we will select (and instruct) BMUs for De-synchronising on the basis of Bid-Offer Data submitted to us.

Localised Negative Reserve Active Power Margin

If Localised NRAPM are not maintained then it may not be possible to alleviate incidences of thermal overloading, system instability and voltage problems following transmission system faults.
We will select and instruct BMUs for De-synchronising on the basis of Bid-Offer Data submitted to us and their effectiveness in restoring the Localised NRAPM to the required level.

- In the event that we are unable to differentiate between BMUs according to Bid-Offer Data and/or their effectiveness in restoring any Localised NRAPM, we will, where time permits, select BMUs in accordance with the General Principles described above.

(d) **Black Start** (Detailed in OC9 of the Grid Code)
The need to invoke the Black Start process or the Re-Synchronisation of De-Synchronised Island process in accordance with OC9.

(e) **Maximum Generation Service**
The need to request the Maximum Generation Service would normally be in order to maintain system security in the event that all valid and feasible Bids and Offers have been accepted in the BM and any Demand Side Balancing Reserve (DSBR) and any available Supplemental Balancing Reserve (SBR) have been despatched. Where possible, the request for Maximum Generation Service will take place prior to the instruction of any measures related to Demand Control under OC6 1.2.(c), (d) or (e) of the Grid Code. Information relating to the instruction of the Maximum Generation Service will be published on the BMRS as soon as reasonably practicable.
The Maximum Generation Service will only be instructed where a BMU has been instructed to, or is generating at, its Maximum Export Limit.
For the avoidance of doubt, valid and feasible Bid and Offers are those Bids and Offers which facilitate the delivery of energy within the relevant Settlement Period. Under certain exceptional circumstances, it may be necessary to invoke the Maximum Generation Service before all valid and feasible Bids and Offers or any available Supplemental Balancing Reserve have been accepted. These circumstances may include:

(i) where the call off of available Offers would lead to an erosion of the system reserve for response below the required level;
(ii) where the acceptance of relevant Offers would lead to the depletion of reactive reserves below the required levels; and
(iii) where no other plant with suitable dynamics is available

For the avoidance of doubt, the decision to instruct the Maximum Generation Service will be taken based upon the prevailing system conditions on the transmission system. The price of other available actions offered through the BM will have no bearing upon the decision to instruct Maximum Generation Service.

(f) **Frequency Sensitivity** (Detailed in BC2.9.5 of the Grid Code)
The need to maintain adequate frequency sensitive Generating Units in accordance with BC2.9.5.

(g) **Communication Failure**
Where unplanned outages of the electronic data communication facilities or NGET associated computing facilities has occurred preventing normal BM operation.

In general, all commercial actions that would resolve the issue would be taken prior to resorting to Emergency Instructions provided that such commercial actions could be implemented in the timescales available.

NGET determines whom the Emergency Instruction will be issued to based on a set of rules and principles that are published in the Balancing Principles Statement. These are generally based on effectiveness, cost, and plant technical capabilities.

Balancing Principles Statement	**General Principles for Issuing Emergency Instructions** Where we identify the requirement to issue Emergency Instructions, and time permits, we will do so with due regard to the following principles: (a) We will instruct those BMU[3]s that are most effective in relieving the system problem; (b) Where BMUs have a similar level of effectiveness in relieving the system problem we will select on the basis of submitted Bid-Offer Data; (c) Where it is not possible to differentiate between the effectiveness or cost of BMUs we will instruct on the basis of: - Effect on power flows (resulting in the minimisation of transmission losses) – BMUs that would lead to the greatest reduction in transmission losses being instructed first. - Reserve/Response capability – BMUs with a lower response/reserve capability being instructed in preference to BMUs with a higher capability; - Reactive Power contribution – BMUs with a lower reactive power capability being instructed in preference to BMUs with a higher capability; - Dynamic Parameters - BMUs with more appropriate dynamic parameters being selected in preference to those with less appropriate parameters. (d) where several BMUs have been instructed in response to an incident we will restore those units, where dynamic parameters and system conditions allow, in the reverse order of their instruction.

In total, 13 Emergency Instructions were issued over the four year period from October 2012 to September 2016. 12 of these were issued to non-BM participants (Power stations that are the subject of a BELLA agreement) in order to resolve a Localised NRAPM issue.

No Emergency Instructions have been issued to DNOs to disconnect any Embedded Generation so far.

Reporting

Emergency Instructions are published on the Balancing Mechanism Reporting Service as they are issued. However, this information tends to be available only for a short period of time.

NGET publishes a summary of Emergency Instructions in its annual Balancing Principles Statement Report.

Compensation for Loss of Revenue following an Emergency Instruction

Customers disconnected by DNOs following an OC6 Emergency Instruction issued by NGET to manually disconnect demand and Non-Embedded Customers disconnected by NGET under Emergency Conditions do not receive any compensation.

Generators receive compensation for any Emergency Instructions in accordance with their Access Rights and their active participation in the Balancing Mechanism. Emergency Instructions Issued to active participants in the BM, including parties that do not hold TEC[4], are treated as Bid Offer Acceptance. Emergency Instructions issued to parties[5] that are not active in the Balancing

[3] For the purpose of discussing the priority list, assume that all embedded generation is a BMU
[4] Some BELLA parties choose to participate in the Balancing Mechanism.
[5] BEGA parties and BCA parties may choose not to submit Bid/Offer prices.

