RELIABILITY INCENTIVE METHODOLOGY STATEMENT

National Grid, Scottish Power, SHE Transmission Ltd

1 PURPOSE AND SCOPE

1.1.1 This document presents the GB Transmission Licensees' methodology for estimating the energy not supplied for the Reliability Incentive Adjustment in respect of Energy Not Supplied under the RIIO-T1 (Revenue = Incentives + Innovation + Outputs) regulatory framework which covers the eight year period 1 April 2013 to 31 March 2021.

1.1.2 The incentive is designed to ensure that the Transmission Licensees minimise the impact of any Loss of Supply to their customers, that is, to restore supplies as soon as possible after an incident. In the longer term it enables the Licensees to identify potential improvements to their networks to prevent the recurrence of such events in the future.

1.1.3 The Reliability Incentive Adjustment in respect of Energy Not Supplied is used as a primary output that provides the Authority with the ability to monitor and incentivise the Transmission Licensees' reliability performance. The targets for energy not supplied are coded into the respective licences for each Licensee.

1.1.4 Special Condition 3C of the Transmission Licence requires that the Licensee must have in place and maintain a reliability incentive methodology statement agreed with the Authority. It may be revised and subsequently applied only with the approval of the Authority under the terms set out in the licence condition. This methodology statement describes the common approach to estimation of energy not supplied as applied by all three Transmission Licensees. It does not include SHE Transmission's Compensatory Payments Scheme (SHE Transmission licence condition 3C, parts D and E). A separate statement describing the methodology for compensating customers has been issued by SHE Transmission. Hence this statement does not reference customer compensation and is based purely upon the incentivised performance.

1.1.5 This methodology applies to energy not supplied at Grid Supply Points (GSPs). GSPs are points of supply from the National Electricity Transmission System to Network Operators or Non-Embedded Customers where demand is being taken. There are separate compensation arrangements for generators where a generation connection is interrupted due to a transmission fault. This applies to transmission connected generation only. The mechanism for compensation in the form of interruption payments is described in Section 5.10 of the Connection and Use of System Code (CUSC). If a power station is taking demand from a GSP for its site supplies, however, any Loss of Supply event would be included within this scheme. Example 6 in Appendix A demonstrates how this would be applied.

1.1.6 Embedded generation is not covered by the compensation mechanism described in section 1.1.3. The Transmission Owners and System Operator have limited visibility of this generation, and as some embedded generation can be interconnected to several GSPs it is not possible to determine its net effect on GSP demand. For this reason, embedded generation is not considered in this scheme. Compensation arrangements for embedded generation are included in the network unavailability rebate payment scheme as specified in their supply agreements under the Distribution Connection Use

of System Agreement. For RIIO-T2, the Transmission Licensees will look into developing a methodology to take into account the contribution from embedded generation directly connected to the GSP via a discrete feeder in the calculation of Energy Not Supplied.

1.1.7 The methodology has been tested using real events and real data. Appendix A includes a number of worked examples which demonstrate how the methodology has been applied for a number of historic Loss of Supply events, including the means by which exclusions and restoration scenarios are dealt with. These examples will be used to illustrate the principles of calculating energy not supplied as described in the methodology.

1.1.8 The treatment of exclusions that will be applied to energy not supplied events, as well as the process for reporting exceptional events, as set out in the Transmission Licence, are described in Section 4 and examples provided in Appendix A.

2 DEFINITIONS

2.1.1 For the purposes of this statement, a Loss of Supply event is defined as any event on the Licensee's transmission system that results in an actual unsupplied energy event to a customer or customers including pumped storage units operating in pump mode.

2.1.2 An Incentivised Loss of Supply Event is defined in Special Licence Condition 1A (Reliability Incentive Adjustment in Respect of Energy Not Supplied) and means any event on the Licensee's Transmission System that causes electricity not to be supplied to a customer, subject to the exclusions defined in the Special Conditions of the Transmission Licence (Incentivised Loss of Supply Event definition). See Section 4.

2.1.3 A Restored Demand Profile is defined as the unsupplied MW load over the duration of the event. Its purpose is to demonstrate how the demand is restored over time. This is demonstrated in Examples 1-4 in Appendix A.

3 METHODOLOGY FOR ESTIMATING ENERGY NOT SUPPLIED

3.1 Principles of Methodology for estimating energy not supplied

3.1.1 Energy not supplied cannot be metered or measured directly. It must be estimated from the information related to the event, including:

I. the number of Transmission Owner (TO) Grid Supply Points (GSPs) affected;
II. the complexity of both the TO network and connected network configuration in the locality;
III. the event's duration;
IV. the process of demand restoration, which is normally a co-ordinated effort between System Operator (SO), TOs, Distribution Network Operators (DNO(s)) and other directly connected customers.

This information is derived from any of the following sources:

- Significant Event Reports issued by Electricity National Control Centre (ENCC)- which alerts the Licensee that an event which may contribute to the Energy Not Supplied scheme has occurred and needs to be investigated.

- Significant Incident Reports issued by the ENCC, and replies from affected customers: which enables the Licensee to determine what happened during the event from the customer's perspective and to determine the cause of the Loss of Supply.
- Data Historian: this captures readings from operational metering as seen by the system operator, providing the energy in MW which was being supplied before the event. The TOs SO and DNOs have their own customised systems.
- SCADA (Supervisory Control And Data Acquisition) system: this enables the licensee to determine the system configuration at the time of the Loss of Supply. It also provides a list of circuit breaker operations, with timings, so that the start and end time of the Loss of Supply can be determined. Each TO, SO and DNO has their own customised system.
- Information from Distribution Network Operators or other customers: in the event of a stepped restoration involving DNO load transfers, this shows how much energy was restored at what time
- Handwritten logs and recorded telephone conversations from the Control Room providing a record of the time at which supplies were offered back to a customer, which contributes to a calculation of the end time of the event

This list is not exhaustive and other sources may be utilised depending on the incident in question. The particular sources of data used to calculate energy not supplied for each incident are fully documented and therefore auditable.

3.1.2 The volume of energy not supplied is an estimate of the energy that would have been supplied had the event not occurred taking into account the energy made available and/or actually supplied by the Licensee for the period of the event.

3.1.3 In practice, calculating these quantities can be complex and dependent upon the type of event. Consequently, the Licensees apply certain rules to facilitate the estimation, consistent with the integrity of the base information and the complexity of the event. For example, the level of energy not supplied is assumed to be constant throughout the event: this is explained further in paragraph 3.3.3. Also if there is any doubt about the accuracy of the metered information available, rounding will be used to reflect the likely degree of accuracy of the data. These assumptions will have a minimal material impact on the energy not supplied volumes, as sometimes they will result in a small over-estimation and sometimes a small under-estimation which, over time, would be expected to balance out.

3.1.4 There are two dimensions relevant to the estimation of energy not supplied — duration of the event (hours) and demand lost (MW). It is the product of these dimensions that yields the energy unsupplied (MWh).

3.1.5 Sections 3.2 and 3.3 below describes in detail the assumptions used by the Licensees that underpin these two dimensions.

