Assurance Activities for Restoration Standard

PURPOSE

1. This paper details a proposal for the technical testing and performance criteria to ensure that the Electricity System Restoration Standard (ESRS) is being met.

BACKGROUND

2. Need to monitor Great Britain's emergency preparedness level against a Partial or Total Shutdown.
3. Emergency preparedness to be monitored via a Restoration Standard and related Assurance Framework.
4. Assurance Framework to detail activities (exercises and tests) and performance required from each stakeholder.
5. This paper is written building on GC0148 text at the time of writing, which is out for consultation.

RELEVANT STAKEHOLDERS

6. Electricity System Operator.
7. Electricity Transmission Owners (TO): National Grid Electricity Transmission, Scottish Hydro Energy Transmission, Scottish Power Transmission.
8. Distribution Network Operators (DNO): Scottish & Southern Electricity Networks, Scottish Power Energy Networks, Electricity Northwest, Northern Powergrid, Western Power Distribution, UK Power Networks.
9. Primary Restoration Service Providers who fall under a Local Joint Restoration Plan (LJRP) or Distribution Restoration Zone Plan (DRZP).
10. Grid Code Parties

RESTORATION STANDARD

Assurance Activities Framework

1 Contents

2 Glossary and Definitions

As the working group progresses into GC0156 it is the intension to adopt any Distribution or Grid Code definitions, and where appropriate introduce= new definitions.

- 'Anchor Generators'- As per Grid Code (GC0148)
- 'Awareness Presentation' A presentation, training or webinar (Live or virtual) where knowledge of Restoration and key roles are shared with the industry.
- 'Control System' means a system used to monitor and control a plant or equipment used to generate electricity or support Restoration. *Examples: Supervisory Control and Data Acquisition (SCADA) or Distributed Control Systems (DCS).*
- 'Distribution Restoration Zone'-A Power Island in the distribution network used for Black Start/Restoration purposes.
- 'Essential Role' means a person with a set of competences deemed fundamental by an organisation to deliver system Restoration.
- 'HVDC converter station' As per the Grid Code
- 'HVDC System' As per Grid Code
- 'HVDC converter' Any **EU Code User Apparatus** used to convert alternating current electricity to direct current electricity, or vice versa. An **HVDC Converte**r is a standalone operative configuration at a single site comprising one or more converter bridges, together with one or more converter transformers, reactors, converter control equipment, essential protective and switching devices and auxiliaries, if any, used for conversion. In a bipolar arrangement, an **HVDC Converter** represents the bipolar configuration.
- 'Live Exercise' means an assessment of capability of a selected number of stakeholders when under a controlled power outage. Designed to test and demonstrate operational performance of plans, processes and equipment.
- 'Mandatory'-Compulsory requirement to be completed within the define timescales.
- 'Total System' – As per Grid Code
- 'Optional'-Possible requirement, the completion of within the defined timescales shows good practice.
- 'Power generating module' As per Grid Code
- 'Power park module' or 'PPM' as per Grid Code
- 'Power System Synchronisers'- The capability with network circuit breakers to join two separate Power Islands together by closing the breaker when Voltage and Frequency are within limits.
- 'Power Station' – As Per Grid Code
- 'Primary Restoration Service Provider' – A provider of a Primary Restoration Service
- 'Primary Restoration Service' - The ability for a Restoration Service Provider, or a combination of Providers connected at transmission or distribution, to meet the three basic requirements for Restoration.

    1. To start-up (following a Total or Partial Shutdown) independently of external electrical supplies and support the re-starting of other Generators and Network Service Providers.
    2. To be able to energise part of the network, and,
    3. To be able to provide block loading of demand.

- 'Relevant Role' means person with a set of competences deemed fundamental by an organisation to assist the delivery of Restoration.
- 'Restoration Auxiliary Power Source' means a source of power with the ability to self-start and supply part or all of the in-house load in the event of a Network failure.
- 'Restoration Service Provider' as per Grid Code.
- 'Review Period' means, under this framework, annual.
- 'Simulation Exercise' means a desktop exercise progressed to assess adequacy of plans, processes and procedures.
- 'Synchronous power-generating module' – as per Grid Code

- ‘Top Up Service’- These are the supplementary services required to fulfil the technical capability of a Distribution Restoration Zone such as Energy (MWs), fast MW control, frequency control, voltage control and short circuit level (Mvars).

3 Primary Restoration Service Provider Assurance Activities

3.1 Primary Restoration Service Provider Test (Phases 1-3 Start up)

3.1.1 Classification:

Mandatory. (GC0148 - OC5.7.1.1, OC5.7.2)

3.1.2 Applicability:

ESO, Primary Restoration Service Providers who fall under a Local Joint Restoration Plan.

3.1.3 Implementation:

Codes and contract between ESO and Primary Restoration Service Provider.

3.1.4 Description:

Disconnect the Primary Restoration Service Provider from the Network and restart the plant and apparatus from shutdown without any external electrical energy supply.

For all Primary Restoration Service Providers, the technical capability to start from shutdown without any external electrical energy supply shall be demonstrated. The test shall be deemed successful if the start-up time to energise a part of the System within Frequency and Voltage limits is kept within the relevant timeframe of the contracted restoration phase.

3.1.5 Requirement:

Power Generating Modules

For power generating modules and at least once every three years, to demonstrate its technical capability to start from shut down without any external electrical energy supply.

HVDC Systems

For HVDC Systems and at least once every three years, to demonstrate its technical capability to start from shutdown without any external electrical energy supply and energise the busbar of the remote AC substation to which it is connected.

3.1.6 Measure:

Power Generating Module

Power generating module: the test shall be deemed successful if the start-up time is kept within the contracted duration following of loss of all external electrical energy supply.

HVDC System

HVDC System: the test shall be deemed successful if the following conditions are cumulatively fulfilled:

(i) the HVDC system has demonstrated being able to energise the busbar of the remote AC substation to which it is connected.

(ii) the HVDC system operates from a stable operating point at agreed capacity.

(iii) the start-up time is kept within the contracted duration following loss of any external electrical energy supply.

3.1.7 Annual reporting to the Monitoring Body:

Date and outcome of the last test(s).

High-Level description of the test(s), Power Station & module or HVDC system.

3.1.8 Contribution to Preparedness Level:

Status	Criteria (time since last successful test completed)	Points
Good	Average is ≤ 3 years	4
Adequate	Average is > 2 years and ≤ 2.5 years	3
Limited	Average is >1 and <2 years	1
Unsatisfactory	> 3 years	0

3.2 Quick Resynchronisation Unit Test

3.2.1 Classification:

Mandatory (OC5.7.3, ECC 6.3.5.6 – currently 27 April 2019 onwards)

3.2.2 Applicability:

ESO, Primary Restoration Service Providers and DNO's

3.2.3 Implementation:

Codes and contract between ESO, DNO and Primary Restoration Service Provider.

