

Statement of Works Materiality Trigger Review

User: **Distribution Network Operator Name**

Connection Sites Studied: **GSP1 XXX kV**
GSP2 XXX kV
GSP3 XXX kV

Materiality Trigger Review Application Date: **XX/XX/XX**

1. Introduction

This report describes the outcome of the assessment carried out by National Grid to determine the impact on the National Electricity Transmission System of the connection of further Relevant Embedded Power Stations (EPS) to your Distribution System beyond the existing Materiality Trigger. For the avoidance of doubt both generation and storage connections are classed as EPS connections.

Where the requirement for reinforcement/operational solution has been identified use the following paragraphs.

The assessment of the GSP(s) studied has determined that there is a requirement for solution(s) in order to accommodate increased volumes of EPS.

Discussions will be required between National Grid and the User in order to facilitate the development of operational solutions and/or reinforcement options on the transmission system or in the Users Distribution System. The suggested timescales for these discussions are covered in the materiality trigger response letter for each connection point.

Where no works are required use the following paragraph

The assessment of the GSP(s) studied has determined that there is no requirement for solutions in order to accommodate increased volumes of EPS along with the total materiality trigger headroom.

2. Report Summary

The a summary of the assessment outcomes of the materiality trigger review are listed by site below

Table 1

Connection Site (GSP)	Materiality Trigger [MW]	Fault Level Trigger [kA]	Network Limit	Solution Required for Firm Network Access	Solution Required for Connection/ Energisation
GSP1 XXX kV	50	3	N/A	No	No
GSP2 XXX kV	10	0	Fault Level	Yes	Yes
GSP3 XXX kV	0	3	Thermal	Yes	No

Brief Description of any network limit identified by GSP

GSP1 XXX kV

No issues.

GSP 2 XXX kV

The fault level issue is due to the rms break rating of circuit breaker XXX at site XXX kV being exceeded. See section 5 of the report.

GSP 3 XXX kV

The thermal issue was due to a thermal overload of the remaining SGT for a fault of the other SGT during Summer Minimum (PM) period. See section 2 of the report.

3. Thermal Studies

3.1. Connection Site

3.1.1. Overfluxing Study

Include this section where an overfluxing study has been carried out to determine if short term reverse power rating would be available. Where ANM is identified include short term rating available if ANM implemented in tables 2 & 3.

An overfluxing study has been carried out to determine if short term reverse power rating would be available via an ANM scheme for the SGTs at **GSP 1 and 2**.

The study has determined that the SGTs should not experience overfluxing when operating to the peak reverse power rating of 1.3pu for 5 seconds.

Or

The study has determined that the SGTs will experience unacceptable overfluxing for reverse powerflows in excess of 1pu therefore no short term reverse power rating will be available.

3.1.2. Grid Supply Point Reverse Power Limits

The reverse power limit is the maximum power that can be exported to the transmission system before the thermal capacity of the Grid Supply Point (GSP) is exceeded. The reverse power limits can be seen in the table below.

The GSP Capacity Margin is the difference between the reverse power limit and the maximum reverse power studied with the generation contained within the application. Where this number is zero or below there is no capacity and a reinforcement or operational solution such as an ANM is required.

Table 2

Connection Site (GSP)	Reverse Power Limit [MVA]	Fault/Outage Condition	GSP Capacity Margin [MVA]	Cap. Margin Study Background
GSP1 XXX kV	240 312 (5 seconds post-fault)	Fault outage of SGTX with a planned outage of SGT Y	-72 0	Summer Min (PM)
GSP2 XXX kV	180 234 (5 seconds post-fault)	Planned/fault outage of SGTY	50 104	Access Period Peak

3.1.2. Assessment Outcome

If there are no thermal issues, use the following:

No thermal overloads were identified at the Grid Supply Point(s) studied. There is sufficient thermal capacity for the EPS Studied.