3.2 Duration of the Event

3.2.1 Only energy not supplied during the event is estimated. The duration of the event is defined as the time between the start and end times. Specifically:

I. the start time of the event is taken as the time of the Licensee's circuit event and equipment operation trip that causes the Loss of Supply;

II. the event end time is taken as the time that supplies (including supply capacity) are restored to TO's customers by any of the following (in order of precedence):

a. Customer demand is actually and directly restored from the Transmission Licensee's system, in the absence of DNO intervention. This could be through:

i. the return to service of the tripped equipment;
ii. the reconfiguration of the Transmission Licensee's own network, for example bringing an alternative transformer back into service; or
iii. a combination of the above;

b. The TO advises the SO (in accordance with STCP 01-1 Operational Switching; section 3.6.3) that supplies are available for restoration at the affected GSP for the customer(s) to restore any demand under their control. This approach is appropriate because the customer may need to take certain actions before they can fully restore their network after supplies have been made available. Example 2 in Appendix A demonstrates an incident where the TO made supplies available but the DNO was not in a position to fully restore its network. Where multiple GSPs and/or demand blocks are lost and restored in stages, the end time is taken as the time that supplies to the final GSP or demand block are restored. In this situation, the estimated energy not supplied would be calculated as described in section 3.3.3.

c. When advised by the TOs' customer/DNO that supplies have been restored. On some occasions, the SO/TO is unable to restore the affected GSP due, for instance, to a permanent fault, and supplies are otherwise restored by customer action. This may be by means of a transfer of whole or partial demand lost to another GSP by the DNO/TO or by the use of local embedded/stand-by generation. On such occasions, the end time is taken as the time advised by the customer that all supplies have been restored. Such action will normally be achieved in operational liaison with the SO.

3.3 Demand Lost

3.3.1 The level of demand lost at the start of the event is taken as the instantaneous power value (in MW). The power is measured by the Licensee's own GSP-located metering systems. This is the metering used for other operational systems and is therefore considered to be sufficiently accurate and reliable for these purposes. In the event of a metering system failure on one particular asset, metering on other nearby assets should enable the Licensee to calculate the MW flow through the asset in question. In the event of a complete metering system failure for the licensee, the relevant data would be sought from the affected customer. If this was not available, an estimate would be made based on historic data.

3.3.2 If the network configuration is such that neighbouring connection points for the affected customer pick up the full demand in the event of a Loss of Supply, the level of demand lost will be taken as zero.

3.3.3 For the purposes of the estimation, the level of the demand lost at the start of the event is assumed to be constant throughout the event, i.e. a flat demand profile, until all demand is restored in a single block or a partial supply restoration is made. This assumption is necessary because it is not possible to tell how much energy would have been supplied to the customer for the day in question. Most energy not supplied events are of a sufficiently short

duration (less than 30 minutes) that the demand profile is unlikely to change. Over a period of time, it is expected that the effect of slight over- and under-estimating energy not supplied on longer duration events would balance out.

3.3.4 If a partial supply restoration is made, a new flat demand level is estimated accounting for the restored supply. The demand level will be recalculated each time a partial restoration is made until all demand is restored. This is known as a stepped restoration. Examples 1-4 of the estimated energy not supplied calculation for a stepped restoration is given in Appendix A. If there is net generation (i.e. the level of generation is greater than the level of demand) at a GSP that suffers a Loss of Supply the level of demand lost will be taken as zero.

3.4 Estimating the Restored Demand Profile

3.4.1 Although supply is normally restored in a single or multiple blocks, the actual restored demand profile may effectively be masked from the Licensee's own GSP-located metering systems due to the following influences:

I. nature of customer load and customers' network reaction (e.g. an automatic process shutting down and awaiting manual restart or an automatic response from voltage control equipment within the network or customer generation)
II. DNO restoration strategies to maximise the number of customers reconnected (e.g. temporary demand regrouping, temporary interconnection, voltage reduction, generation support),
III. restoration management of major users (e.g. Network Rail, London Underground, Steelworks and continuous process interruption effects).

3.4.2 Consequently, in some circumstances, the Licensee may require information from the DNO (or TO) in order to assess the restored demand profile. Operational information is exchanged during the management of the event under the obligations of the Grid Code, under the STC (System Operator – Transmission Owner Code) and through post event analysis and investigation.

3.5 Operational Data

3.5.1 The accuracy of the base data for the demand is measured using the Licensee's operational systems at any GSP and is better than 0.5 per cent at full load

3.5.2 The duration of an event is usually measured to the nearest minute using data obtained from the Licensee's own operational systems. Where data sources permit, a higher resolution may be used for duration measurement. In determining events of 'more than 3 minutes, any event with a duration over 3 minutes will be included within the incentive.

3.5.3 Where there are discrepancies between the information provided by the customers and the Licensee's own operational systems, or the data is missing or incomplete, best endeavours will be made to obtain the most accurate estimate. The default option is to use the Licensee's metering where this is available; if this is not available then information will be sought from the relevant customers. Where there is remaining doubt, the Licensee will estimate the energy not supplied from the worse case scenario i.e. the values that correspond to the highest value of energy not supplied. The Licensees are reliant on the quality and accuracy of information provided in these circumstances.

3.5.4 Due to these inherent uncertainties, the energy not supplied estimation will be rounded to the nearest 0.1MWh. A minimum loss of 0.1MWh will be recorded where actual demand has been lost, even if the actual estimated energy not supplied is of a lower value.

4 SCENARIOS APPLYING TO THE RELIABILITY INCENTIVE ADJUSTMENT IN RESPECT OF ENERGY NOT SUPPLIED

4.1 Excluded Events

4.1.1 The Incentivised Loss of Supply Event definition within section 1A of the Special Conditions of the Transmission Licence defines events which may be excluded from the estimation of energy not supplied calculation.

4.1.2 Where a Loss of Supply Event occurs which may involve a full or partial exclusion the energy not supplied would be calculated according to the process described above. Each case is assessed to determine whether exclusions would apply. For a simple exclusion, for example, if the event duration is 3 minutes or less, the energy not supplied is calculated and recorded but is not included in the incentivised energy not supplied figure and is reported separately. There may be instances when a proportion of the total energy not supplied would be excluded, for example if an event occurred at a GSP where there were two or more customers connected but one of these was a customer choice connection. To determine the energy not supplied the demand for each customer would be estimated according to the methodology and the calculated energy not supplied for the customer choice connection subtracted from the total. The excluded demand would be recorded and reported as excluded. Examples demonstrating how an exclusion would be applied is shown in Examples 2, 4 and 5 in Appendix A.

4.2 Exceptional Events

4.2.1 An Exceptional Event is defined in section 1A of the Transmission licence.

4.2.1.1 For the purposes of defining an Exceptional Event, the number of faults recorded for a severe weather event is specific to each Licensee and is specified in their Special Licence Conditions.

4.2.2 When an event is considered to be Exceptional, the Licensee shall follow the process described in Special Licence Condition 3C.10, notifying the Authority of the event and providing details of the volume of unsupplied energy and any further information. Special Licence Condition 3C.11 requires that the Authority respond to such notification, providing direction and the reasons for their decision.

4.2.3 Following receipt of the Authority's decision in relation to an Exceptional Event, the Licensee will adjust the energy not supplied estimation in accordance with that direction.