3.2.4 Description:

Following shutdown of any auxiliary generating units, the generating unit will be tripped from the system and supply its house load. The generating unit will then synchronise with the system but not load until instructed by relevant network operator.

3.2.5 Requirement:

For the generating unit to trip and resynchronise with the system without Auxiliary or external electrical supplies.

3.2.6 Measure:

Completion of trip and resynchronisation within the contractual time.

3.2.7 Annual reporting to the Monitoring Body:

Date and outcome of the last test(s).

High-Level description of the test(s), Power Station & module or HVDC system.

3.2.8 Contribution to Preparedness Level:

Status	Criteria (time since last successful test completed)	Points
Good	Average is ≤ 2 years	4
Adequate	Average is > 2 years and ≤ 2.5 years	3
Limited	Average is >2.5 and <3 years	1
Unsatisfactory	> 3 years	0

3.3 Distribution Restoration – Primary Restoration Service Providers that fall under a DRZP.

3.3.1 Classification:

Mandatory. (GC0148 - OC5.7.1.2, OC5.7.4, DOC 9)

3.3.2 Applicability:

DNO led, Primary Restoration Service Providers that fall under a DRZP, ESO.

3.3.3 Implementation:

Codes and contract between ESO, DNO and Primary Restoration Service Provider that fall under a DRZP.

3.3.4 Description:

Disconnect the Anchor Generator from the system and restart the generator from shutdown without any external electrical energy supplies. The generator will then energise a part of the system within Frequency and Voltage limits within the duration of the contracted time

For Top up service providers to demonstrate capability of their equipment contracted for within the Distribution Restoration Zone without external supplies. This demonstration will only use the mains resilient communication paths available in a restoration.

3.3.5 Requirement:

For Anchor Generators at least every three years, to demonstrate its technical capability to start from shut down without any external electrical energy supply.

For Top up Services at least every three years, to demonstrate its technical capability to as per the Distribution Restoration Zone contract.

3.3.6 Measure:

The Anchor Generator test shall be deemed successful if the start-up time to energise a part of the network within Frequency and Voltage limits is within the duration of the contracted time

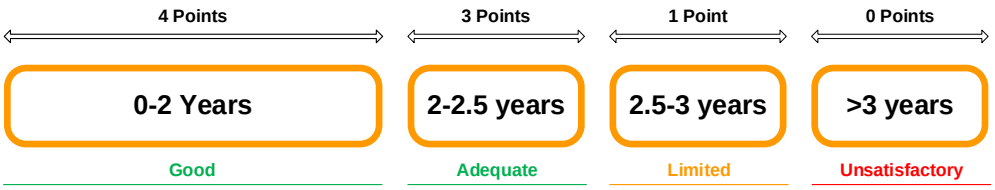
The Top up services test shall be deemed successful if the contractual technical parameters are met within given timescales.

3.3.7 Annual reporting to the Monitoring Body:

Date and outcome of the last test(s).

High-Level description of the test(s), Anchor Generator facility, Distribution Restoration Zone

3.3.8 Contribution to Preparedness Level:



Status	Criteria (time since last successful test completed)	Points
Good	Average is ≤ 2 years	4
Adequate	Average is > 2 years and ≤ 2.5 years	3
Limited	Average is >2.5 and <3 years	1
Unsatisfactory	> 3 years	0

3.4 Distribution Restoration Zonal Control Tests

3.4.1 Classification:

Mandatory. (Drafting in GC0148)

3.4.2 Applicability:

DNO led, Primary Restoration Service Providers that fall under a DZRP, ESO.

3.4.3 Implementation:

Codes and contract between ESO, DNO and Distribution Restoration Zone.

3.4.4 Description:

The Distribution Restoration Zone will operate in Restoration mode with automation of control for 24 hours. Whilst this may use non-emergency auxiliary power and communications, proved elsewhere, this will functionally check operation.

3.4.5 Requirement:

For each Distribution Restoration Zones at least every three years, to demonstrate its technical capability to operate as per the Distribution Restoration Zone contract.

3.4.6 Measure:

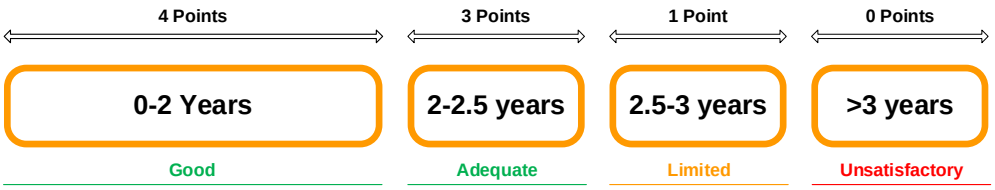
The Distribution Restoration Zone Controller test shall be deemed successful if the contractual technical parameters are met within given timescales with only interaction/ external control available during a Restoration.

3.4.7 Annual reporting to the Monitoring Body:

Date and outcome of the last test(s).

High-Level description of the test(s), Anchor / Top up facility, Distribution Restoration Zone

3.4.8 Contribution to Preparedness Level:



Status	Criteria (time since last successful test completed)	Points
Good	Average is ≤ 2 years	4
Adequate	Average is > 2 years and ≤ 2.5 years	3
Limited	Average is >2.5 and <3 years	1
Unsatisfactory	> 3 years	0

3.5 Dead Line Charge Test

3.5.1 Classification:

Mandatory.

3.5.2 Applicability:

ESO, Primary Restoration Service Providers that fall under an LJRP or DRZP, TOs, DNO.

3.5.3 Implementation:

Codes and contract between ESO, DNO and Primary Restoration Service Provider / Distribution Restoration Zone.

3.5.4 Description:

A Primary Restoration Service Provider to re-energise a dead test section of the Network.

For Restoration Service Providers that fall under a DRZP complete a Dead Line Charge test to energise other components of the Distribution Restoration Zone, such as Top up Services, demand points and/or load banks.

3.5.5 Requirement:

At least every 3 years for the Primary Restoration Service Provider to energise a dead test section of network, isolated from the system by the Network Operator/Owner. Following the approach of Distribution Restoration. energising the network during restoration.

Typically, this will be completed following a Primary Restoration Service Provider Test.

3.5.6 Measure:

Aligned with the reactive capability of the Primary Restoration Service Provider and its ability to manage Voltage, demonstrate the ability to re-energise a potential Restoration route. Ability of Primary Restoration Service Provider to control and maintain the frequency of the energised Power Island. Confirm correct operation of switching and protection systems to energise.