If there are thermal issues, use the following:

The following thermal overloads were identified for which a reinforcement /operational solution is identified:

Table 3

#	Connection Site (GSP)	Overloaded Component	Rating [MVA]	Loading [%]	Outage/ Fault	Study Background/ Year
1	GSP1 XXX kV	SGTY	240 312 (5 seconds post-fault)	110 92	Outage of SGT X	Summer Minimum (PM)
2	GSP1 XXX kV	SGTZ	240 312 (5 seconds post-fault)	110 92	Outage of SGT X	Summer Minimum (PM)
3	GSP1 XXX kV	SGTZ	240 312 (5 seconds post-fault)	130 100	SGTX fault and SGTY planned outage	Summer Minimum (PM)

3.1.3. Possible Network Reinforcement & Operational Solutions

Section only required if thermal issues have been identified

Network reinforcement will be required for SQSS compliance[3] to resolve overload(s) 1, 2 and 3 in section 3.1.2. The following are viable solutions:

- Reinforce GSP XXX kV with an additional SGT
- An Active Network Management (ANM) scheme to manage the EPS to within the reverse power limits, including any short term capability identified in tables 2 & 3, of GSP XXX kV. This solution is a customer choice design variation to connection design.
- Alternate solution to be identified in the offer period.

3.1.4. Option Development

Section only required if issues have been identified

As overload(s) requiring reinforcement /operational solution at the GSP have been identified the following will need to be discussed between National Grid and the User in order to develop the solution:

The User will specify whether that an ANM scheme is their preferred solution to reinforce their GSP where additional reverse power capacity is required.

If they have confirmed this in the connection application form use the following:

- Confirmation from the User that an ANM scheme is the preferred 'customer choice' solution
- The operational requirements of an ANM scheme
- The transmission reinforcement solution that would be required if an ANM scheme is not pursued

If they have not confirmed that the ANM scheme is the preferred solution use the following:

- Whether an ANM scheme would be acceptable to the User as a 'customer choice' solution
- The operational requirements of an ANM scheme
- The transmission reinforcement solution that would be required if an ANM scheme is not pursued

3.2. Local Transmission Network

3.2.1. Assessment Outcome

If there is no thermal issues requiring enabling works use the following:

No overloads requiring enabling works were identified in the thermal studies of the local transmission network.

If are thermal issues use the following:

The following overloads which will require reinforcement prior to firm network access of the EPS were identified:

	Overload	Outage/Fault	Study Background/ Year	Possible solutions/ Reinforcement Options
1	Circuit 1	Circuit 2	Access Period Peak	Thermal Uprate circuit 1
2				

The following overloads which will require reinforcement prior to the connection of the EPS were identified:

	Overload	Outage/Fault	Study Background/ Year	Possible solutions/ Reinforcement Options
1	Circuit 1	Circuit 2	Access Period Peak	Thermal Uprate circuit 1
2				

The following n-3 overloads which met the criteria for operational intertripping were identified:

	Overload	Outage & Fault	Study Background/ Year	Possible solutions/ Reinforcement Options
1	Circuit 1	Circuit 2 outage & Double Circuit A	Access Period Peak	ANM
2				

3.2.2. Option Development

Section only required if issues have been identified

The transmission reinforcement options will be developed by National Grid. Operational solutions such as ANM or intertripping may also require operability and control works by the DNO and EPS customers which will need to be developed.

If there are works required for a firm network access

As overload(s) requiring reinforcement prior to the firm network access of the EPS have been identified there will need to be a discussion between National Grid and the User covering:

- If a firm network access is required for the EPS or an earlier non-firm network access is acceptable.
- If a non-firm network access is acceptable, under what outage condition(s) will be EPS be affected.
- The options to resolve the issue and make the EPS connections firm and potential timescales.

If there are works required before the EPS connect

As overload(s) requiring reinforcement prior to the connection of the EPS have been identified there will need to be a discussion between National Grid and the User covering:

- The options to resolve the issue and make the connections firm and when they are likely to be complete.

