Elia Restoration Plan (non-confidential version)

Summary	This document sets out the Restoration Plan designed by Elia pursuant to the criteria of Commission Regulation (EU) 2017/2196 and the Federal Grid Code (FGC). The Minister of Energy has approved the confidential version of this document, excluding those aspects specified in the corresponding Ministerial Decree of 19 December 2019.	
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Previous versions

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1 Introduction

This document sets out Elia's Restoration Plan, which contains a range of measures that can be implemented in the wake of a serious disruption with a view to restoring a normal state on the system following an emergency or blackout state.[1]

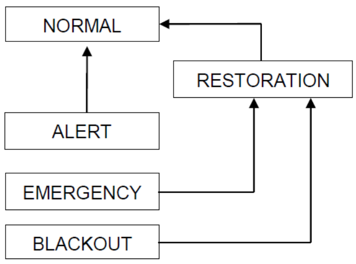

Figure 1: The various system states and the transitions between them

The measures within the Restoration Plan are initiated once the system has been stabilised following a disruption. System restoration comprises a sequence of coordinated measures that are prepared in advance as far as possible.

This Restoration Plan has been designed by Elia pursuant to the provisions of Commission Regulation (EU) 2017/2196 of 24 November 2017 establishing a network code on electricity emergency and restoration (NC E&R) and to other network codes, the Royal Decree of 22 April 2019 establishing a federal technical regulation for the management of and access to the electricity transmission system (the Federal Grid Code, or FGC), other relevant legal provisions (public health and safety, nuclear safety, etc.) as well as any pertinent local requirements.

Elia developed this Restoration Plan in consultation with distribution system operators (DSOs), the relevant significant grid users (SGUs), CREG, FPS Economy - DG Energy, the CGCCR, neighbouring transmission system operators (TSOs) and other TSOs within the Continental Europe synchronous area.

References to the 'restoration code' in other legislative or regulatory texts are considered to be referring to the Restoration Plan as per FGC Article 262.

Elia activates those Restoration Plan procedures with a major cross-border impact in coordination with the affected TSOs.

Pursuant to NC E&R Article 23(5), the Restoration Plan comprises three procedures:

- The re-energisation procedure;
- The frequency management procedure;
- The resynchronisation procedure.

The re-energisation procedures are based on the assumption that:

- no grid components were damaged or rendered unavailable as a result of the incident(s) that led to the blackout;

[1] System states are described in section **Error! Reference source not found.**

- there are sufficient numbers of well-trained personnel in the operational control centres;
- operators have an overview of the state of the system via the SCADA system;
- circuit breakers can be controlled remotely from the control centres.

In practice, one or more of these conditions may not be met. The measures in this plan were designed without prejudice to other emergency measures applied by Elia to handle a crisis depending on the circumstances.

Pursuant to FGC Article 378, and without prejudice to the NC E&R or the System Operation Guideline (SOGL), **the restoration code** drawn up in accordance with the Royal Decree of 19 December 2002 establishing a federal technical regulation for the management of and access to the electricity transmission system **shall continue to apply until the date of the entry into force of the** Restoration Plan under FGC Article 262(1).

Any technical or organisational measures for which the implementation deadlines specified in this Plan fall after the date on which this Plan was approved by the Minister of Energy shall only apply from the time they are implemented onwards.

Pursuant to NC E&R Article 51, Elia shall review the effectiveness of this Plan at least once every five years. Elia shall perform this periodic review in accordance with the provisions of NC E&R Article 51.

Pursuant to NC E&R Article 6(1), when designing or reviewing their respective restoration plans all European TSOs must ensure consistency with the corresponding measures contained within the plans of other TSOs in their synchronous area as well as those of neighbouring TSOs belonging to another synchronous area. Such measures include the following as a minimum:

- The frequency management procedure (section 9);
- The top-down re-energisation strategy (section 8.2).

Elia submitted the necessary documentation to Coreso (the regional security coordination centre for electricity) for a consistency check in June 2019. Should this Restoration Plan be amended due to inconsistencies identified in the aforementioned measures, Elia will review said Plan.

The non-confidential version of the Restoration Plan will be appended to the relevant connection contracts. Elia has shared the confidential version of the Restoration Plan only with the competent authorities. Only the names of the sections deemed confidential by Elia have been retained in this non-confidential version.

2 Legal framework

In accordance with the NC E&R, Elia is required to design a Restoration Plan in consultation with the relevant DSOs, SGUs, the National Regulatory Authority (NRA), neighbouring TSOs as well as TSOs belonging to the same synchronous area.

In the event of conflict between the NC E&R and any other legislation, the superior legislation shall take precedence.

2.1 Powers of approval

Pursuant to NC E&R Article 4(5), the Belgian TSO shall notify the NRA or any other entity specified by the Member State of the Restoration Plan by 18 December 2018 at the latest.

Pursuant to FGC Article 259, the Minister of Energy approves, on the proposal of the TSO and after consulting CREG, the proposals referred to in Article 4(2)(c), d) and g) of the NC E&R of 24 November 2017 establishing a network code on electricity emergency and restoration.

Pursuant to FGC Article 262, the TSO is required to submit, after consulting CREG and DG Energy, a proposed restoration plan to the Minister of Energy by 18 December 2018. Elia submitted its initial proposal to the Minister of Energy on 18 December 2018. On 26 June 2019, Elia received a letter from said Minister requesting that it submit a new, amended proposal in September 2019. Elia submitted an amended proposal on 30 September 2019.

Pursuant to Article 2 of the Ministerial Decree approving the proposed system defence and restoration plans as per Articles 261 and 262 of the Royal Decree of 22 April 2019 establishing a federal technical regulation for the management of and access to the electricity transmission system, the proposed restoration plan has been approved, excluding those few aspects specified.

Certain parts of this Restoration Plan refer to other related documents. Section 16 contains a list of such documents, some of which are only available in-house. Elia does not seek the Minister of Energy's approval for these documents. Public authorities may ask to consult these documents for information purposes.