4.3 Events on Another Network that Result in a Loss of Supply

4.3.1 This methodology statement applies to Loss of Supply events that occur on the transmission owner's network, hence events initiated on a DNO network are not included within this scheme. However, there may be instances where concurrent faults on a transmission line and a connected distribution line may lead to a Loss of Supply. Should this happen, the TO will request information from the DNO and any disputes would be resolved by investigating the matter to determine the root cause of the incident on a case-by-case basis. Information used would include examining protection records to establish the

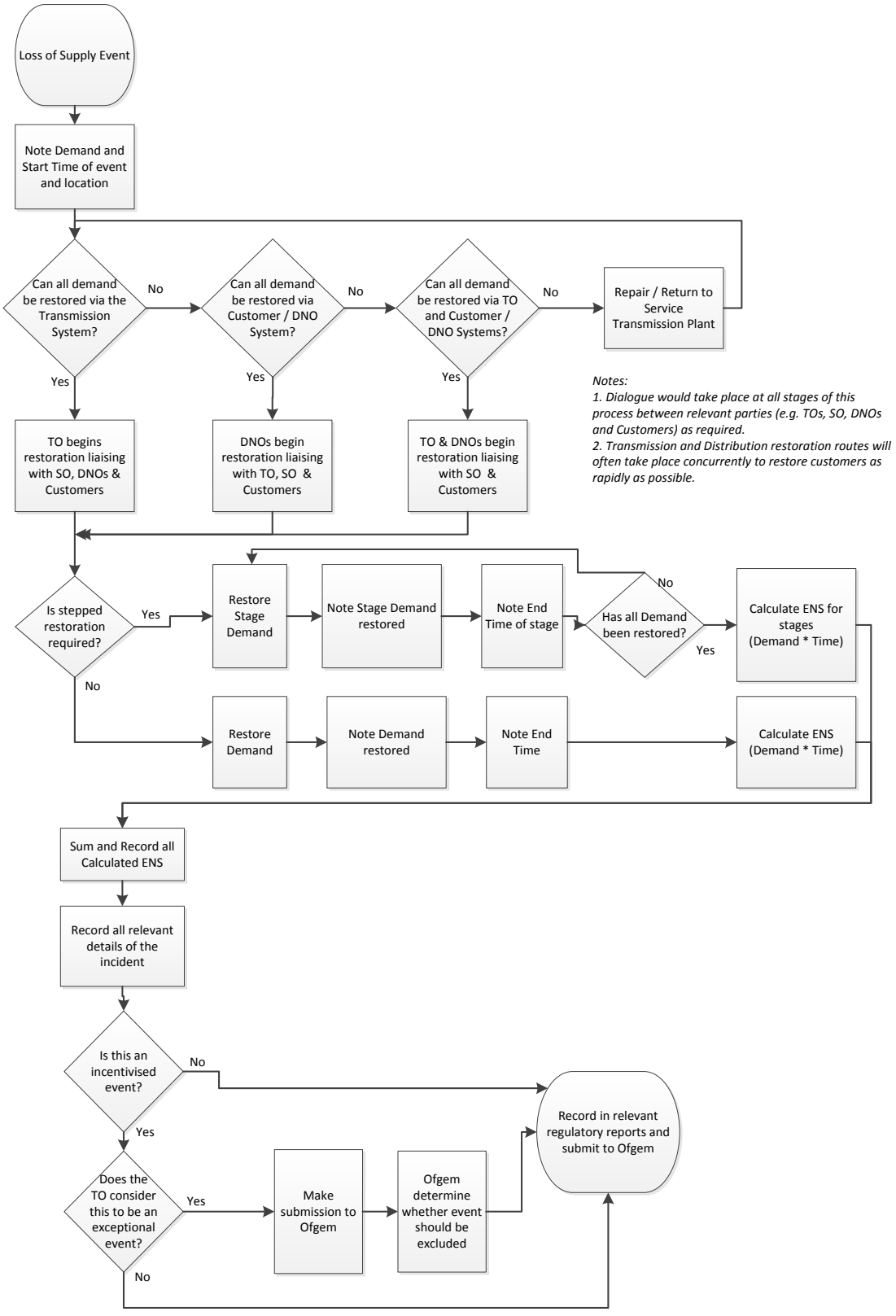
sequence of events as well as using other information sources such as incident reports, Data Historian which captures readings from operational metering, SCADA system records and logs of communications between the operators.

4.3.2 For a Loss of Supply event triggered by an event on an adjacent or interconnected transmission system, both/all Transmission Owners will work together to ensure that the fault is located and its effect on the customers is minimised. Each Transmission Owner will report the loss of energy to the customers supplied from their network irrespective of where the fault actually occurred. Where the event is beyond the reasonable control of both/all of the licensees, both/all TOs will work together to ensure that any claim(s) for the event to be excluded from the incentive mechanism are accurate and consistent with the criteria set out in Special Condition 1A of the Licence, and comply with the rules and timelines as defined in the TO's License. This scenario is demonstrated in Example 7 in Appendix A.

5 REPORTING TO THE AUTHORITY

The Licensee will report to the Authority as required under the Regulatory Instructions and Guidance (RIGs), developed and maintained in accordance with Standard Licence Condition B15 of the transmission licence.

6 FLOW CHART DESCRIBING ENERGY NOT SUPPLIED CALCULATION PROCESS



Version Control

Issue	Date	Summary of changes/reasons
1	23 January 2014	New document addressing new Licence Condition and replacing existing Transmission Network Reliability Incentive methodologies
2	30 September 2014	Document revised following Ofgem's letter of 16th June 2014.
3	15 September 2015	Document revised following discussions with Ofgem during 2015

7 APPENDIX A

This appendix demonstrates the application of the methodology for calculating energy not supplied using historic events. A number of scenarios are presented. These examples show a step-by-step description of each event and provide information about the data sources used and how the total energy not supplied was calculated. A Single Line Diagram representing the configuration of the TO's network is also shown.

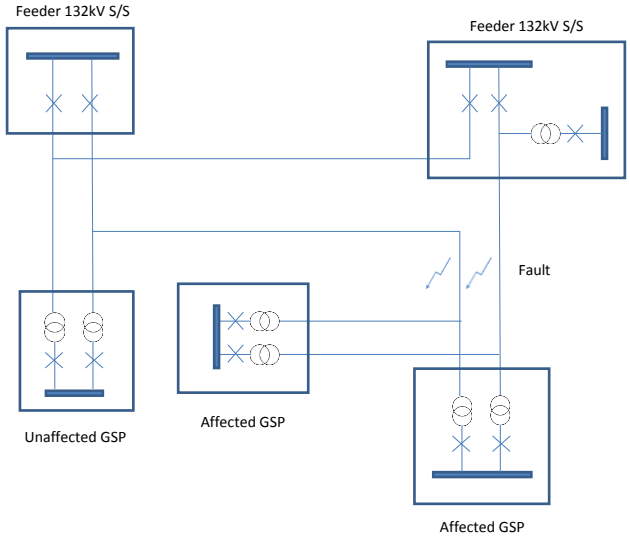
Glossary of terms used in the examples

Term/Abbreviation	Meaning
ENCC	Electricity National Control Centre
SER	Significant Event Report – generated by the ENCC to inform internal stakeholders of the occurrence of a significant event, which may include a Loss of Supply
SCADA system	Supervisory Control And Data Acquisition system which the licensee uses to determine the system configuration.
SGT	Supergrid transformer
HV circuit breaker	Circuit breaker connected at the same voltage as the higher voltage windings of the transformers.
LV circuit breaker	Circuit breaker connected at the same voltage as the lower voltage windings of the transformers.
Busbar	The common connection point of two or more transmission circuits.
Fault outage	An outage of one or more items of primary transmission apparatus initiated by automatic unplanned action (e.g. tripping), which may or may not involve the passage of fault current.
Protection	The provisions for detecting abnormal conditions on a system and initiating fault clearance or actuating signals or indications.
DAR	Delayed Auto Reclose whereby a circuit that has tripped is automatically put back into service after a several second delay. If the fault condition persists after DAR has been attempted, the circuit will remain out of service.
Intertripping	The tripping of circuit-breaker(s) by commands initiated from protection at a remote location independent of the state of the local protection
Mesh	A single busbar substation in which the busbar is formed as a closed loop with circuit breakers in series within the loop.