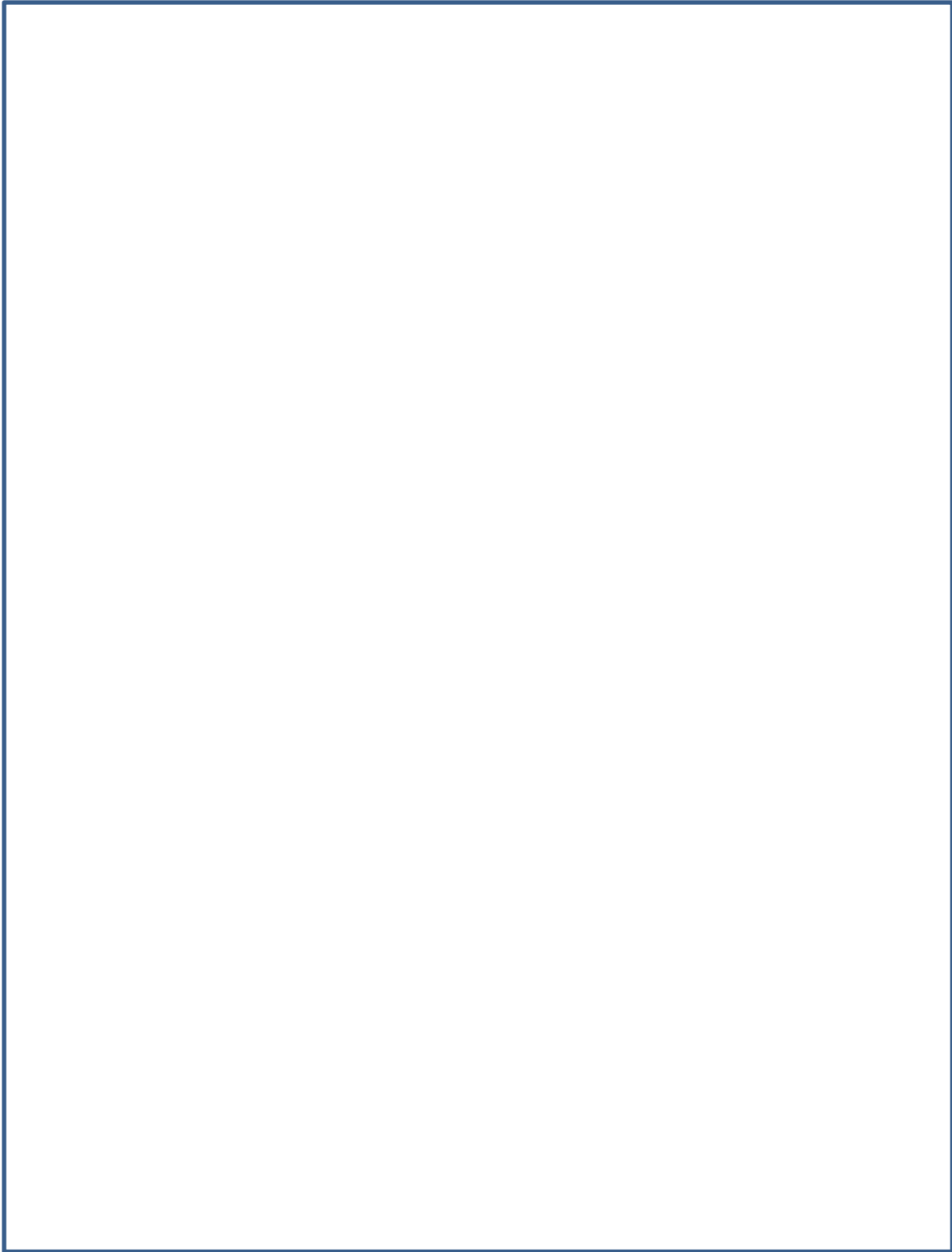
If the requirement ANM intertripping

As overload(s) that meet the criteria for ANM intertripping have been identified following the connection of the EPS there needs to be discussion between National Grid and the DNO covering:

- The outage fault combination(s) which cause the overload
- The study background and year
- The speed of the response required and the capability of the EPS.
- The volume of response and the EPS connections affected
- The works required by NGET, the User and EPS connections for the ANM intertripping in order to facilitate the operational intertripping of the required EPS.