3 Conditions for activating the Restoration Plan

Pursuant to NC E&R Article 25(1), the Restoration Plan may be activated when:

(a) the system is in the **emergency** state as per section 5.3, **once the system has been stabilised** following the activation of measures under the System Defence Plan (please note that the Restoration Plan measures need not start from a blackout state). The Restoration Plan measures may also be activated after, for example, a **splitting of the system** into independent synchronous regions;

(b) The system is in the **blackout** state as per section 5.4.

The procedures of the Restoration Plan must be activated in coordination with the DSOs and SGUs identified in section 5.4 and, if necessary, with the restoration service providers (RSPs). If these procedures have a major cross-border impact, Elia must cooperate with the affected TSOs.

Pursuant to NC E&R Article 25(3), every DSO and SGU identified in section 4.1 and every RSP must obey the Restoration Plan instructions issued by Elia without undue delay.

4 List of significant grid users and high priority significant grid users

Some Restoration Plan measures are based on capacities that are mandatory for SGUs pursuant to the requirements of the network codes on requirements for generators (NC RfG), demand connection (NC DCC) and high-voltage direct current (NC HVDC).

Some Restoration Plan measures are based on capacities that are not mandatory for grid users pursuant to the requirements of the NC RfG, NC DCC and NC HVDC but are defined as mandatory in national legislation.

Some Restoration Plan measures are based on capacities expected to be provided on a voluntary basis. In accordance with the NC E&R, Elia uses these voluntary capacities through RSPs on a legal or contractual basis.

Pursuant to NC E&R Article 23(4)(c), the Restoration Plan must include a list of the SGUs responsible for implementing within their facilities those measures resulting from the mandatory requirements set out in the NC RfG, NC DCC, NC HVDC or in national legislation, as well as a list of measures to be implemented by those SGUs.

Elia identifies the SGU capacities for direct use in its Restoration Plan in section 4.1 and provides a detailed list in Annex 1.

Without prejudice to the provisions of NC E&R Article 4(2)(c) and (d) and Article 51(5), Elia will send the list of identified SGUs and the list of high priority SGUs relevant to the Restoration Plan to the Minister of Energy by 1 October every year at the latest.

These identified SGUs are a subset of the following categories of grid users to which the NC E&R applies pursuant to NC E&R Article 2(2):

a) Existing and new type C and D power generating modules (PGMs) pursuant to NC RfG Article 5;
b) Existing and new type B PGMs pursuant to NC RfG Article 5 when they are identified as SGUs in accordance with NC E&R Articles 11(4) and 23(4);
c) Existing and new demand facilities connected to a transmission system;
d) Existing and new closed distribution systems connected to the transmission system;
e) Providers of redispatching of PGMs or demand facilities by means of aggregation and providers of active power reserves in accordance with SOGL Title 8; and,
f) Existing and new high-voltage direct current (HVDC) systems and power park modules connected to direct current in accordance with the criteria set out in NC HVDC Article 4(1).

4.1 List of identified significant grid users

Elia has identified the following Restoration Plan requirements that SGUs[2] are required to satisfy by law:

[2] Legally, 'SGU' refers to infrastructure. In order to be able to implement those measures required by Elia under the Restoration Plan in such infrastructure, Elia contacts the grid user that signed the connection contract covering the infrastructure in question.

Type of user	Capacity used in the Restoration Plan	Legal obligation pursuant to
Existing and new PGMs with a maximum active power greater than or equal to 25 MW. This does not include backup generators installed within these PGMs.	Obey an instruction from the TSO concerning the set point for the exchange of active or reactive power with the system, taking into account the technical capacities of the PGM in question.	FGC Article 262
New PGMs with a maximum active power greater than or equal to 25 MW. This does not include backup generators installed within these PGMs.	Houseload operation (resynchronisation + re-energisation)	NC RfG Article 15(5)(c)
Existing and new demand facilities connected to the transmission system	Obey an instruction from the TSO concerning the set point for the exchange of active or reactive power with the system, taking into account the technical capacities of the demand facility in question.	FGC Article 262
Existing and new closed distribution systems (CDSs) connected to the transmission system	Obey an instruction from the TSO concerning the set point for the exchange of active or reactive power with the system, taking into account the technical capacities of the CDS in question.	FGC Article 262
Existing and new HVDC systems	Obey an instruction from the TSO concerning the set point for the exchange of active or reactive power with the system, taking into account the technical capacities of the HVDC system in question.	FGC Article 262

Table 1: Type, capacity and legal obligations with regard to identified SGUs

Annex 1 contains a detailed list of identified SGUs (confidential).

Elia intends to use a limited number of resources in order to ensure an efficient response to the transmission system being in an emergency state. As a result, Elia wants to use a small number of PGMs with a maximum active power greater than or equal to 25 MW, rather than using more PGMs with lower active power.

4.2 High priority significant grid users

4.2.1 List of high priority significant grid users relevant to the Restoration Plan (confidential)

4.2.2 General terms and conditions for disconnecting and re-energising high priority significant grid users relevant to the Restoration Plan (confidential)

5 Classification of system states

SOGL Article 18 sets out harmonised requirements for system management applicable to TSOs, regional security coordinators (RSCs), DSOs and SGUs. The article describes the various critical system states (normal, alert, emergency, blackout and restoration); these are detailed below.

5.1 Normal

A transmission system is in the normal state when all of the following conditions are met:

- **Voltage and power flows** are within operational security limits:
  - Voltage ranges at the connection point between 110 kV and 300 kV: 0.90 pu – 1.118 pu
  - Voltage ranges at the connection point between 300 kV and 400 kV: 0.90 pu – 1.05 pu
  - Current limits in terms of thermal rating, including transitory admissible overloads, taking into account the type of components such as overhead lines (Cu, Al), underground cables, transformers and so on, as well as ambient conditions (wind, solar radiation, temperature, etc.)
- The **frequency** meets the following criteria:
  - The steady state system frequency deviation is within the standard frequency range, equal to approx. 50 MHz; or
  - The absolute value of the steady state system frequency deviation is not larger than the maximum steady state frequency deviation (200 MHz) and the system frequency limits established for the alert state are not met.
- Active and reactive power reserves are sufficient to withstand contingencies from the contingency list defined in accordance with SOGL Article 33 without violating operational security limits;
- The operation of the control area of the TSO in question is and will remain within operational security limits following the activation of remedial actions in the wake of a contingency from the contingency list defined in accordance with SOGL Article 33.