Where multiple parties collaborate to become a Primary Restoration Service Provider, it may be more practical to assess site capabilities at different times.

3.5.7 Annual reporting to the Monitoring Body:

Date and outcome of the last test(s).

High-level description of the test(s),

3.5.8 Contribution to Preparedness Level:

Executed within the last 3 years: 2 points.

Not executed: 0 points.

3.6 Remote Synchronisation Tests

3.6.1 Classification:

Mandatory.

3.6.2 Applicability:

ESO, Primary Restoration Service Providers that falls under a LJRP or DZRP, TOs, DNOs.

3.6.3 Implementation:

Codes.

3.6.4 Description:

A Primary Restoration Service Provider or Distribution Restoration Zone re-energises a dead test section of the Network with the Network Operator. The Primary Restoration Service Provider or Distribution Restoration Zone, led by the Network Operator, then synchronises the Power Island on the test network area with the main power system using a Power System Synchroniser not used in normal operations of the generator.

3.6.5 Requirement:

Demonstrate the ability to create and re-synchronise power islands, controlling Voltage and Frequency.

3.6.6 Measure:

Power Island established to which the Primary Restoration Service Provider is connected within this test successfully synchronised (via a real or *dummy* synchronisation) onto the wider System at a circuit breaker other than that at which this normally occurs.

3.6.7 Annual reporting to the Monitoring Body:

Date and outcome of the last test(s).

High-level description of the test(s), including stakeholders involved and lessons learnt.

3.6.8 Contribution to Preparedness Level:

Executed Live within the last 3 years: 2 points.

Executed Dummy within the last 3 years: 1 point.

Not executed within the last 3 years: 0 points.

3.7 Assurance Visit

3.7.1 Classification:

Mandatory.

3.7.2 Applicability:

ESO led, Primary Restoration Service Providers (LJRP and DZRP), Zonal Controllers, TOs, DNOs.

3.7.3 Implementation:

Codes, Contract between ESO and Primary Restoration Service Provider, Distribution Restoration Zone Contracts, System Restoration Plan, System Defence Plan.

3.7.4 Description:

Validate Primary Restoration Service Providers have the appropriate documentation, operational and training procedures in place to support Restoration.

3.7.5 Requirement:

ESO and each Primary Restoration Service Provider that fall under an LJRP shall progress with an Assurance Visit at least every three years.

DNO and each Primary Restoration Service Provider that fall under a DRZP party shall progress with an Assurance Visit at least every three years.

ESO, TO(s) and DNO(s) to assure the Restoration Plans and Distribution Restoration.

Share key themes from lessons learnt across the industry.

3.7.6 Measure:

ESO / DNO to confirm appropriateness of documentation, technical and training procedures in place to support Restoration, conformity of overall information reported to the Monitoring Body.

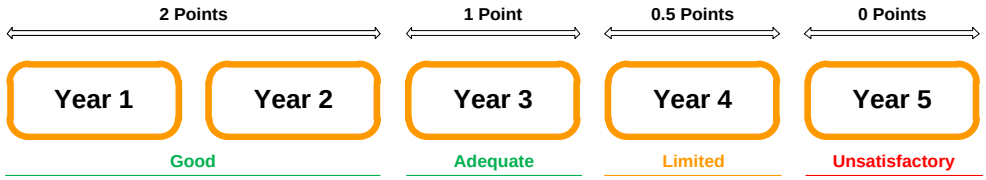
3.7.7 Annual reporting to the Monitoring Body:

Date and outcome of the last Assurance Visit(s).

High-level description of the visit, any outstanding action(s), and lessons learnt.

3.7.8 Contribution to Preparedness Level:

Primary Restoration Service Providers that fall under an LJRP or DRZP:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 2 years	2
Adequate	> 2 years and ≤ 3 years	1
Limited	> 3 years and ≤ 4 years	0.5
Unsatisfactory	> 4 years	0

4 Network & Demand Assurance Activities

4.1 Restoration Skeleton Network Review

4.1.1 Classification:

Mandatory.

4.1.2 Applicability:

ESO, TOs, DNOs.

4.1.3 Implementation:

Codes.

4.1.4 Description:

Assess and design the capability of the Transmission and Distribution Networks to create and sustain an LJRP, DZRP, and then energise further sections of network to access Secondary Restoration Service Providers, demand and energise all substations.

4.1.5 Requirement:

On an annual basis, in line with the planning of network infrastructure (Both Operational and Planning Timescales), to provide evidence of energisation routes that are suitable for use within the 24 hours (0-60% demand loading) of a restoration.

This will involve a process being established to consider Restoration within the long-term design process across the network operators. This assurance activities check that the process has been completed and a design is in place.

4.1.6 Measure:

self-evaluation.

4.1.7 Annual reporting to the Monitoring Body:

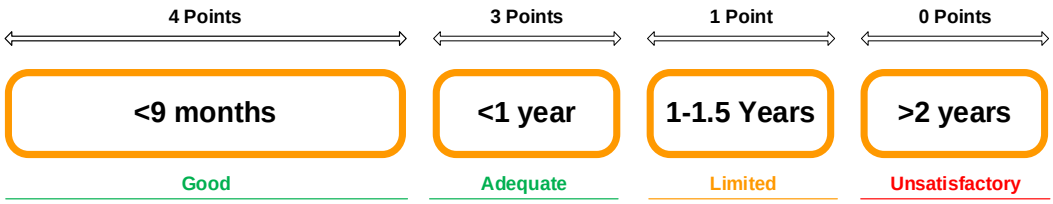
List of routes and studying completed.

Date(s) updated report.

Confirmation of Assurance/capability.

4.1.8 Contribution to Preparedness Level:

Adequate network design is in place for the Restoration strategy.



Status	Criteria (time since last successful assessment)	Points

Good	≤ 0.75 years	4
Adequate	≤ 1 years	3
Limited	> 1 years and ≤ 2 years	1
Unsatisfactory	> 2 years	0

4.2 Restoration Skeleton Network Availability

4.2.1 Classification:

Mandatory.

4.2.2 Applicability:

ESO, TOs, DNOs.

4.2.3 Implementation:

Codes.

4.2.4 Description:

Assess the operational availability of routes utilised in the restoration plans.

4.2.5 Requirement:

Within planning and operational timescales assess the outages/availability of LJRP and Network restoration routes across the GB network to ensure that the capability is maintained.

For DRZP, within planning and operational timescales assess the outages/availability of DRZPs across GB to deliver upon the requirements provided for in Restoration Service Providers Contractors. This including contractor and circuit outage consideration.