Example 1 – Stepped Restoration Where Demand Restored by DNO

1. Introduction

Two 132kV Grid Supply Points (GSPs), each with a single 33kV busbar and connection to the main interconnected transmission system via two three-ended circuits, have two Grid Transformers, T1 and T2, providing supplies to the DNO. A double circuit 132kV cable fault resulted in supplies being lost to all customers that were fed from both substations.



2. Event Description and Actions Taken

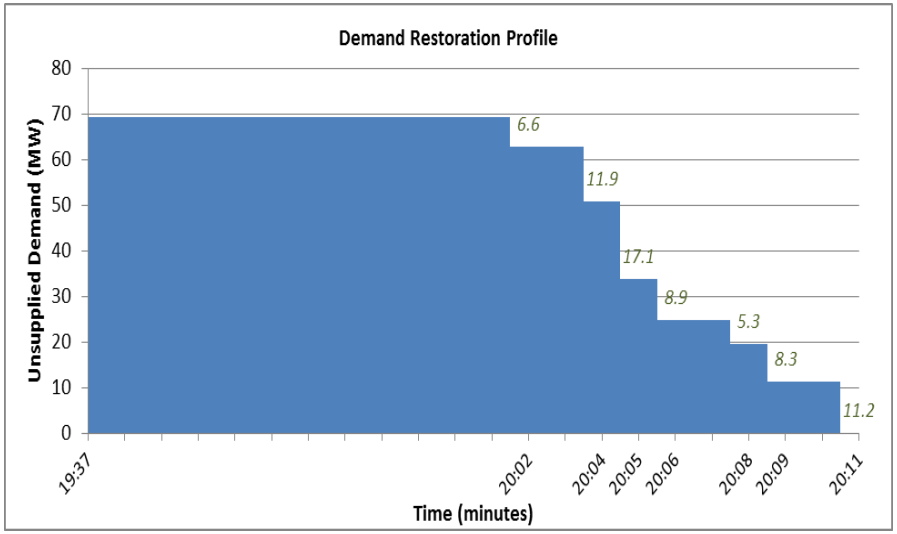
Step	Time	Event/Action	Parameters Used/Data Sources	Demand at time of event
1	19:37	Both 132kV cables feeding two GSPs caused Main Protection operations on both circuits feeding those substations and all circuit breakers on these circuits to operate. This resulted in supplies being lost to all customers fed from those substations.	EMS SCADA System, Alarms Database, Fault Reporting System, Data Historian, DNO	69.3MW
2	19:43	An unsuccessful attempt was made to return one of the faulted circuits to service to restore customers directly from the Transmission System by re-closing the 132kV feeder Circuit Breaker on the No.1 circuit.	EMS SCADA System, Alarms Database, Fault Reporting System, Data Historian	
3	19:50	Between 19:50 and 20:01 all DNO feeders from both Grid Substations were opened to allow demand to be transferred to alternative sources via the DNO's network.	DNO, EMS SCADA System, Alarms Database, Fault Reporting System, Data Historian	
4	20:02	Demand was restored to 3,347 customers in 25 minutes by switching by the DNO (6.6MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
5	20:04	Demand was restored to 10,100 customers in 27 minutes by switching by the DNO (11.9MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
6	20:05	Demand was restored to 12,988 customers in 28 minutes by switching by the DNO (17.1MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
7	20:06	Demand was restored to 6,260 customers in 29 minutes by switching by the DNO (8.9MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
8	20:08	Demand was restored to 4,494 customers in 31 minutes by switching by the DNO (5.3MW).	DNO, Alarms Database, Fault Reporting System, Data	Demand restored

			Historian	
9	20:09	Demand was restored to 2,507 customers in 32 minutes by switching by the DNO (8.3MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
10	20:11	Demand was restored to 6,828 customers in 34 minutes by switching by the DNO (11.2MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
11		Supplies were reverted to their normal routes following the repair of one of the circuits on 14 days later and the second circuit repair after a further 6 days.	EMS SCADA System, Alarms Database, Fault Reporting System, Data Historian, DNO	

3. Energy Not Supplied Calculation

Step	Estimated demand unsupplied (MW)	Duration of unsupplied demand (hrs)	Exclusions applied? Give details	Total Energy Not Supplied (MWhr)	Incentivised Energy Not Supplied
4	6.6	0.42	N	6.6 x 0.42 = 2.7	2.7 MWh
5	11.9	0.45	N	11.9 x 0.45 = 5.4	5.4 MWh
6	17.1	0.47	N	17.1 x 0.47 = 8	8 MWh
7	8.9	0.48	N	8.9 x 0.48 = 4.3	4.3 MWh
8	5.3	0.52	N	5.3 x 0.52 = 2.7	2.7 MWh
9	8.3	0.53	N	8.3 x 0.53 = 4.4	4.4 MWh
10	11.2	0.57	N	11.2 x 0.57 = 6.3	6.3 MWh
				Total Incentivised Energy Not Supplied	**33.8 MWh**

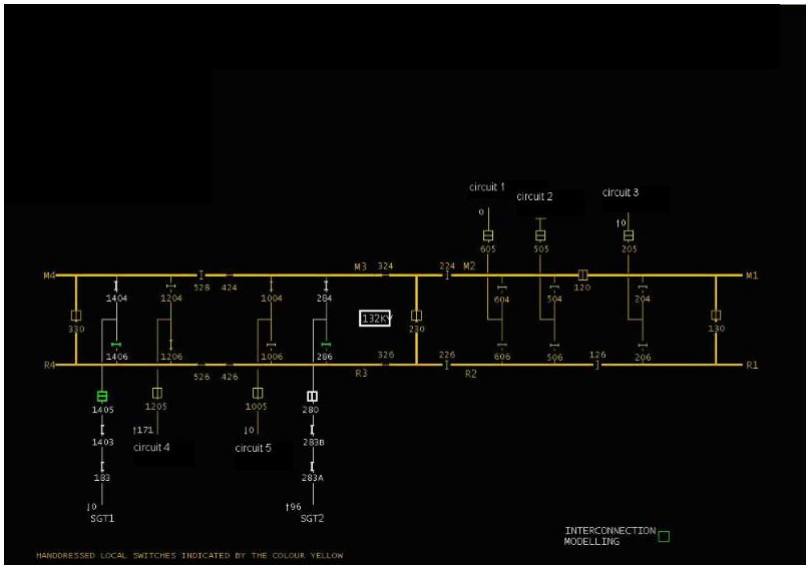
4. Energy Not Supplied Restoration Stages Graph



Example 2 – Stepped Restoration Where DNO Partially Restores Network, TO Makes Supplies Available But Customer Not Ready to Take Supplies When Offered

1. Introduction

A DNO's 132kV substation is fed from a transmission 275kV substation by two supergrid transformers (SGTs). DNO demand was at single circuit risk to prevent technical issues associated with another outage: SGT2 was the only transformer on load.