5.2 Alert

A transmission system is in the alert state when the following conditions are met:

- **Voltage and power flows** are within the operational security limits (identical to those for normal state):
  - Voltage ranges at the connection point between 110 kV and 300 kV: 0.90 pu – 1.118 pu
  - Voltage ranges at the connection point between 300 kV and 400 kV: 0.90 pu – 1.05 pu
  - Current limits in terms of thermal rating, including transitory admissible overloads, taking into account the type of components such as overhead lines (Cu, Al), underground cables, transformers and so on, as well as ambient conditions (wind, solar radiation, temperature, etc.)

AND

- The **TSO's reserve capacity** is reduced by more than 20% for longer than 30 minutes without any way to offset said reduction through real-time operation;

OR

- Frequency meets the following criteria:
    - The absolute value of the steady state system frequency deviation is not larger than the maximum steady state frequency deviation (200 MHz); and
    - The absolute value of the steady state frequency deviation has continuously exceeded 50% of the maximum steady state frequency deviation (200 MHz) for a period of time longer than the alert state trigger time (5 minutes) or has continuously exceeded 50% of the standard frequency range (approx. 50 MHz) for a period of time longer than the time to restore frequency (15 minutes);

OR

- At least one contingency from the contingency list defined in accordance with SOGL Article 33 results in the violation of the TSO's operational security limits, even after the activation of remedial actions.

  Contingencies are classified as follows:
    - Ordinary contingency: loss of a 380 kV-30 kV line or cable, a generator, a 380 kV or 220 kV busbar coupling, a transformer, a 380 kV busbar;
    - Exceptional contingency: loss of a high-voltage pylon (that supports several lines). These contingencies are only included in operational security analyses in the event of anticipated wind speeds greater than 130 km/h;
    - Out-of-range contingency: loss of several nuclear reactors or an entire high-voltage substation. These contingencies are only included in operational security analyses if there is a clear risk of them occurring.

5.3 Emergency

A transmission system is in the emergency state when at least one of the following conditions is fulfilled:

- There is at least one violation of a TSO's operational security limits, defined as follows:
    - Voltage ranges at the connection point between 110 kV and 300 kV: 0.90 pu – 1.118 pu
    - Voltage ranges at the connection point between 300 kV and 400 kV: 0.90 pu – 1.05 pu
    - Current limits in terms of thermal rating, including transitory admissible overloads, taking into account the type of components such as overhead lines (Cu, Al), underground cables, transformers and so on, as well as ambient conditions (wind, solar radiation, temperature, etc.)

  The operational security limits for the different network elements are reflected in the ELIA operating criteria. (confidential)

- The frequency does not meet the criteria for the normal or alert state;
- At least **one measure of the TSO's system defence plan is activated**;

- There is a **fault affecting the operation of tools, means and facilities** as per SOGL Article 24(1), resulting in the unavailability of those tools, means and facilities for **longer than 30 minutes**.

  The tools, means and facilities referenced in SOGL Article 24 are listed below:

(a) Facilities for monitoring the state of the transmission system, including state estimation applications and facilities for load-frequency control (LFC).

This encompasses the following applications and facilities:

- An Energy Management System (EMS) with, for instance, a state estimation and security analysis tool;
- The ENTSO-E Awareness System (EAS);
- Elia's control centres, including regional and backup control centres;
- The data warehouse and LAN connection;
- The frequency restoration controller for the LFC area;
- The FRR manual control system;
- Telecommunication systems (data and voice).

(b) Means to control the switching of circuit breakers, coupling circuit breakers, transformer tap changers and other equipment that serves to control transmission system elements.

Such systems and facilities include but are not limited to:

- SCADA at (main, backup and regional) control centres;
- Substation SCADA for those substations identified as key to the Restoration Plan;
- Communication of data to key substations;
- Data and voice communication to control rooms;
- Substation bay controller
- Local communication of data within a substation.

(c) The means to communicate with the control centres of other TSOs and RSCs:

- Only voice communication is taken into account for RSCs;
- Voice and data communication systems between TSOs are taken into account, including the Electronic Highway and EAS.

(d) Tools for operational security analysis, including the EMS with, for example, a SCADA, state estimation and security analysis tool.

(e) Tools and means of communication required by Elia to facilitate cross-border electricity market activities, i.e. market tools associated with the EMS, such as the tool for managing nominations, schedules, the activation of energy bids, and so on.

5.4 Blackout

A transmission system is in the blackout state when at least one of the following conditions is met:

- **Loss of more than 50% of demand**[3] in the control area of the TSO in question;
- **Total absence of voltage for at least 3 minutes** in the control area of the TSO in question, consequently triggering the Restoration Plan.

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[3] Demand is understood as 'total load'.

5.5 Restoration

A transmission system is in the restoration state when a TSO in the emergency or blackout state begins to activate measures under its restoration plan.

6 Roles and responsibilities

The specific role played by each of the entities listed below is vital to the efficient implementation of Restoration Plan procedures.

- Transmission system operators
- Significant grid users[4]
- Distribution system operators[5]
- Restoration service providers
- Balance responsible parties
- Balancing service providers

The Restoration Plan describes the strategy and working methods used by Elia and these entities to:

- re-energise connection points to the transmission system as quickly as possible and in a coordinated manner;
- manage the frequency of the system during restoration;
- resynchronise asynchronous regions.