4.2.6 Measure:

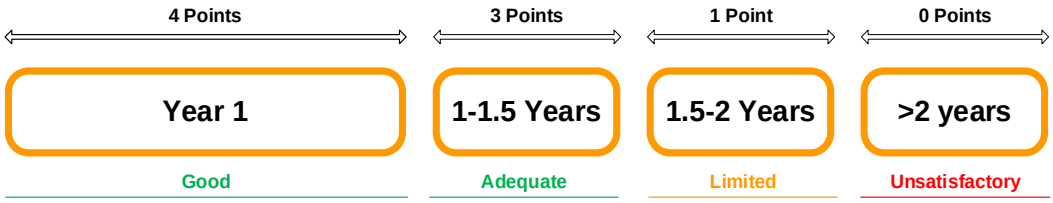
Self-evaluation.

4.2.7 Annual reporting to the Monitoring Body:

Summary of Skeleton Network availability at various Planning and Operational timescales, TO/DNO Network assessments, Year ahead handover, operational planning, and outturn.

4.2.8 Contribution to Preparedness Level:

Adequate network is available for the Restoration strategy.



Status	Criteria (time since last successful assessment)	Points
Good	≤ 1 years	4

Adequate	> 1 years and ≤ 1.5 years	3
Limited	> 1.5 years and ≤ 2 years	1
Unsatisfactory	> 2 years	0

4.3 Remote Synchroniser Testing

4.3.1 Classification:

Mandatory.

4.3.2 Applicability:

TOs, DNOs.

4.3.3 Implementation:

Codes.

4.3.4 Description:

Assess capability of Power System Synchronisers to operate as expected.

4.3.5 Requirement:

At least every three years, test Power Island Synchronisers and demonstrate their ability to resynchronise adjacent power islands. As a minimum, the capability assessment shall include a dummy remote synchronisation.

4.3.6 Measure:

Self-evaluation.

4.3.7 Annual reporting to the Monitoring Body:

List of Power Island Synchronisers installed/maintained.

Date(s) of last test(s).

Confirmation of Assurance/capability.

4.3.8 Contribution to Preparedness Level:

Power Island Synchronisers last tested:

Status	Criteria (time since last successful test completed)	Points
Good	≤ 2 years	4
Adequate	> 2 years and ≤ 3 years	3
Limited	> 3 years and ≤ 4 years	1
Unsatisfactory	> 4 years	0

4.4 Low Frequency Demand Disconnection Tests (Total Demand)

4.4.1 Classification:

Mandatory. (Restoration Defence plan) Appendix A5 of Grid Code European connection conditions for new distribution networks. GC0148.

4.4.2 Applicability:

TOs, DNOs.

4.4.3 Implementation:

Codes.

4.4.4 Description:

Assess the capability of Low Frequency Relays.

4.4.5 Requirement:

At least every three to five years, test the low frequency relays and demonstrate their ability to segregate the Network as defined under Grid Code OC6. As a minimum, the capability assessment shall comply with ENA's Technical Specification 48-6-5, ENA Protection Assessment Functional Test Requirements Voltage and Frequency Protection. Grid Code ECC.A.5.4.1 for new distribution networks.

4.4.6 Measure:

Self-evaluation.

4.4.7 Annual reporting to the Monitoring Body:

List of Low Frequency Relays installed/maintained.

Date(s) of last Test(s).

Confirmation of Assurance/capability.

4.4.8 Contribution to Preparedness Level:

Low Frequency Relays last tested:

Status	Criteria (time since last successful test completed)	Points
Good	≤ 2 years	4
Adequate	> 2 years and ≤ 3 years	3
Limited	> 3 years and ≤ 4 years	1
Unsatisfactory	> 4 years	0

5 Planning and Training Assurance Activities

5.1 Restoration / Loss of external grid supplies / Loss of Network Procedure Review

5.1.1 Classification:

Mandatory.

5.1.2 Applicability:

ESO, Primary Restoration Service Providers that fall under LJRPs or DRZPs, TOs, DNOs

5.1.3 Implementation:

Codes.

5.1.4 Description:

internal organisational review of all relevant restoration / loss of external grid supplies / loss of network procedure(s) to ensure these are up to date.

5.1.5 Requirement:

Procedure reviewed at least every three years.

5.1.6 Measure:

Self-evaluation.

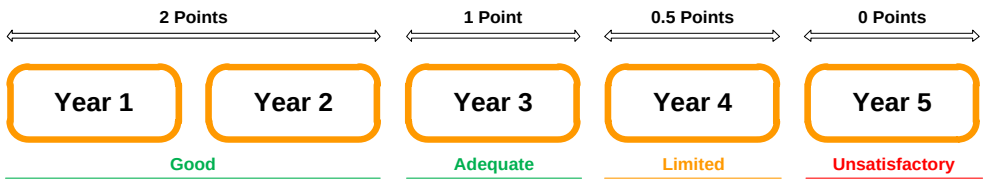
5.1.7 Annual reporting to the Monitoring Body:

Date of last review(s).

Confirmation of adequacy of the relevant procedure.

5.1.8 Contribution to Preparedness Level:

Procedure reviewed and results of review issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 2 years	4
Adequate	> 2 years and ≤ 3 years	3
Limited	>3 years and ≤ 4 years	1
Unsatisfactory	> 4 years	0

5.2 LJRP and DRZP Reviews

5.2.1 Classification:

Mandatory (OC9.4.7.7).

5.2.2 Applicability:

ESO led LJRPs, DNO led for DZRPs Primary Restoration Service Providers, TOs.

5.2.3 Implementation:

Codes and contract between ESO, DNO and Primary Restoration Service Provider.

5.2.4 Description:

Cross-party review to increase the familiarity around the relevant Plan, update it on a need basis and, also, an opportunity to agree any areas for development.

5.2.5 Requirement:

Restoration plan(s) reviewed and agreed at least every three years.

5.2.6 Measure:

Plan(s) agreed and ready to (re-)issue every three years.

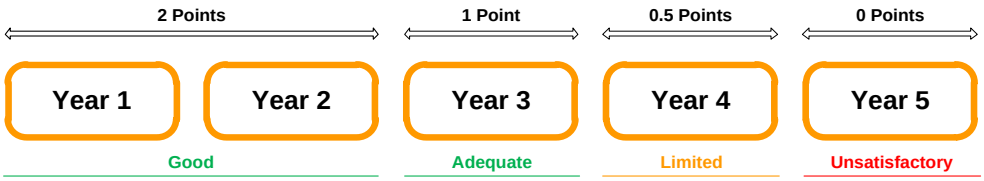
5.2.7 Annual reporting to the Monitoring Body:

Date and outcome of the last review(s).

High-level description of stakeholders involved, and changes made to the plan(s).