2. Event Description and Actions Taken

Step	Time	Event/Action	Parameters Used/Data Sources	Demand at time of event
1	07:00	DNO open one of their circuit breakers in response to cable oil pressure low alarm	DNO	N/A
2	07:00	LV circuit breaker on SGT2 opened on receipt of intertrip, coincident with DNO circuit breaker operation.	DNO, IEMS	92.25MW (75.85 MW (incentivised) and 16.4 MW (non-incentivised)
3	07:01	DNO commence partial restoration, demand transfers etc restoring 16.40MW of unsupplied demand in under 3 minutes.	DNO	Non-incentivised demand restored
4	07:19	ENCC advise DNO that supplies are available. DNO request that circuit breaker is left open.	Phone logs	
5	07:51	DNO advise ENCC that supplies can be restored	Phone logs	
6	07:55	ENCC LV close circuit breaker on SGT2	IEMS	

7	08:07	DNO confirm that all demand restored	Phone logs	

3. Energy Not Supplied Calculation

Step	Estimated demand unsupplied (MW)	Duration of unsupplied demand (hrs)	Exclusions applied? Give details	Total Energy Not Supplied (MWh)	Incentivised Energy Not Supplied (MWh)
2	92.25	0.0167	Y 16.4 MW restored within 3 minutes (0.05hrs)	0.0167 x (92.25-16.4) = 1.2667	1.27
3	75.85	0.1167	N	0.1167 x 75.85 = 8.85	8.85
	71.23	0.0167	N	0.0167 x 71.23 = 1.19	1.19
	65.77	0.0167	N	0.0167x 65.77 = 1.10	1.10
	58.54	0.15	N	0.15 x 58.54 = 8.78	8.78
				Total	**21.19**

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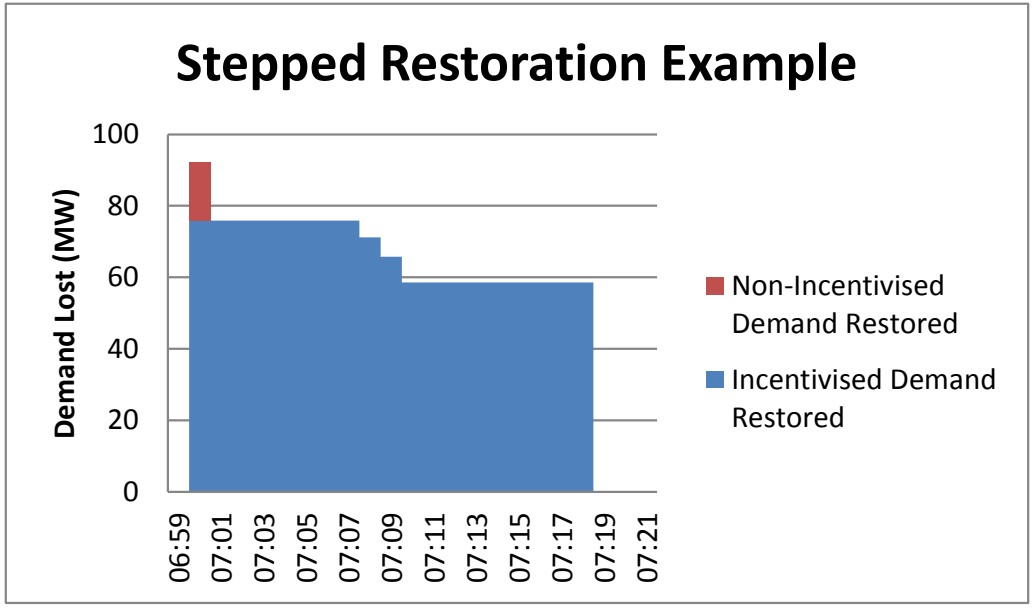
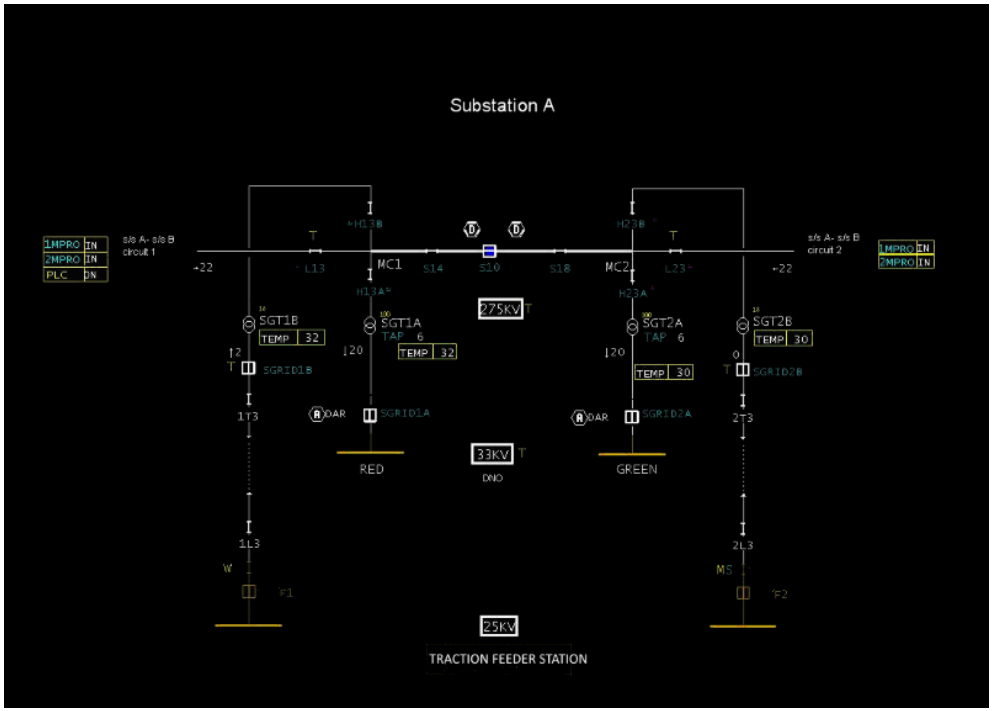


Example 3 – Partial Restoration For Multiple Customers

1. Introduction

A 275kV substation (Substation A) supplies a DNO 33kV substation and a large consumer at 25kV. It is connected by a double circuit to another 275kV substation (Substation B).