6.1 Transmission system operators (TSOs)

Elia is responsible for updating the procedures and organising regular training for its operators.

In the event of a blackout, the National Control Centre (NCC), with the support of the Regional Control Centres (RCCs), will analyse the situation and will request information from neighbouring TSOs as well as DSOs, RSPs, balance responsible parties (BRPs), balancing service providers (BSPs) and SGUs to this end.

Once it has analysed the situation, the NCC will choose the most appropriate strategy. The NCC and RCCs will notify the parties concerned.

Elia decides whether to suspend or restore energy market activities in accordance with the 'Rules for suspension and restoration of market activities' and the 'Specific rules for imbalance settlement and settlement of balancing energy'. These rules must be approved by CREG.

Elia is responsible for clearing its substations before they are re-energised.

The system is operated in 'TSO-controlled dispatching' mode during the implementation of the Restoration Plan and while energy market activities are suspended. The NCC and RCC managers and operators serve as coordinators, passing on the necessary instructions to neighbouring TSOs as well as DSOs, RSPs, BRPs, BSPs and SGUs to ensure implementation without undue delay.

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[4] The list of SGUs is given in section **Error! Reference source not found.**

[5] For the avoidance of doubt, references to 'DSO' in this document should be understood as 'public DSO' and not 'closed DSO'.

During system restoration, Elia identifies and monitors:

- the scale and boundaries of the synchronised region(s) to which its control area belongs;
- the TSO(s) with which it shares one or more synchronous regions; and
- the active power reserves available within its control area.

Neighbouring TSOs are involved in any top-down restoration strategy.

During the restoration state, Elia works with a Frequency Leader to manage system frequency and resynchronises any asynchronous regions if necessary.

6.2 Significant grid users (SGUs)

6.2.1 Operators of power generating modules (PGMs)

Any connection of a PGM to the transmission system must be coordinated with Elia in real time, meaning that automatic connection to the grid after the slightest disturbance is not permitted. Communication with Elia via a voice or data communication system is required before the PGM in question is reconnected to the grid.

If a PGM with a maximum active power greater than or equal to 25 MW can operate in houseload or island mode, the operator of this PGM must ensure that it can also re-energise an inactive main busbar at Elia's request.

Operators of PGMs with a maximum active power greater than or equal to 25 MW must designate a point of contact that is available 24/7. In the event of a blackout, this point of contact must be able to provide Elia with clear information on the capacities and limitations of the module in question, more specifically:

- If houseload operation was successful:
    - If the PGM is unable to re-energise an inactive busbar on the transmission system, the maximum time during which the PGM can continue to work in houseload mode until it is resynchronised with the restored grid;
    - The time needed to re-energise an inactive busbar on the transmission system.
- If houseload operation was not successful:
    - The time needed to restart the PGM and until it is ready to be resynchronised with the transmission system.
- The limitations in terms of active power generation:[6]
    - Minimum load to achieve stable PGM operation;
    - Maximum ramping rate;
    - Maximum generation level;

[6] This information is collected in advance as much as possible. However, the point of contact must be able to provide Elia with information in real time upon request.

    - The maximum load block that can be supported by the PGM without jeopardising stability.
- The limitations in terms of the generation and absorption of reactive power.

The point of contact must obey Elia's instructions without undue delay. Such instructions may include:

- resynchronising with the transmission system;
- adjusting the voltage of a re-energised transmission system busbar;
- maintaining a given frequency between 49.00 Hz and 51.00 Hz (only for generation units providing black start services or restoring a local network from houseload mode), if technically possible;
- maintaining a certain set point for active/reactive generation;
- deactivating the dead band of the primary power/frequency controller, if technically possible;
- obeying any other instructions necessary for grid restoration.

6.2.2 Demand facilities connected to the transmission system

Demand facilities connected to the transmission system must designate a point of contact (or dispatching) available when the system is in restoration state with a view to:

- providing Elia with information on the state of its facilities and capacity to take over the load;
- gradually increasing its consumption according to Elia's instructions (e.g. in blocks of maximum 5 MW).

During the transition phase, until the communication requirements set out in section 12 are implemented, Elia and the demand facility connected to the transmission system shall communicate using the best available solution.

6.2.3 Closed distribution system operators (CDSOs) connected to the transmission system

CDSOs connected to the transmission system must designate a point of contact (or dispatching) that is available during restoration. In particular, this point of contact must be able to:

- provide Elia with information about the state of its CDS and any capacity to re-energise the substations on this CDS and, more specifically, high priority SGUs as per section 4.2 and about potential RSPs;

- follow up on the indications given by Elia's RCCs regarding the amount of active and reactive power exchanged at the connection point with the transmission system (e.g. block loads of up to 5 MW).

During the transition phase, until the communication requirements set out in section 12 are implemented, Elia and the CDSO connected to the transmission system shall communicate using the best available solution.

If an RSP connected to a CDS provides its restoration services, the CDSO connected to the transmission system must coordinate this in real time with the RSP and Elia.

6.3 Distribution system operators (DSOs)

DSOs are key to grid restoration at regional level as they can ensure access to distribution for high priority SGUs. Every DSO must designate one or more points of contact that are available 24/7. This point of contact will provide Elia with information about the state of its facilities, more specifically regarding:

- the capacity to re-energise distribution substations and in particular high priority SGUs as per section 4.2;
- any permanent faults noted on the distribution system;
- the time needed to clear the substations.

If an RSP connected to a distribution system provides its restoration services, the DSO must coordinate this in real time with the RSP and Elia.

While Elia is re-energising transmission substations, the DSOs partially clear[7] their substations. They clear all connections, except those with high priority SGUs. When re-energising transformers to distribution substations, Elia re-energises high priority SGUs first.

6.4 Balance responsible parties (BRPs)

The obligations applicable to BRPs as per the 'General terms and conditions for BRPs' are suspended during 'TSO-controlled dispatching' or during the suspension of market activities, without prejudice to BRP obligations under the 'Rules for suspension and restoration of market activities' and the 'Specific rules for imbalance settlement and settlement of balancing energy' as published on Elia's website.