5.2.8 Contribution to Preparedness Level:

Plan reviewed and agreed:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 2 years	3
Adequate	> 2 years and ≤ 3 years	2
Limited	> 3 years and ≤ 4 years	1
Unsatisfactory	> 4 years	0

5.3 Staff Training

5.3.1 Classification:

Mandatory. (OC9.4.7.5.3)

5.3.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs,

5.3.3 Implementation:

Codes.

5.3.4 Description:

Training for staff deemed essential and/or relevant for system restoration, across all levels of seniority, to raise awareness and demonstrate competence on Restoration and/or system restart for LJRP and DRZP. As minimum, training contents shall include the Restoration / loss of external grid supplies / loss of network procedure(s) and a presentation on Restoration provided by the ESO.

For ESO, TOs and DNOs relevant staff will be trained on the Restoration Decision Support Tool and use of Power System Synchronisation.

5.3.5 Requirements:

Essential Roles:

training delivered at least every two years to 90% of staff deemed essential for Restoration.

Relevant Roles:

training delivered at least every two years to a minimum of 70% Staff deemed relevant for system restart.

5.3.6 Measure:

Self-evaluation.

5.3.7 Annual reporting to the Monitoring Body:

List of roles essential and relevant for Restoration and/or system restart.

Date(s), number of people and hours allocated for training on Restoration and/or system restart over the review period.

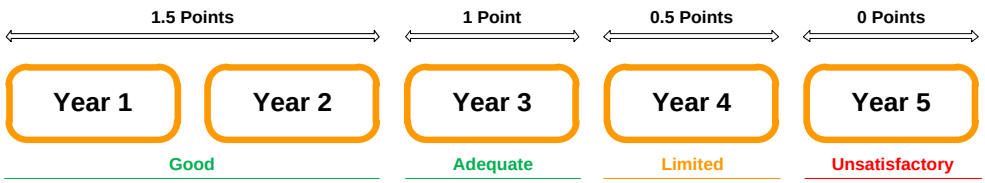
High-Level summary of training contents.

Confirmation of attendance and competence of:

- 90% Staff deemed essential for Restoration.
- ≥ 70% Staff deemed relevant for system restart.

5.3.8 Contribution to Preparedness Level:

Training delivered/completed:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 2 years	4
Adequate	> 2 years and ≤ 3 years	3
Limited	> 3 years and ≤ 4 years	1
Unsatisfactory	> 4 years	0

5.4 Awareness Presentations

5.4.1 Classification:

Mandatory (OC9.4.7.5.3).

5.4.2 Applicability:

ESO.

5.4.3 Implementation:

Codes.

5.4.4 Description:

ESO demonstrating engagement with Industry

Presentation on Restoration to selected stakeholders covering, as a minimum:

i. GB's Restoration approach (aligned with the ESO's Restoration Strategy).
ii. Potential consequences in the event of a power outage.
iii. Challenges and best practices.
iv. An open discussion (Q&As).

Stakeholders:

regulatory bodies (example: Ofgem, Ofcom, etc.), key consumers/stakeholders (examples: railways, airports, nuclear facilities, etc.), government working groups, including devolved administrations and Local Resilience Forums. Energy Industry participants, TO's and Network Operators.

5.4.5 Requirement:

Presentation delivered to one or more stakeholders at least annually.

5.4.6 Measure:

Self-evaluation.

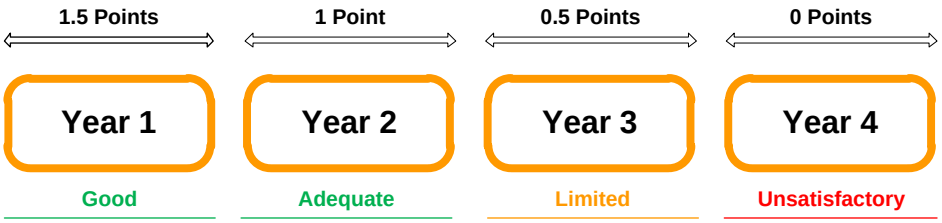
5.4.7 Annual reporting to the Monitoring Body:

Date of presentation(s) delivered over the review period.

Summary of contents.

5.4.8 Contribution to Preparedness Level:

Presentation delivered:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

5.5 Industry Exercises

5.5.1 Classification:

Mandatory. (OC9.4.7.5.3)

5.5.2 Applicability:

ESO led, Primary Restoration Service Providers, TO, DNO

5.5.3 Implementation:

Codes.

5.5.4 Description:

This is a desktop / desk based exercise, bringing together Restoration Service Providers, Network Owners and ESO to work through processes for Restoration as a training and knowledge build. This may be based around a simulated event on training simulators.

5.5.5 Requirement:

Desktop Exercise delivered at least every three years and staggered as follows:

5.5.6 Measure:

Self-evaluation.

5.5.7 Annual reporting to the Monitoring Body:

Date(s) of last Industry exercise(s).

Summary of contents, including:

i. Stakeholders involved.
ii. Scope, objectives, goals;
iii. Exercise outcome and lessons learnt;
iv. Demonstrate that exercise results and learnings were shared across the Industry.

5.5.8 Contribution to Preparedness Level:

Exercise delivered:

Status	Criteria (time since last successful test completed)	Points
Good	≤ 2 years	4
Adequate	> 2 years and ≤ 3 years	3
Limited	>3 years and ≤ 4 years	1
Unsatisfactory	> 4 years	0

6 Communication and control systems Assurance Activities

6.1 Voice Systems Test Demonstration

6.1.1 Classification:

Mandatory. CC/ECC.6.5.4.4

6.1.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs,

6.1.3 Implementation:

Codes.

6.1.4 Description:

Aligned with the "*EC-RRG Resilience Guidelines for Providers of Critical National Telecommunications Infrastructure*", Communications Providers shall demonstrate that potential failure scenarios have been envisaged and that contingency plans for service Restoration have been prepared, tested and are in place. Contingency plans shall guarantee the Communications Provider's ability to fulfil, as a minimum, its service obligations in the event of a Network failure.

6.1.5 Requirement:

At least annually, stakeholders shall demonstrate the resilience of the Voice Systems and demonstrate its ability to withstand a minimum of 72 hours under a Restoration event. *Note: demonstration should be achieved by complying against* Restoration *Auxiliary Power Source Tests*

6.1.6 Measure:

Self-evaluation.

6.1.7 Annual reporting to the Monitoring Body:

List of Voice systems (internal/external) installed.