3.2.3. Network Diagram Showing Affected Circuits

The diagram below shows the overloaded circuits referred to in section 3.2.1



4. Voltage Studies

The power factor control 0.95 lead/lag capability of the EPS was used within the voltage study and their set point was modified in order to offset the impact of the EPS on the voltage at the GSPs studied and the NETS.

4.1. Assessment Outcome

If there are no voltage compliance issues use the following:

No voltage compliance issues were identified in the voltage studies undertaken at the GSP and in local network.

If there are voltage compliance issues use the following:

The following voltage compliance issues were identified along with possible reinforcement options.

4.1.1. Connection Point (GSP)

Delete tables below if not required:

Pre and Post-fault Voltage Compliance

GSP	Node/ Busbar	Voltage [p.u]	Outage/Fault	Study Background	Possible Solutions/ Reinforcement Options
GSP1 XXX kV	MB1 GSP1 XXXkV	1.08pu	SHR 1 at SUB1 XXXkV [Fault]	Summer Min (PM)	New Reactor at connection point or ANM scheme to manage voltage

Voltage Step Change

GSP	Node/ Busbar	Voltage [p.u]	Outage/Fault	Study Background	Possible Solutions/ Reinforcement Options
GSP1 XXX kV	MB1 GSP1 XXXkV	-8%	SGT2 fault during SGT1 outage	Access Period Peak	New Running Arrangement at GSP1

4.1.2. Local Transmission Network

Delete table below if not required:

Pre and Post-fault Voltage Compliance

GSP	Node/ Busbar	Voltage [p.u]	Outage/Fault	Study Background	Possible Solutions/ Reinforcement Options
GSP1 XXX kV	MB1 SUB1 XXXkV (HV substation of GSP)	1.06pu	SHR 1 at SUB1 XXXkV [Fault]	Summer Min (PM)	Additional Reactor or ANM scheme to manage voltage

4.2.Option Development

Section only required if issues have been identified

4.2.1. Connection Point (GSP)

Section only required if issues have been identified at the GSP

In order to develop solution(s) to reinforce the GSP for voltage compliance the following must be carried out:

- The solution(s) to resolve the voltage non-compliance must be discussed and agreed between NGET and the User.
- Where ANM is a viable solution, the User will need to confirm if they want to pursue the customer choice design variation option of an ANM. If an ANM is required the operational requirements should be discussed.

4.2.2. Local Transmission Network

Section only required if issues have been identified on the transmission system

The voltage issues identified on the transmission system will need to be resolved prior to the connection of the EPS. Although the issue is on the Transmission system, Distribution system based solutions may be applicable. Therefore in order to develop solution(s) to reinforce the NETS for voltage compliance the following must be carried out:

- The solution(s) to resolve the voltage non-compliance must be discussed and agreed between NGET and the User.
- Where ANM is a viable solution, the User will need to confirm if they want to pursue the customer choice design variation option of an ANM. If an ANM is required the operational requirements should be discussed.

5. Fault Level Studies

5.1. Fault Level Trigger Headroom

The fault level trigger headroom for a GSP is the margin between the simulated peak make or rms break current and the equipment rating of the limiting component in a fault level study assessing the maximum fault level at the site using the G74 methodology. The fault level headroom of the limiting component is referred to the GSP voltage to determine applicable fault current at the GSP.

GSP	Fault Level Trigger (Peak Make) [kA]	Fault Level Trigger (rms break) [kA]	Limiting Component
GSP1 XXX kV	6	3	CB1 at SITE1 XXX kV
GSP2 XXX kV	0	0	CB2 at GSP2 XXX kV

5.2. Assessment Outcome and Possible Solutions

If there is no fault level issue use the following:

No issues were identified in the fault level assessment. The fault level headroom of the EPS transmission connection sites will be updated in appendix G in the BCA as above.