Under these rules, during a period of 'TSO-controlled dispatching', BRPs are not responsible for maintaining the balance of their respective portfolios, as this could reduce the efficiency of the restoration of the transmission system to a normal or alert state. Elia will notify the BRPs about the timing of the suspension and restoration of market activities via the Market Suspension and Market Restoration notifications described in sections 11.2 and 11.3 in accordance with the communication procedure set out in the Rules.

When the system is in 'TSO-controlled dispatching' mode, Elia will send instructions directly to PGM operators.

When the system is in a restoration state following system split, the relevant obligations for BRPs as set out in the General Terms and Conditions for BRPs or the FGC shall continue to apply.

6.5 Balancing service providers (BSPs)

The obligations applicable to BSPs as per the 'General terms and conditions for BSPs' are suspended during 'TSO-controlled dispatching' or during the suspension of market activities, without prejudice to BSP obligations under the 'Rules for suspension and restoration of

[7] Clearing involves disconnecting individual connections (cables or lines) of the main busbars of a substation with zero voltage in order to prepare for the controlled re-energisation of this substation.

market activities' and the 'Specific rules for imbalance settlement and settlement of balancing energy' as published on Elia's website.

Elia will notify the BSPs about the timing of the suspension and restoration of market activities via the Market Suspension and Market Restoration notifications described in sections 11.2 and 11.3 in accordance with the communication procedure set out in the Rules.

When the system is in 'TSO-controlled dispatching' mode, Elia will send instructions directly to PGM operators.

When the system is in a restoration state following system split, the relevant obligations for BSPs as set out in the General Terms and Conditions for BSPs or the FGC shall continue to apply.

6.6 Restoration service providers (RSPs)

At Elia's request, RSPs must activate their restoration services as instructed by the relevant system operator(s) in accordance with their contractual obligations and the General Terms and Conditions for RSPs.

7 Substation clearing

In order to prevent the unwanted and uncontrolled re-energisation of loads, it is crucial that all connections to a substation are disconnected before the substation is re-energised. This minimises the likelihood of instability in the re-energised area during the initial stages of re-energisation.

The System Engineer (SE) must always check that a main busbar is fully cleared before it is re-energised. If clearing is not complete, the SE must manually open the circuit breakers in the 'closed' position.

In some places, clearing takes place automatically in the event of a drop in voltage. Relays able to detect the drop in voltage and disconnect the circuit breakers are installed to this end at the following locations on the grid:

- On 380 kV transformers where the circuit breaker at lower voltage levels is interrupted, thus automatically separating the high-voltage 380 kV grid and the lower voltage levels. This allows the NCC SEs to restore the 380 kV grid while the regional dispatchers at the RCCs deal with lower voltage networks. The complex task of restoring the entire grid consequently becomes clearer and the risk of unintentional interference is minimised;
- On 380 kV lines and cables, including cross-border lines;
- On transformers between different transmission networks (e.g. 150 kV/70 kV, 150 kV/36 kV, 220 kV/70 kV);
- On transformers between Elia and DSO systems;
- On certain grid elements connecting regional areas.

8 The re-energisation procedure

8.1 Overview of the phases in the re-energisation procedure

Following a blackout, Elia strives to gradually restore the grid and re-energise at least 90% of connection points on the Elia grid to SGUs and DSOs within 24 hours. To this end, Elia adopts a step-by-step re-energisation procedure intended to restore normal operation.

Elia has approximately 800 substations that could be re-energised via six operational consoles located in three control centres (the NCC and two RCCs). Around 160 substations are re-energised via a console in an RCC. It takes 10 minutes or so to re-energise one substation and 24 hours to re-energise 90% of the 160 substations. In light of the complex coordination and communication requirements, using several consoles in parallel to restore part of the grid is not advised.

Figure 2 illustrates the three main phases of the re-energisation procedure:

- Phase 1: Analysis;
- Phase 2: Restoration of the system (activation of top-down or bottom-up re-energisation procedures);
- Phase 3: Restoration of the load (TSO-controlled dispatching of generation and load).

Restoration Plan strategy

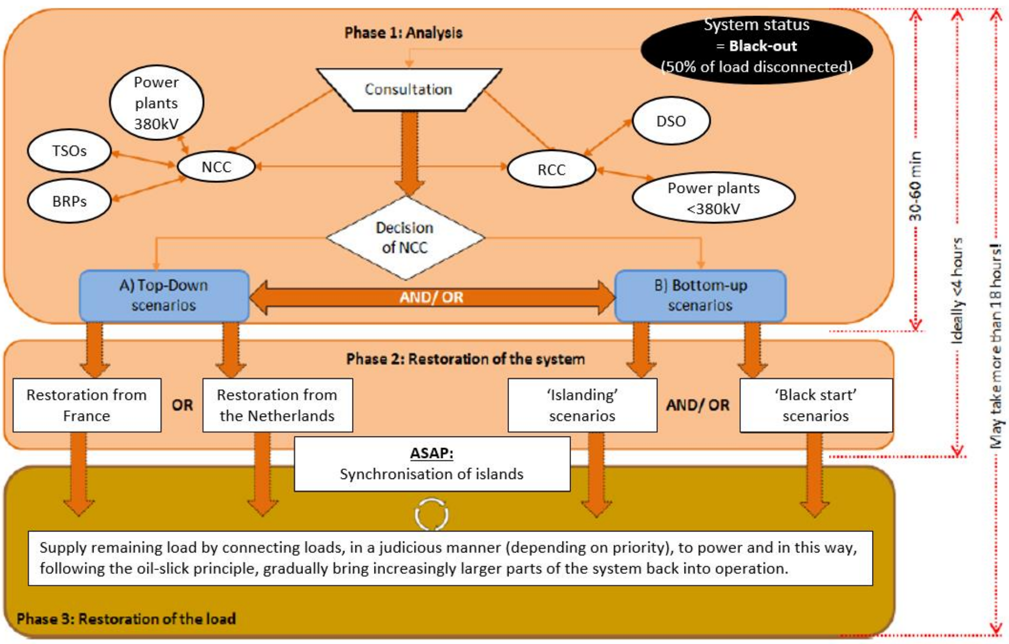

Figure 2: Phases of the restoration process

8.1.1 Phase 1: Preparation

An internal Elia tool has been developed to help Elia operators analyse blackouts and quickly check the following key aspects:

- The state of interconnectors and whether neighbouring TSOs are available to support a top-down restoration strategy;

- The possibility of combining top-down and bottom-up re-energisation strategies;
- The potential risks of possible re-energisation strategies and the estimated duration of re-energisation;
- Whether PGMs with a maximum active power greater than or equal to 25 MW have been able to operate in houseload mode:
  - How long houseload operation can be maintained;
  - Whether the unit operating in houseload mode can re-energise an inactive busbar and how long this will take;
  - Whether a restoration channel has to be created to the PGM to allow resynchronisation.
- Whether RSPs with a contractual obligation are available to perform a black start with the PGMs;
- The level of availability of other PGMs with a maximum active power greater than or equal to 25 MW;
- The status of grid assets and any major damage;
- The location of high priority SGUs (re-energise these first and as quickly as possible).

The Elia NCC SEs evaluate the extent of the blackout and its impact on grid users and components. This phase involves communicating, if necessary, with PGMs, RCCs, neighbouring TSOs, DSOs, RSPs and other (high priority) SGUs. Based on this analysis, the Elia SE in question decides on the restoration strategy.

There are several system restoration scenarios:

- The **top-down scenario**, where the entire Belgian high-voltage grid is de-energised but where it is still possible to call on systems in other countries to supply all or some of the power needed.

  In this case, restoration is carried out using power from France, Luxembourg, the Netherlands or the UK. After consulting the system operator concerned, the most robust system is chosen for restoration. The individual actions to be taken during top-down restoration are set out in section 8.2.1;
- The **bottom-up scenario**, where the entire Belgian high-voltage grid is de-energised and where it is not possible to call on systems in other countries for help.

In this case, the system is restored using PGMs that have successfully switched to island and/or houseload mode and/or using black start power plants.

Pursuant to NC E&R Article 23(4)(f), the number of energy sources within the Elia control area necessary to re-energise its system using a bottom-up re-energisation strategy having black start capability, fast resynchronisation capability (in houseload mode) and island operation capability is shown in Table 2.

Type of electricity source	Number of energy sources needed to re-energise the Elia control area using a bottom-up strategy	Comments
Black start	5	

Fast resynchronisation (via houseload mode)	0	Given the uncertainties surrounding the availability of PGMs, the limited duration of houseload operation and other risk factors, Elia wants to avoid using PGMs operating in houseload mode to re-energise the system based on a bottom-up strategy.
Island operation	0	Given the uncertainties surrounding the PGMs operating in island mode following a blackout, Elia wants to avoid using PGMs operating in island mode to re-energise the system based on a bottom-up strategy.

Table 2: Electricity sources for the re-energisation strategy

If a strong system is available in a neighbouring country, the top-down strategy is preferred. If not, the bottom-up strategy must be applied. The two strategies can be combined, in which case potential locations for the resynchronisation of the two systems must be chosen.

The Elia NCC SE will ask each RCC to run one or more top-down or bottom-up scenarios in parallel.

Elia assumes that this will take around 30 to 60 minutes. Although a full analysis can take an hour to complete, Elia would be able to issue instructions for a black start after 30 minutes.

8.1.2 Phase 2: System restoration

The second phase involves the restoration of the system. This is intended to form electrical islands (separate systems) around PGMs with black start capability or operating in houseload mode and that have a maximum active power greater than or equal to 25 MW, and to re-energise high priority SGUs within the set timeframes.

Elia will also re-energise most of the 380 kV grid (including substations connected to neighbouring countries) as quickly as possible and will establish a restoration path to non black start (BS) modules, which could further support system restoration.

Once stable electrical islands are formed, they can start being resynchronised with the main grid. Electrical islands are considered stable when:

- Regional networks (150 kV): 350 MW of load and at least three PGMs with a maximum active power greater than or equal to 25 MW are in service;
- 380 kV main grid: 1000 MW of load and at least five PGMs with a maximum active power greater than or equal to 25 MW are in service, or three PGMs with a maximum active power greater than or equal to 25 MW are in service, at least one of which is a nuclear PGM.

Phase 2 therefore includes the start-up of the system where Elia enters a 'TSO-controlled dispatching' phase.

8.1.3 Phase 3: Restoration of the load

Before returning to normal state, Elia maintains 'TSO-controlled dispatching' for generation and load and takes steps with a view to:

- restoring N-1 security on the transmission system;
- re-energising the remaining connection points, including coordination with DSOs to restore networks at lower voltages.

During system restoration, Elia identifies and monitors:

- the scale and boundaries of the synchronised region(s) to which its control area belongs;
- the TSO(s) with which it shares one or more synchronous regions; and
- the active power reserves available within its control area.

Figure 3 provides an indicative timeframe for the re-energisation procedure.