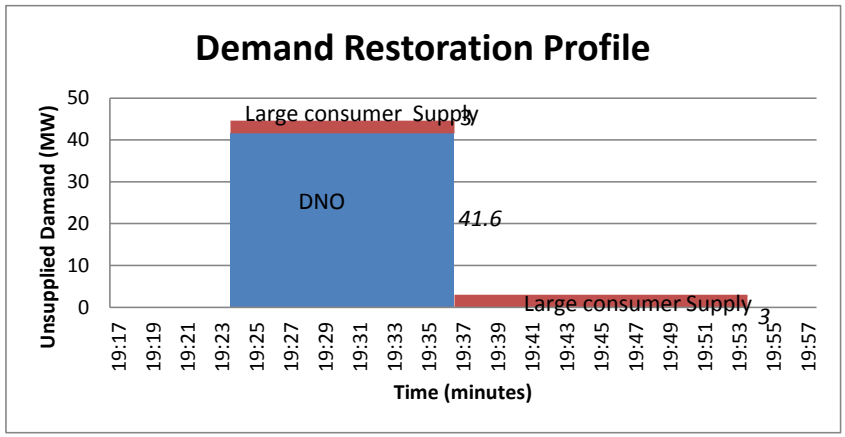


2. Event Description and Actions Taken

Step	Time	Event/Action	Parameters Used/Data Sources	Demand at time of event
1	19:17	Substation A – Substation B circuit no1 tripped, offloading one transformer for the 33kV substation and one transformer for the 25kV substation by opening the LV circuit breakers. Circuit tripped and returned via DAR twice before remaining out of service at 19:18. Adverse weather was reported at time.	IEMS SCADA system, SER	N/A
2	19:20	Both transformers were recharged automatically from HV side. LV circuit breakers did not close, therefore Substation A demand was left at single circuit risk.	IEMS SCADA System, SER	N/A
3	19:24	Substation A – Substation B circuit no 2 tripped. The other two transformers at site are offloaded. Loss of supply to 33kV and 25kV substations.	IEMS SCADA System, SER, Data Historian, large consumer	DNO 41.6MW Large consumer 3MW
4	19:24	Substation A – Substation B circuit no1 recharged from Substation B end.	IEMS SCADA system, SER	
5	19:36	ENCC advise DNO that transformer associated with circuit no 1 is available. DNO start switching on their network	Phone logs	
6	19:44	DNO allow LV circuit breaker to be closed to energise transformer, ending loss of supply to DNO	SER, IEMS SCADA system	
7	19:53	LV circuit breaker closed to restore supplies to 25kV customer.	SER, IEMS SCADA system	

3. Energy Not Supplied Calculation

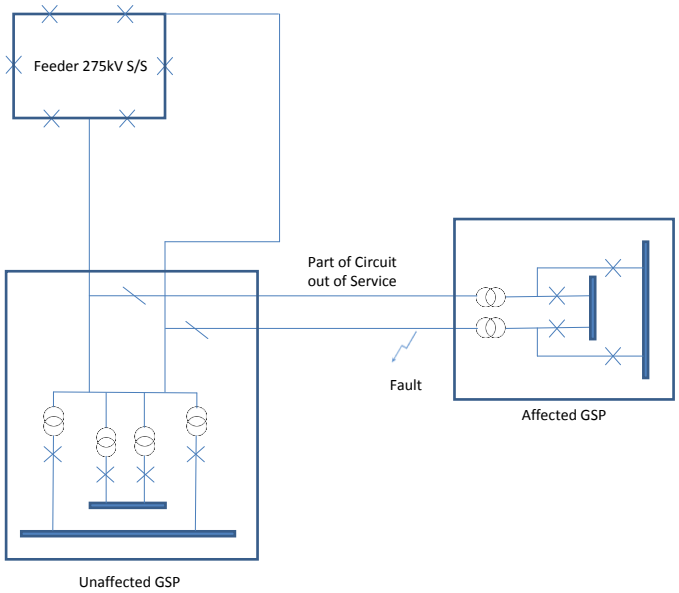
Step	Estimated demand unsupplied (MW)	Duration of unsupplied demand (hrs)	Exclusions applied? Give details	Total Energy Not Supplied	Incentivised Energy Not Supplied
3 (DNO restoration)	41.6MW	0.2	N	41.6 x 0.2 = 8.32	8.32 MWh
7 (large consumer supply restoration)	3MW	0.483	N	3 x 0.483 = 1.45	1.45 MWh
				Total Incentivised Energy Not Supplied	**9.77MWh**


Demand Restoration Profile
Unsupplied Damand (MW)
50
40
30
20
10
0
Large consumer Supply
3
DNO
41.6
Large consumer Supply
3
19:17
19:19
19:21
19:23
19:25
19:27
19:29
19:31
19:33
19:35
19:37
19:39
19:41
19:43
19:45
19:47
19:49
19:51
19:53
19:55
19:57
Time (minutes)

Example 4 – Energy Not Supplied with Partial Exclusion

1. Introduction

A 275kV substation with two 33kV busbars ('A' Board and 'B' Board) and connection to the main interconnected transmission system via two three-ended circuits has two Supergrid Transformers, SGT1 and SGT2, providing supplies to the DNO. Due to an ongoing outage the Number 1 circuit and SGT1 were out of service.



2. Event Description and Actions Taken

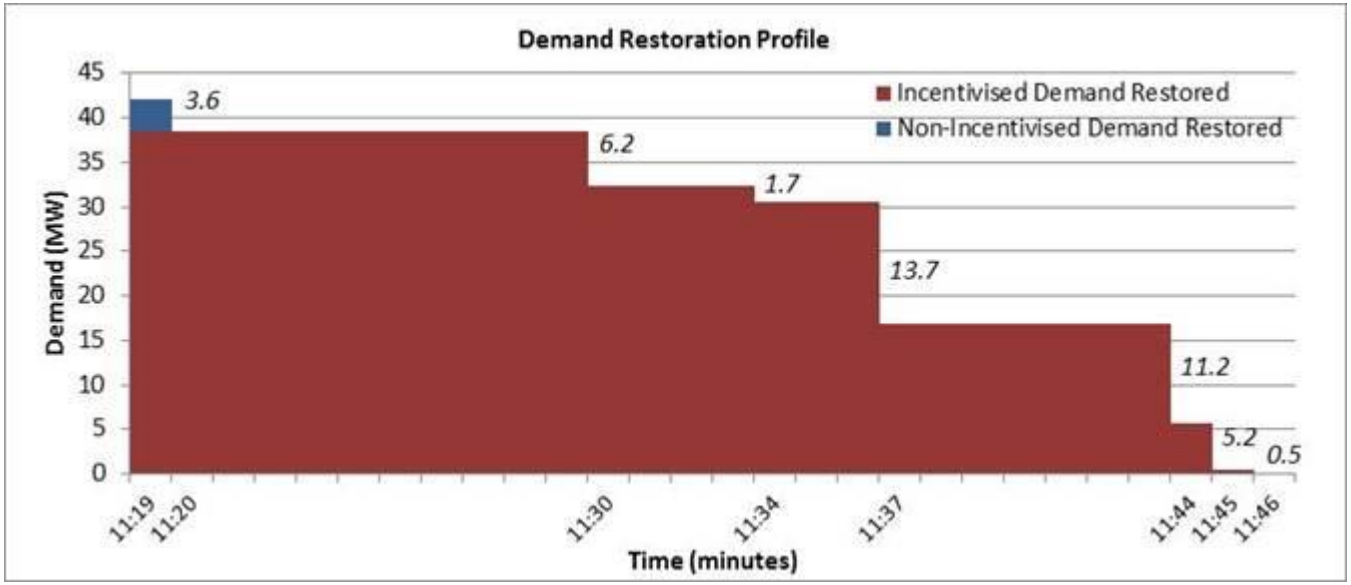
Step	Time	Event/Action	Parameters Used/Data Sources	Demand at time of event
1	11:19	The 1st and 2nd Main Protection on the second circuit feeding the 275kV Grid Supply Point operated resulting in all the circuit breakers associated with the circuit opening, including the 33kV circuit breakers at the GSP, resulting in supplies being lost to all customers being fed from the site.	EMS SCADA System, Alarms Database, Fault Reporting System, Data Historian, DNO	38.5MW (incentivised) + 3.6MW (non-incentivised)
2	11:20	At 11:20, supplies were restored to 6,687 customers by use of an 11kV interconnector and auto-changeover scheme; as result 3.6MW of demand was restored. This portion of the incident was reported separately as a non-incentivised incident because it was less than three minutes duration.	DNO, Alarms Database, Fault Reporting System, Data Historian	Non-incentivised Demand restored
3	11:20	The circuit affected was auto-isolated and the mesh at the feeding end was re-closed.	EMS SCADA System, Alarms Database	
4	11:30	Volts were restored to the 'A' Board 33kV Busbar from neighbouring GSP.	DNO	
5	11:30	Demand was restored to 2,951 customers in 11 minutes by switching by the DNO (6.2MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
6	11:34	Demand was restored to 4,193 customers in 15 minutes by switching by the DNO (1.7MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
7	11:37	Demand was restored to 1,790 customers in 18 minutes by switching by the DNO (13.7MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
8	11:42	Volts were restored to the 'B' Board 33kV Busbar from neighbouring GSP.	DNO	
9	11:44	Demand was restored to 12,324 customers in 25 minutes by switching by the DNO (11.2MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored

10	11:45	Demand was restored to 2 customers in 26 minutes by switching by the DNO (5.2MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored
11	11:46	Demand was restored to 1 customer in 27 minutes by switching by the DNO (0.5MW).	DNO, Alarms Database, Fault Reporting System, Data Historian	Demand restored

3. Energy Not Supplied Calculation

Step	Estimated demand unsupplied (MW)	Duration of unsupplied demand (hrs)	Exclusions applied? Give details	Total Energy Not Supplied (MWhr)	Incentivised Energy Not Supplied
2	3.6	0.0167	Yes (3 minutes or less)	3.6 x 0.0167 = 0.06	0.0 MWhr
5	6.2	0.183	N	6.2 x 0.183 = 1.135	1.135 MWhr
6	1.7	0.25	N	1.7 x 0.25 = 0.425	0.425 MWhr
7	13.7	0.3	N	13.7 x 0.3 = 4.11	4.11 MWhr
9	11.2	0.417	N	11.2 x 0.417 = 4.67	4.67 MWhr
10	5.2	0.433	N	5.2 x 0.433 = 2.252	2.252 MWhr
11	0.5	0.45	N	0.5 x 0.45 = 0.225	0.225 MWhr
				Total Incentivised Energy Not Supplied =	**12.82 MWhr**

4. Energy Not Supplied Restoration Stages Graph



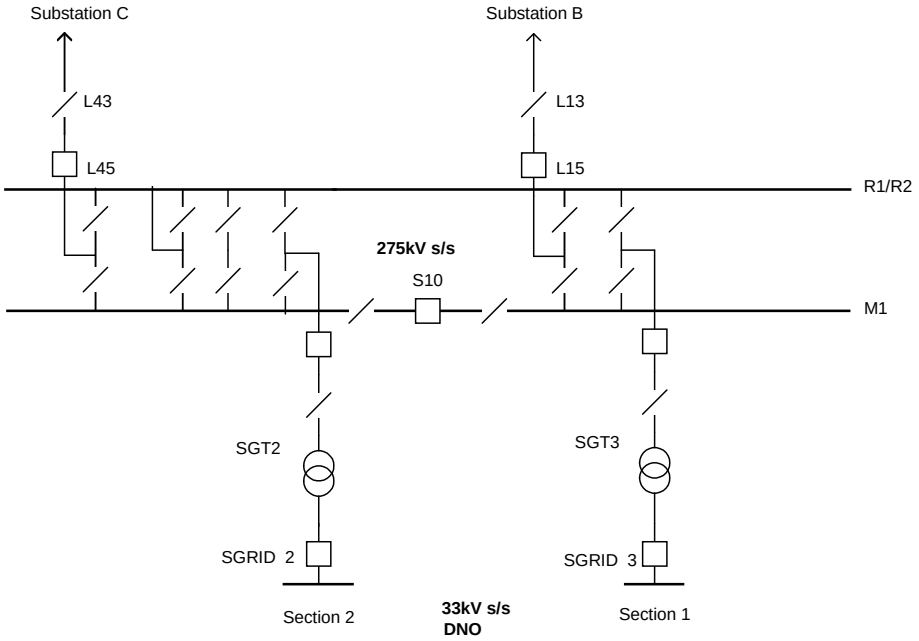
Example 5 – Energy Not Supplied Exclusion On Grounds of Safety

1. Introduction

275kV Substation A has connections to the main interconnected transmission system via two single circuits to Substations B and C. It also serves as a GSP for a DNO's 33kV substation, fed by two transformers, SGT2 and SGT3.

There was a spell of high intensity rain across large parts of Britain. In this area the average monthly rainfall fell in just a few hours, resulting in widespread flooding affecting thousands of homes and business premises on this day.

There were reports from site personnel at substation A about flood water at site. Due to concerns of safety, personnel were advised to evacuate site immediately and ENCC discussed with DNO regarding transfer of all demand supplied from 33kV substation.



2. Event Description and Actions Taken

Step	Time	Event/Action	Parameters Used/Data Sources	Demand at time of event
1	13:45	Site personnel advised to evacuate site and ENCC discussed with DNO regarding transfer of all demand supplied from 33kV substation. DNO carried out pre-emptive demand transfer.	SCADA System, DNO, site personnel, phone logs	
2	15:23	Circuit breakers tripped unloading SGT2 and SGT3, resulting in loss of supply to 35,000 customers.	SCADA System, DNO, phone logs	38.1
3	15:25	DNO transfers 2.4 MW demand	DNO	
4	15:40	Attempt to close circuit breaker on SGT3. It tripped immediately. Site remained live, but rain was still falling in area and consideration given to switching out entire substation.	SCADA System, DNO, site personnel, phone logs	
5	16:28	Site control of Substation A from ENCC was lost. DNO continued switching on their networks.	SCADA System, DNO, site personnel	
6	17:20	DNO transfers 2.50 MW demand	DNO	
7	17:22	DNO transfers 6.10 MW demand	DNO	
8	18.22	Switching completed at Substations B and C to make Substation A dead after decision made to de-energise substation. Substation under approx 4 ft water.	SCADA System, Control Room logs, Site personnel	
9	19:13	DNO transfers 9.60 MW demand	DNO	
10	19:15	DNO transfers 1.40 MW demand. TO offers full support to DNO to assist with restoring supplies	DNO, Site personnel, Control Room logs	
11	15:55 + 1 day	DNO transfers 2.40 MW demand	DNO	
12	04:40 + 2 days	DNO transfers 2.40 MW demand	DNO	
13	16:24 + 2 days	DNO transfers 2.40 MW demand	DNO	
14	15:38 + 3 days	DNO installed temporary cable and demand restored to all customers.	DNO	
15	4 days	Circuit A-C restored at 21:36. SGT2 restored at 23.19 fully securing supplies to DNO substation	DNO, Site personnel, SCADA system, Control Room logs	
16		Event reported to Ofgem.	TO	