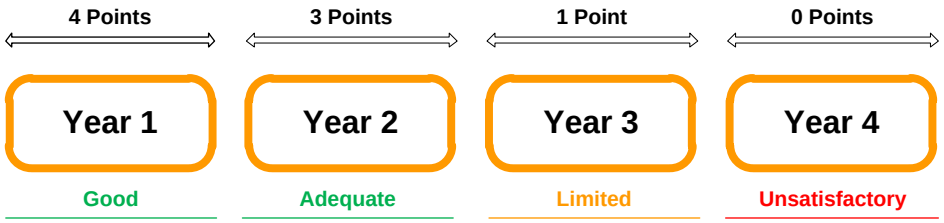
Minimum service obligations per system installed.

Confirmation of resilience from the relevant Communications Provider(s) (if available).

Statement of compliance.

6.1.8 Contribution to Preparedness Level:

Statement of compliance last issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

6.2 Control System Resilience Demonstration – Client Power Resilience

Note: Main Control Centre and Disaster Recovery SCADA (DRS) Centres

6.2.1 Classification:

Mandatory.

6.2.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs,

6.2.3 Implementation:

Codes.

6.2.4 Description:

Power supply requirements of Control System environment to withstand a sustained restoration event.

6.2.5 Requirement:

At least annually, stakeholders shall demonstrate the Control System's ability to withstand a minimum of 72 hours under a Restoration event. *Note: demonstration should be achieved by complying against* Restoration *Auxiliary Power Source Tests (section 17 below).*

6.2.6 Measure:

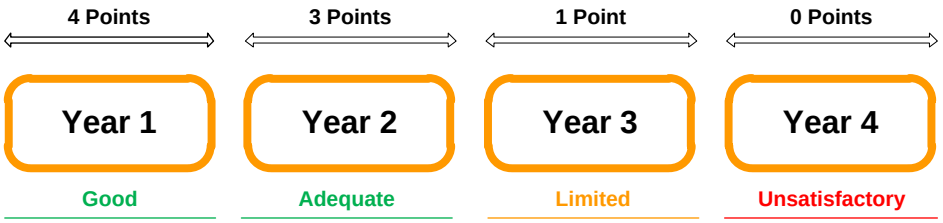
Self-evaluation.

6.2.7 Annual reporting to the Monitoring Body:

Statement of compliance around Power Resilience.

6.2.8 Contribution to Preparedness Level:

Statement of compliance last issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

6.3 Control System Resilience Demonstration – Server Power Resilience

6.3.1 Classification:

Mandatory.

6.3.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs,

6.3.3 Implementation:

Codes.

6.3.4 Description:

Power supply requirements of Control System environment to withstand a sustained Restoration event.

6.3.5 Requirement:

at least annually, stakeholders shall demonstrate the Control System's ability to withstand a minimum of 72 hours under a Restoration event. *Note: demonstration should be achieved by complying against* Restoration *Auxiliary Power Source Tests.*

6.3.6 Measure:

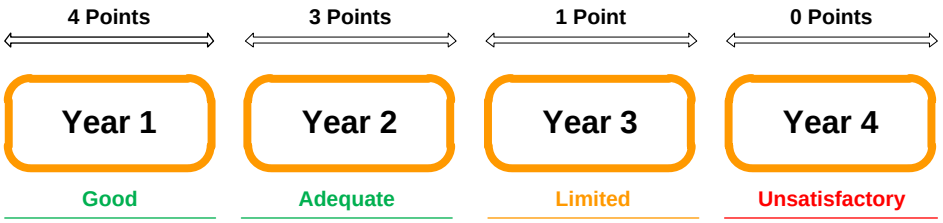
Self-evaluation.

6.3.7 Annual reporting to the Monitoring Body:

Statement of compliance around Power Resilience.

6.3.8 Contribution to Preparedness Level:

Statement of compliance last issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

6.4 Control System Resilience Demonstration –Server Architecture & Connectivity

6.4.1 Classification:

Mandatory.

6.4.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs

6.4.3 Implementation:

Codes.

6.4.4 Description:

Key resources required to ensure that Control System are maintained throughout a Restoration event, ability to lock down the SCADA system to external interference, and ability to operate the Control System with no external connections (standalone).

6.4.5 Requirement:

At least annually, stakeholders shall demonstrate they have a list of the key resources required to ensure Control System's operability. At least annually test the ability to lock down the Control System to external interference as well as the ability to operate the Control System with no external connections (standalone).

6.4.6 Measure:

Self-evaluation.

6.4.7 Annual reporting to the Monitoring Body:

List of key resources required to ensure Control System's Operability.

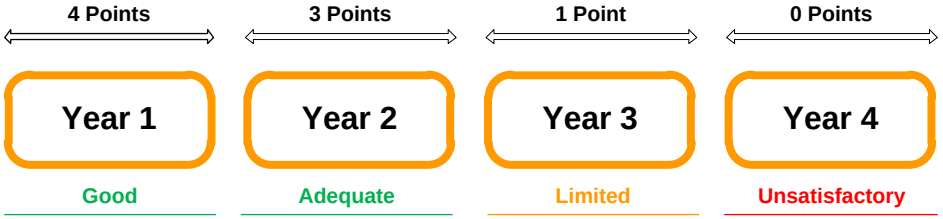
Test results demonstrating ability to lock down Control System to external interference.

Test results demonstrating ability to operate Control System with no external connections (standalone).

Note: demonstration can be achieved via compliance with Network & Information Systems (NIS) regulations, provided the stakeholder (1) didn't have a 'significant impact' on the continuity of the service over the assessment period, (2) provides the relevant compliance status report (red/amber/green) against the individual elements of the NIS Regulations and (3) shares the planned roadmap for achieving compliance.

6.4.8 Contribution to Preparedness Level:

Statement of compliance last issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

6.5 Control System Resilience Demonstration – Alarm Event Handling

6.5.1 Classification:

Mandatory.

6.5.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs

6.5.3 Implementation:

Codes.

6.5.4 Description:

Assess the performance of the Control System when handling a Restoration event or other extreme Network activity.

6.5.5 Requirement:

At least annually, stakeholders shall demonstrate the Control System's ability to handle challenging events like a blackout (stress tests).

6.5.6 Measure:

Self-evaluation.

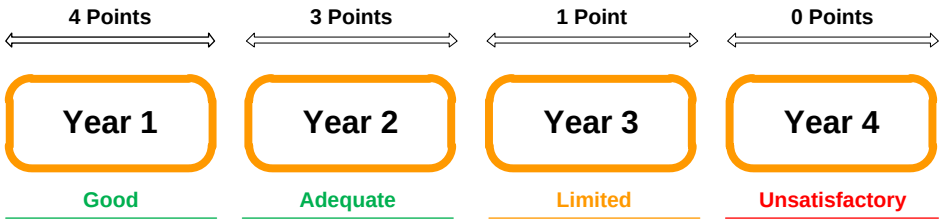
6.5.7 Annual reporting to the Monitoring Body:

Event(s) considered, test(s) conducted over the review period, test results.