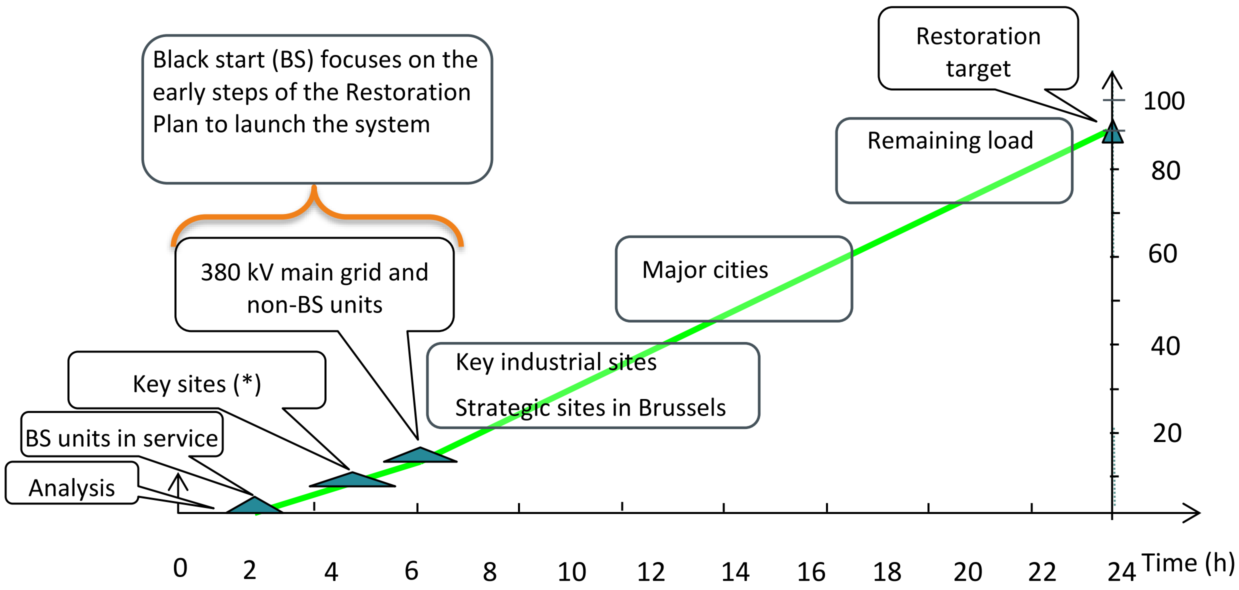

Figure 3: Timeframe of the re-energisation procedure

(*) Confidential

8.1.4 Failure of system restoration

In a bottom-up restoration strategy, and particularly in phases 1 and 2 of system restoration, each component being re-energised has a limited stability, meaning that frequency and voltage have a more volatile response to the connection of consumers than in a normal situation.

During these phases, there is an increased risk of spurious tripping, resulting in the potential collapse of some parts of the system.

Should this occur, the operator of the NCC (380 kV and 220 kV networks) or an RCC (150–30 kV networks) must conduct a new analysis and apply all security measures in consultation with colleagues in the field.

The NCC operator will then decide whether the collapsed part of the system will be restored either via a bottom-up strategy using a BS PGM or via a top-down strategy using a neighbouring part of the system that has since been re-energised.

The specific terms and conditions of RSPs stipulate that a BS PGM must be able to carry out at least three consecutive black start procedures.

8.2 Individual re-energisation procedures

An extensive operational re-energisation procedure is devised for each Elia RCC. This procedure comprises a set of instructions.

Elia has three operational control centres:

- The NCC in Schaerbeek;
- The RCC North in Merksem;
- The RCC South in Gembloux (Créalys).

The instructions are prepared in advance.

Re-energisation procedures are devised based on the assumption that:

- no grid components were damaged as a result of the incident(s) that led to the blackout;
- there are sufficient numbers of well-trained personnel in the operational control centres;
- operators have an overview of the state of the system via the SCADA system;
- circuit breakers can be controlled remotely from the control centres.

If one of these conditions is not met, ad hoc solutions must be rolled out and it may be necessary to deviate from predetermined re-energisation procedures. Elia sets up specialist crisis units during system restoration so that it can best respond to abnormal situations.

8.2.1 The re-energisation procedure for the National Control Centre

The components of the NCC's operational re-energisation procedure are as follows:

- Black start procedure;
- Re-energisation of the 380 kV main grid between Gramme and Doel, via Courcelles or Van Eyck, depending on the condition of the facilities;
- Re-energisation of other 380 kV substations (in the direction of Aubange, Stevin and the MOG, Avelgem, etc.);
- Top-down re-energisation from France via Avelgem, Lonny, Chooz or Moulaine;
- Top-down re-energisation from the Netherlands via Zandvliet or Van Eyck;
- Top-down re-energisation from the UK via the HVDC interconnector connected to the Gezelle substation;

- Top-down re-energisation from Germany via the HVDC interconnector connected to the Lixhe substation;[8]
- Locations for the resynchronisation of regional electrical islands with the main 380 kV grid;
- Procedures for resynchronisation with neighbouring TSOs.

8.2.2 The re-energisation procedure for the Regional Control Centre North

The components of the operational re-energisation procedure for the RCC North are as follows:

- Top-down from Mercator to the port and city of Antwerp;
- Top-down from Massenhove to the port and city of Antwerp;
- Top-down from Meerhout towards the Campine/Kempen and Limburg;
- Top-down from André Dumont towards Limburg;
- Top-down from Verbrande Brug to Brussels-North and Flemish Brabant;
- Top-down from Lint;
- Top-down from Avelgem towards Koksijde;
- Top-down 36 kV East Flanders and West Flanders;
- Top-down 70 kV networks, north-east and north-west.

8.2.3 The re-energisation procedure for the Regional Control Centre South

The components of the operational re-energisation procedure for the RCC South are as follows:

South-east zone

- Restoration of the south-east zone (Liège zone)
- Top-down re-energisation of the Luxembourg 220 kV zone from re-energised 380 kV substations
    - Assuming that the 380 kV substations in Brume and Aubange are re-energised, the 220 kV substations in Aubange, Saint-Mard, Latour, Villeroux and Brume are re-energised.
    - Under this scenario, it is possible to continue re-energising Luxembourg.
- Top-down restoration of south-east zone from re-energised 380 kV substations
    - Assuming that the 380 kV substations in Gramme, Aubange, Champion and Achène are re-energised:
    - the 150 kV substations in Gramme, Bressoux; and
    - the 220 kV substations in Rimière, Jupille, Lixhe, Seraing, Aubange and Brume are re-energised.