Mechanism do not attract compensation. Compensation for the loss of TEC (CAP48 payments), where applicable, would only be paid to parties that hold TEC.

Since this Grid Code modification does not

- affect the Access Rights for embedded Small Power Stations and embedded Medium Power Stations, or
- place a requirement on them to participate in the Balancing Mechanism;

and in order to ensure a level playing field, the expectation is that Generators will not receive any compensation for the loss of revenue due to the disconnection of their embedded Small or Medium Power Stations following an Emergency Instruction. Any change to this status quo will need to take place as a part of a wider review.

<u>Impact on DNOs</u>

I- Process Impact

DNOs will have to

- provide the capability and sign up to the process that will be set out in the Grid Code,
- submit additional data as a part of Week24 Submissions to ensure that NGET is aware of what capability is available within which timescales, and
- from time to time, carry out an Emergency Instruction to disconnect some of the Power Stations embedded within their Distribution System.

II- Contractual Impact

BCA between NGET and DNOs

Ideally, all the relevant requirements will be specified in the Grid Code. However, there may be a scope that some BCAs may have some site specific requirements in relation to Emergency Instructions. An example for this would be where some embedded generation has already been connected with Emergency Instructions being a part of their connection agreement, and provided that the Grid Code requirement would only apply after a future date, the relevant BCA will have to refer to such embedded generation sites in order to ensure that the existing facilities continue to be provided.

Connection Agreements between DNOs and embedded generation

It is not clear yet to what extent the contractual arrangements between DNOs and Power Stations Embedded within their system would change. It is noted that, through bilateral discussions with some DNOs, those DNOs already have such requirements included within their agreements. However, it is unlikely that all DNOs will have such clauses already within their contracts.

III- Security of Supply Impact

In the absence of the facility to disconnect embedded generation, and where an embedded power station imposes material risk to the integrity of the National Electricity Transmission System, other User's Systems, or to public and personnel, the only option available, although completely undesirable, to mitigate such risk could be the disconnection of the whole User's Network.

Therefore, the consequence of making such facility available would be to reduce the potential of having to disconnect an entire Grid Supply Point and, consequently, and increase in the Security of Supply.

IV- Legal Issues

There is a risk that where a DNO carries out an Emergency Instruction issued by NGET to disconnect an Embedded Power Station, this DNO could be left exposed to civil action taken by the owner of the Embedded Power Station[6].

Arrangements will need to be put in place, potentially via CUSC and the Distribution Code, to ensure that this risk is minimised.

Impact on Embedded Generation

I- Loss of Revenue

Embedded generation disconnected in response to an Emergency Instruction will suffer some loss of revenue.

This loss of revenue is not expected to take place on regular basis. With 13 Emergency Instructions issued over the period of four years, the overall risk a certain party is exposed to seems marginal. This risk exposure could be further reduced by ensuring the process does not discriminate against certain parties.

In addition, Generators could choose to participate in the Balancing Mechanism or any similar mechanism that may be developed at a later date to facilitate the visibility and control of embedded generation. They could also choose to offer additional services to NGET, either directly or via aggregators. This would reduce the risk that commercial actions available to NGET become insufficient to manage emergency circumstances and allow those Generators to receive constraints payments.

In all cases, any loss of revenue would be

- similar to that experienced by the same party if NGET finds itself having to disconnect the whole Grid Supply Point to manage the emergency situation, and

[6] CUSC currently requires that DNOs de-energise User's System connected to their distribution network in response to an instruction from NGET (See CUSC 5.2 for reference). With the User being defined as a CUSC Party, this would not cover embedded Small Power Stations or embedded Medium Power Stations. However, this suggests that, in principle, any legal consequences that arise from this should have been already covered.

- potentially less than that that could take place in cases where the integrity of the National Electricity Transmission System has been compromised.

II- Contractual Impacts

As discussed earlier, it is not clear yet how the contractual arrangements between DNOs and embedded generation would change, if at all.

Impact on the Grid Code

It is likely that the following sections of the Grid Code will need to be changed

BC2.9: Additional examples to stipulate that NGET could require DNOs to disconnect embedded generation to reduce the total output of embedded generation connected to their network and/or to disconnect a specific embedded power station

OC6 (or a new OC): To clarify the requirements of Emergency Disconnection of Embedded Generation and any data that are required to be exchanged between DNOs and NGET.

Impact on the other codes

CUSC, Distribution Code, and BSC could be affected to some extent. The scope of the change required might be limited due to the fact that the affected embedded generation is not party to CUSC or BSC.

Next Steps

1. Interested parties will be invited to the GCDF on the 7th of March to discuss this paper. Ideally, participants would include NGET and DNOs as the two main affected parties. Ideally elexon and ofgem would also participate. The aim is to
    - Clarify what the Grid Code modification is about,
    - Agree what the scope of the change is,
    - Identify what other changes to other codes are necessary
2. A follow up discussion on the same issue may be required in April to follow on actions from the previous meeting and ensure the correct modification proposals have been raised.
3. Progress a Grid Code modification and any other code modifications identified through the two workshops to change the Distribution Code, CUSC, and/or BSC.