Statement of compliance on the Control System's ability to handle challenging events.

6.5.8 Contribution to Preparedness Level:

Statement of compliance last issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

6.6 Control System Resilience Demonstration – Diagram & Topology

6.6.1 Classification:

Mandatory.

6.6.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs

6.6.3 Implementation:

Codes.

6.6.4 Description:

Assess Control System's performance to an upstream de-energising of the Network and actions required to demonstrate the Network topology as de-energised.

6.6.5 Requirement:

At least annually, stakeholders shall demonstrate the capability of the Control System to handle customer incidents when the entire Network is shown in a de-energised state.

6.6.6 Measure:

Self-evaluation.

6.6.7 Annual reporting to the Monitoring Body:

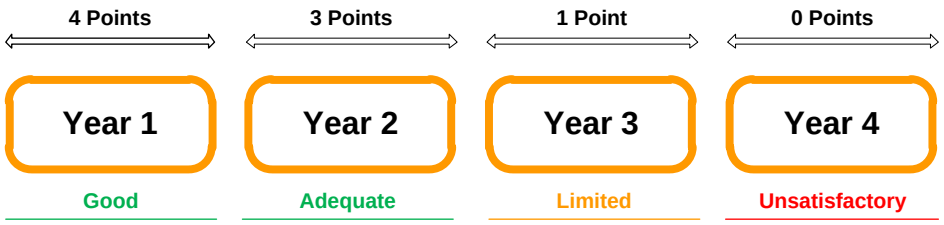
Test results demonstrating system's ability to handle customer incidents when the entire Network is shown in a de-energised state.

Risk assessment and mitigation actions taken over the review period to address dependencies and criticality of other supporting IT systems on the core Control System.

Statement of compliance.

6.6.8 Contribution to Preparedness Level:

Statement of compliance last issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

6.7 Cyber-Security Tests

6.7.1 Classification:

Mandatory.

6.7.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs

6.7.3 Implementation:

Codes.

6.7.4 Description:

Identification, monitoring, and actions (defence measures) on vulnerabilities of Voice and Control Systems to NIS regulations.

6.7.5 Requirement:

At least annually, stakeholders shall demonstrate the cyber-security of their Voice and Control Systems.

6.7.6 Measure:

Self-evaluation of whether Cyber resilient test/audit to be carried out in line with the NIS regulations

6.7.7 Annual reporting to the Monitoring Body:

Test results demonstrating the Voice and Control System's ability to defend themselves against computer failure including cyber-attacks.

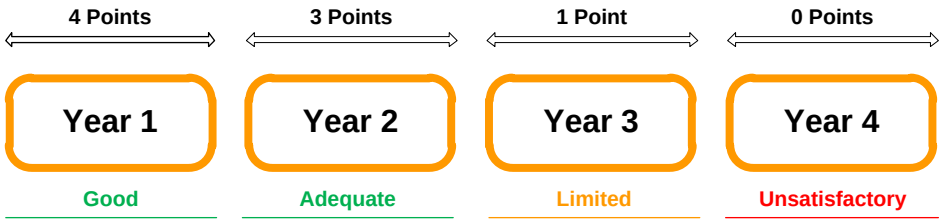
Risk assessment and mitigation actions taken over the review period to address cyber-security vulnerabilities.

Statement of compliance.

Note: demonstration can be achieved via compliance with Network & Information Systems (NIS) regulations, provided the stakeholder (1) didn't have a 'significant impact' on the continuity of the service over the assessment period, (2) provides the relevant compliance status report (red/amber/green) against the individual elements of the NIS Regulations and (3) shares the planned roadmap for achieving compliance.

6.7.8 Contribution to Preparedness Level:

Statement of compliance last issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

6.8 Telephony Services

6.8.1 Classification:

Mandatory.

6.8.2 Applicability:

ESO, Primary Restoration Service Providers, TOs, DNOs,

6.8.3 Implementation:

STC Codes and Contracts

6.8.4 Description:

To ensure that communication infrastructure and applications are maintained to a high standard

6.8.5 Requirement:

Annual reporting of Service Level Agreement compliance.

Annual report of infrastructure and service provision.

6.8.6 Measure:

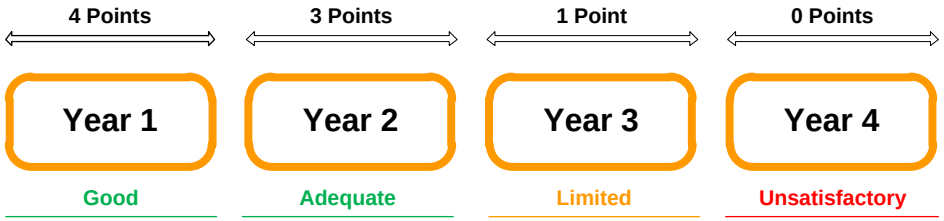
Self-evaluation.

6.8.7 Annual reporting to the Monitoring Body:

Annual statistics on compliance.

6.8.8 Contribution to Preparedness Level:

Statement of compliance last issued:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	4
Adequate	> 1 year and ≤ 2 years	3
Limited	> 2 years and ≤ 3 years	1
Unsatisfactory	> 3 years	0

7 Equipment & Plant Assurance Activities

7.1 Auxiliary Power Sources

7.1.1 Classification:

Mandatory (GC148 – Distributed Restart)

7.1.2 Applicability:

ESO, Primary Restoration Service Providers, Distribution Restoration Zones, TOs, DNOs

7.1.3 Implementation:

Codes.

7.1.4 Description:

Assess the performance and capability of backup auxiliary power sources.

7.1.5 Requirement:

At least annually, demonstrate the Auxiliary Power Source's capability to operate minimum of 72 hours post-power outage event.

- The technology type may vary from Diesel Generation, Batteries, Hydro, renewables etc. This is not intended to be an exhaustive list. Functionally the Auxiliary Power Sources test will include, a load test run at rated output for a minimum of two hours, and steady state and transient loads to ensure pick up performance.
- Where conventional fuels are used (Diesel, Hydrogen, Gas etc) the fuel quality will be checked, and capacities calculated to achieve 72 hours.
- For Uninterruptable Power Sources these will include a capacity/discharge test and impedance test.

Note: the assessment will take cognisance of the fact that once back up supplies are restored the batteries duty may be complete and that therefore the batteries duty is likely to cover the period between loss of grid supplies and back up supplies, unless the batteries are the source of site back up supply, being established.

7.1.6 Measure:

Self-evaluation.