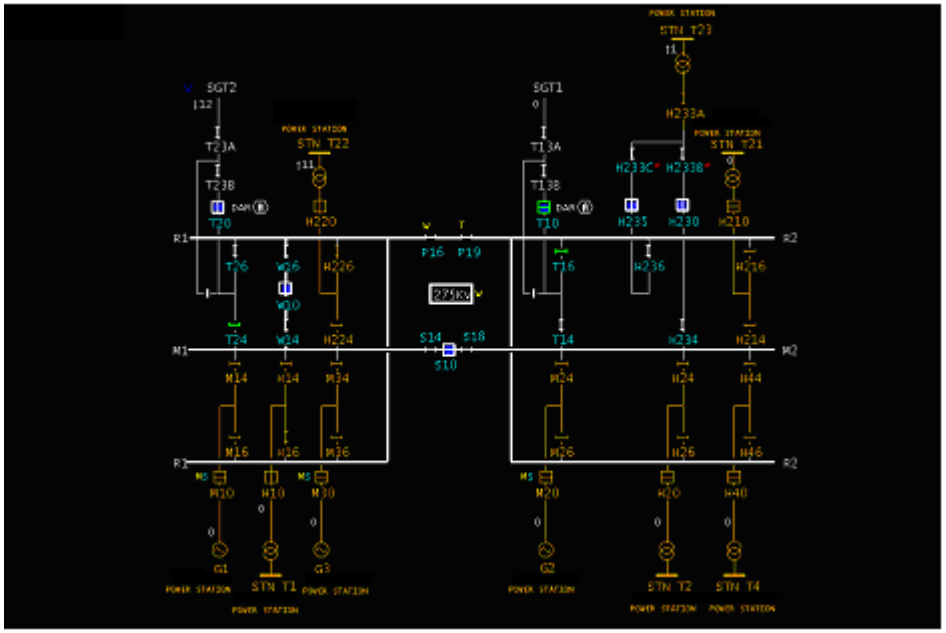
3. Energy Not Supplied Calculation

Step	Estimated demand unsupplied (MW)	Duration of unsupplied demand (hrs)	Exclusions applied? Give details	Total Energy Not Supplied (MWh)	Incentivised Energy Not Supplied (MWh)
2	38.1	0.033	Y – excluded on safety grounds	38.10 x 0.033 = 1.27	0
3	35.7	1.92		35.7 x 1.92 = 68.42	0
6	33.2	0.033		33.2 x 0.033 = 1.11	0
7	27.10	1.85		27.10 x 1.85 = 50.14	0
9	17.50	0.033		17.5 x 0.03 = 0.58	0
10	16.10	20.67		16.10 x 20.67 = 332.73	0
11	13.70	12.75		13.70 x 12.75 = 174.68	0
12	11.30	11.73		11.30 x 11.73 = 132.59	0
13	8.9	23.23		8.9 x 23.23 = 206.78	0
				Total Incentivised Energy Not Supplied	0 MWh

Example 6 – Energy Not Supplied at Power Station Taking Site Supplies

1. Introduction

- A power station draws its station supplies from TO 275kV substation via 3 station transformers, STN T21, T22 and T33, which supply the main cooling water system pumps for the condensers on both power station units. The power station exports its power to the transmission network at TO 400kV substation.
- The 400kV substation is connected to the 275kV substation via 2 transformers, SGT1 and SGT2. These transformers are the only transmission connection between the 275kV substation and the rest of the transmission network.
- Heavy winds were experienced in the area on the day of the event.



2. Event Description and Actions Taken

Step	Time	Event/Action	Parameters Used/Data Sources	Demand at time of event
1	06:29	SGT1 tripped and remained out of service	IEMS SCADA system, SER	
2	07:05	SGT2 tripped and remained out of service. Power station automatically tripped both generation units.	IEMS SCADA system, SER, Data Historian	12MW
3	07:05	Power station switched on 6MW of diesel generators for site supplies	Customer	
4	15:50	Site staff investigated trip of SGT2. It was returned to service following removal of wind borne debris.	IEMS SCADA system, ENCC logs	

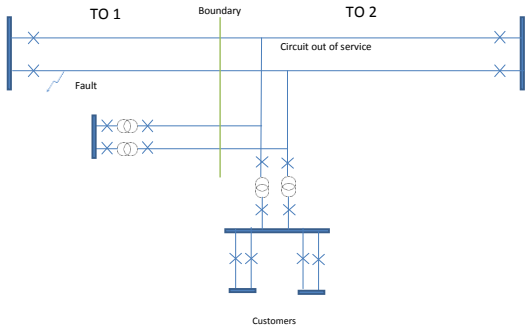
3. Energy Not Supplied Calculation

Step	Estimated demand unsupplied (MW)	Duration of unsupplied demand (hrs)	Exclusions applied? Give details	Total Energy Not Supplied (MWh)	Incentivised Energy Not Supplied (MWh)
2 (trip of SGT2)	12	0	y- less than 3 minutes	12 x 0 = 0	0
3 (switching on of diesels)	6	8.75	N	6 x 8.75 = 52.5	52.5
				Total Incentivised Energy Not Supplied	**52.5 MWh**

Example 7 – Energy Not Supplied Triggered by Event on Another Transmission System

1. Introduction

A 132kV Substation has two in-feeds that are connected to two Transmission Owners' Systems via two 132kV circuits that join the two systems. A Main Protection operation at one end of one of these 132kV circuits resulting in the circuit tripping, causing supplies to be lost to two customers in the other TO's area. The second circuit feeding these customers was out of service at the time for planned works.



2. Event Description and Actions Taken

Step	Time	Event/Action	Parameters Used/Data Sources	Demand at time of event
1	02:00	The 132kV circuit tripped due to an out of area fault, this caused supplies to be lost to two customers.	EMS SCADA System, Alarms Database, Fault Reporting System, Data Historian	7.5MW
2	02:01	The main part of the circuit was automatically returned to service by the operation of Delayed Auto Reclose (DAR), which closed the circuit breakers at the remote ends but at the Grid Supply Point (GSP) substation the circuit breakers did not automatically reclose. This was in accordance with the design of the system.	EMS SCADA System, Alarms Database, Fault Reporting System, Data Historian	
3	02:09	The 132kV circuit breaker at the GSP was closed to energise the Grid Transformer, after this the 33kV Circuit Breaker was closed to energise the customer's busbars, making supplies available to both customers.	EMS SCADA System, Alarms Database, Fault Reporting System, Data Historian	Demand restored
4	02:25	The customers confirmed they had re-energised their internal network by the use of their own generation.	DNO, Alarms Database, Fault Reporting System, Data Historian, Control Room Information Log	
5	02:25	The customers were re-connected to the Transmission System.	Alarms Database, Fault Reporting System, Data Historian, Control Room Information Log	

3. Energy Not Supplied Calculation

Step	Estimated demand unsupplied (MW)	Duration of unsupplied demand (hrs)	Exclusions applied? Give details	Total Energy Not Supplied (MWhr)	Incentivised Energy Not Supplied
3	7.5	0.15	N	7.5 x 0.15 = 1.125	1.1 MWhr
Total Incentivised Energy Not Supplied =					**1.1 MWhr**