If fault level has exceeded the equipment rating:

The following issues were identified in the fault level assessment:

	Circuit Breaker	Location	Limitation - Breaker/Infrastructure Rating	Possible Solutions/ Reinforcement Options
1	CB2	GSP2 XXX kV	breaker rating (peak make or rms break)	new split running arrangement at GSP

5.3. Option Development

The solution to the fault level issue must be in place for the EPS to connect. The timescale for the delivery of the option will determine the earliest connection date.

Where the solution involves a new running arrangement at the GSP, for example running a site split, there may be a requirement to use an auto-close scheme to manage demand compliance. If this option is progressed NGET and the User will need to collaborate in order to develop the scheme, which may involve both parties running fault level and demand compliance studies; verifying compliance with SQSS and P2/6.

If the issue is on the NETS use:

National Grid will develop the solution(s) to resolve the fault level issue(s) on the local transmission system. National Grid will consult with the User in regards to this solution.

If the issue affects connection assets use:

National Grid will propose solutions to resolve the fault level issue(s) on the users connection assets system to be discussed and agreed with the User. National Grid will collaborate with the User in developing the agreed solution.

If the Issue affects user assets use:

National Grid will explain the fault level issue(s) affecting the User's assets. The user will need to verify the issue and develop the solution. National Grid will assist the User as required.

Terms and Definitions

ANM	Active Network Management Scheme – An operational scheme to alleviate overloads or other network issues via the control of DER.
BSP	Bulk Supply Point – the lowest voltage node modelled in NGETs representation of the relevant distribution network
DER	Distributed Energy Resources:
DNO	Distribution Network Operators
EPS	Embedded Power Station(s). See Power Station definition below.
Firm network access	A connection to the transmission system that is not restricted unless via balancing mechanism or during abnormal system conditions
GSP	Grid Supply Point – the interface between the transmission and distribution system
GSP Peak Demand	BSP demand data for the GSP maximum demand (typically occurring between 16:00 – 19:00 in Winter). DNO to specify the date and time of Maximum. This demand should not include the effect of embedded generation of a registered capacity greater or equal to 1MW
Maintenance Period Peak Demand	DNO to provide the maximum gross demand at the GSP during the maintenance period (between week 13 to calendar week 43 inclusive). This demand should not include the effect of embedded generation of a registered capacity greater or equal to 1MW.
NETS	National Electricity Transmission System
NGET	National Grid Electricity Transmission
Power Station	An installation comprising one or more Generating Units or Power Park Modules (even where sited separately) owned and/or controlled by the same Generator, which may reasonably be considered as being managed as one Power Station. The term Power Station includes generators and energy storage.
SoW	Statement of Works
Summer Minimum AM Demand	BSP demand data for the GSP minimum demand between 4:00 – 6:00 in Summer. DNO to specify the date and time of Summer Minimum AM. This demand should not include the effect of embedded generation of a registered capacity greater or equal to 1MW
Summer Minimum PM Demand	BSP demand data for the gross GSP minimum demand between 10:00 – 16:00 in Summer. DNO to specify the date and time of Summer Minimum PM. This demand should not include the effect of embedded generation of a registered capacity greater or equal to 1MW.

References

- [1] Grid Code, Issue 5 Revision 21 – 21 March 2017, National Grid, available: <http://www2.nationalgrid.com/UK/Industry-information/Electricity-codes/Grid-code/The-Grid-code/>
- [2] Connect and Manage Guidance, March 2013, National Grid, available: <http://www2.nationalgrid.com/UK/Services/Electricity-connections/Industry-products/connect-and-manage/>
- [3] National Electricity Transmission System Security and Quality of Supply Standard, Version 2.3, February 2017, available: <http://www2.nationalgrid.com/uk/industry-information/electricity-codes/sqss/the-sqss/>