7.1.7 Annual reporting to the Monitoring Body:

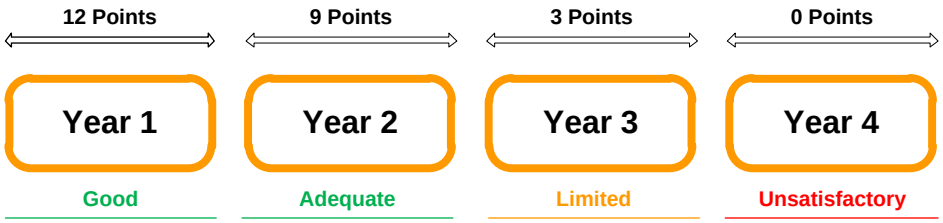
List of Auxiliary Power Sources installed/maintained.

Date(s) of last test(s).

Statement of compliance.

7.1.8 Contribution to Preparedness Level:

Auxiliary Power Source(s) last tested:



Status	Criteria (time since last successful test completed)	Points
Good	≤ 1 year	12
Adequate	> 1 year and ≤ 2 years	9
Limited	> 2 years and ≤ 3 years	3
Unsatisfactory	> 3 years	0

8 Compliance & Monitoring

Departing from the annual reports submitted by the relevant stakeholders it will be for the Monitoring Body to calculate individual / GB /Regional assurance levels. Templates to be made available at a later stage by the Monitoring Body.

8.1 Minimum Expected Assurance Level

Rationale: score 'Adequate' against each mandatory assurance activity. The scoring will inform the associated risk.

Risk classification:

High	• Fundamental weaknesses in the exercising activities. • Immediately put in place compensating controls to mitigate the risk. • Address and mitigate the risk as a matter of urgency.
Medium	• Weaknesses in the exercising activities. • Any pending issue to be resolved within the pre-agreed schedule/timescales.
Low	• Desirable continuous improvement to the exercising activities. • Any pending issue to be resolved within the pre-agreed schedule/timescales.

a. Individual Stakeholders

Mandatory? **Yes** **No**

	ESO	TO	DNO	Pry Restoration SP	Sec Restoration SP
Primary Restoration Service Provider Assurance Activities					
Primary Restoration Service Provider Test (Phases 1-3)	3			3	
Quick Resynchronisation Unit Test	3			3	
Distribution Restoration – Anchor Generator Test			3	3	
Distribution Restoration – Top Up Service Test			3	3	
Distribution Restoration – Zonal Control Unit Test			3	0	
Dead Line Charge Test	2	2	2	2	
Remote Synchronisation Tests	2	2	2	2	
Assurance Visits	1			1	
Minimum Expected Assurance Level (≥)	**8**	**4**	**13**	**8**	**0**

Network & Demand Assurance Activities					
Skeleton Network Design Review	3	3	3		
Skeleton Network Availability Review	3	3	3		
Remote Synchroniser Testing		3	3		
Automatic/Manual LFDD Tests		3	3		
Minimum Expected Assurance Level (≥)	**6**	**12**	**12**	**0**	**0**

Planning and Training Assurance Activities					
Restoration Procedure(s) Review	3	3	3	3	
Restoration Plan Review	3	3	3	3	
Staff Training	3	3	3	3	

Awareness Presentations	3				
Industry Exercise	3				
Minimum Expected Assurance Level (≥)	**15**	**9**	**9**	**9**	**0**

Communication and Control Systems Assurance Activities					
Voice Systems	3	3	3	3	
Control System Resilience Tests – Client Power Resilience	3	3	3	3	
Control System Resilience Tests – Server Power Resilience	3	3	3	3	
Control System Resilience Tests – Server Architecture & Connectivity	3	3	3	3	
Control System Resilience Tests – Alarm & Event Handling	3	3	3	3	
Control System Resilience Tests – Diagram & Topology	3	3	3	3	
Cyber Security Tests	3	3	3	3	
Minimum Expected Assurance Level (≥)	**21**	**21**	**21**	**21**	**0**

Equipment & Plant Assurance Activities					
Restoration - Auxiliary Power Sources	9	9	9	9	
Minimum Expected Assurance Level (≥)	**9**	**9**	**9**	**9**	**0**

8.2 Risk Matrix

b. Great Britain & ESO

Summation of 5 categories above would total 59 for good operation.

		Vulnerability to Threat			
		Low	Moderate	High	Very High
Impact of Failure	Devastating	R <30	R <26	R <22	R <14
	Severe	R <36	R <30	R <24	R <16
	Noticeable	R = 42	R <36	R <24	R <18
	Minor	**R >42**	R = 42	R <24	R <20

c. TOs & DNOs – Risk Matrix

Summation of 5 categories above would total 55 (TOs) and 64 (DNOs) for good operation.

		Vulnerability to Threat			
		Low	Moderate	High	Very High
Impact of Failure	Devastating	R <29	R <25	R <20	R <13
	Severe	R <34	R <29	R <23	R <15
	Noticeable	R = 39	R <34	R <23	R <17
	Minor	**R >39**	R = 39	R <23	R <19

d. Restoration Zone Risk Matrix

Summation of 5 categories above would total 64 for good operation

Impact of Failure	Vulnerability to Threat: Low	Moderate	High	Very High
Devastating	R < 28	R < 24	R < 20	R < 12
Severe	R < 33	R < 28	R < 22	R < 14
Noticeable	R = 37	R < 33	R < 22	R < 16
Minor	**R >37**	R = 37	R < 22	R < 18

e. Primary Restoration Service Providers – Risk Matrix

Summation of 4 categorise above would total 47 for good operation.

Impact of Failure	Vulnerability to Threat: Low	Moderate	High	Very High
Devastating	R < 28	R < 24	R < 20	R < 12
Severe	R < 33	R < 28	R < 22	R < 14
Noticeable	R = 37	R < 33	R < 22	R < 16
Minor	**R >37**	R = 37	R < 22	R < 18

8.3 Non-Compliance Consequences

Non-compliance with ESRS or delegated accountabilities / responsibilities to be determined by BEIS / Ofgem.

9 Implementation Framework

A. Current

Network Code on Emergency and Restoration (NCER) and related regulations.
→ System Restoration Plan (SRP) and the System Defence Plan (SDP).
→ Test Plan.
→ Codes and contracts.

B. Likely future

NCER and related regulations.
→ Restoration Standard (including Assurance Framework).
→ System Restoration Plan (SRP) and the System Defence Plan (SDP).
→ Test Plan.
→ Codes and contracts.

10 Issue Record

Date	Issue / Review / Amendment
November 2021	Draft v0
February 2022	Draft v0.1 Revised draft following working group input
March 2022	Draft V2 Revised following consultation with the informal working group.
April 2022	Draft V3 Capturing comments from Working Group and preparation for submission to GC0156.