[8] Applicable as soon as the HVDC link is operational.

- Restoration of 70 kV networks in the Namur zone, in both top-down and bottom-up scenarios
- Restoration of 70 kV networks in the Luxembourg zone, in both top-down and bottom-up scenarios
- Restoration of 70 kV networks in the Liège zone, in both top-down and bottom-up scenarios
- Restoration of 70 kV networks in the Bressoux zone, in both top-down and bottom-up scenarios

South-west zone

- Top-down restoration of south-west zone from re-energised 380 kV substations
- Top-down restoration of centre and parts of the north-east zone from re-energised 380 kV substations
- Restoration of Brussels, parts of the south-west zone and parts of the north-east zone

8.3 Managing frequency and voltage deviations during bottom-up procedures

Control over the frequency and power of PGMs is vital throughout restoration. As such, the following principles should be observed:

- The first PGM with a maximum active power greater than or equal to 25 MW that energises an island (either a PGM in houseload mode, in island mode or a BS module) must always have isochronous frequency control to avoid excessive frequency deviations when demand facilities are switched on. The following principles apply **for the first PGM**:
    - The frequency of the PGM is set at a set point of 51 Hz;
    - The voltage is initially set to the lowest possible value, i.e. approx. 90% of the rated value;
    - Continuous care must be taken to ensure that the PGM has sufficient margin to withstand the next power increase. As a general rule of thumb, avoid exceeding 70% of the nominal active power output during the initial phases of island restoration;
    - The power generated by the first PGM with a maximum active power greater than or equal to 25 MW will be used to supply high priority SGUs.
- After a certain length of time, other units will be connected to the grid and will be able to inject additional power. Once **several PGMs** are connected to the island, Elia will apply the following principles:
    - Only one PGM per island is permitted to operate in isochronous frequency control;
    - The other PGMs switch to power control mode (also called droop control mode) and must follow Elia's instructions to adjust the active power set point;

- If the active power output of a PGM with a maximum action power greater than or equal to 25 MW that controls frequency exceeds 70% of its nominal value, the other PGMs will be asked to increase their active power set point. The PGM controlling the frequency will therefore automatically reduce its active power.

The **target frequency** will be reduced from 51 Hz to 50 Hz as soon as the following conditions are met:

- There is enough margin to increase or reduce the active power reserve on the PGM that has control over frequency so that it can handle the expected PV injection; AND
- Resynchronisation with another independent region is planned, even if there is only one PGM in the island in question;

OR

- Two PGMs are operating with P > 200 MVA.

During 'TSO-controlled dispatching' while the markets are suspended, Elia will deactivate its frequency restoration control of the LFC area (Automatic Generation Controller (AGC) in Off mode).

8.4 Monitoring and managing electrical islands

During the initial phases of system restoration, several electrical islands are re-energised independently of one another in order to limit the impact of potential instability to the affected area only.

Close communication between Elia and the PGM operators on the one hand and between Elia and the DSO, demand facilities or CDSOs with a direct connection on the other is key to guaranteeing a balance between the generation and consumption of active power.

The roles and responsibilities of Elia's NCC and RCC operators depend on the number of independent zones and the voltage level.

- Elia's RCCs are responsible for:
  - monitoring the re-energisation of 220-150 kV networks and lower voltage levels;
  - coordinating PGMs connected to the 220-150 kV network and lower voltage levels (including RESs) if there is only one island;
  - monitoring black start procedures for the 220 and 150 kV networks;
  - carrying out switching on the 220-150 kV networks and lower voltage levels;
  - coordinating with Elia operators in substations or in the field;
  - coordinating with DSOs and industrial customers.
- The Elia NCC is responsible for:
  - monitoring the re-energisation of the 380 kV network;

- coordinating between the PGMs in the re-energised part of the system (Doel, Tihange, Coo, other modules);
- coordinating with foreign TSOs;
- monitoring the black start procedure for re-energising the 380 kV network;
- coordinating between the various zones including the resynchronisation of asynchronous regions;
- monitoring the PGMs as soon as two independent zones are resynchronised;
- coordinating with the RCCs and monitoring the proper application of the restoration strategy;
- managing the AGC.

8.5 Resynchronising areas in island mode

Independent electrical zones can only be resynchronised via the 380 kV network, which must first be restored. Two independent local 150 kV islands cannot be directly synchronised with one another.

Resynchronisation takes place in substations equipped with automatic synchronisation devices. Such devices are fitted on the circuit breakers on the secondary side of 380/150 kV or 380/220 kV transformers and on the couplings of most 380 kV substations.

For synchronisation to succeed, both independent electrical zones must have almost identical frequencies and voltage magnitudes as well as a sufficiently small voltage angle between the voltage vectors. This means that just after interconnection the flow on the interconnection line will be close to zero.

The resynchronisation of electrical zones increases the total inertia of the system and makes it more stable and less vulnerable to frequency and voltage deviations during load switching.

If possible, independent electrical zones must be resynchronised when:

- at least three PGMs with a maximum active power greater than or equal to 25 MW are activated AND the total load in each independent zone is greater than 350 MW;

  OR

- one of the zones is connected to the grid in France, Germany, the Netherlands or the UK.

Independent electrical zones must be resynchronised at a target frequency of approximately 50 Hz.

When two independent zones are synchronised, one of the PGMs controlling the frequency must switch to power control mode (droop mode). The PGM that continues to control frequency is preferably the one with the greatest inertia.

9 Frequency management procedure

9.1 Activation

Elia activates its frequency management procedure:

- in preparation for resynchronisation, when a synchronous zone is divided into several synchronised regions;
- in the event of a frequency deviation in the synchronous area if the system is in a restoration state; or
- in the event of top-down re-energisation.

The frequency deviation management procedure set out in the **System Defence Plan** is intended to **stabilise frequency after an incident**, prior to the appointment of a Frequency Leader.

The frequency management procedure set out in the **Restoration Plan** is intended to **restore the rated frequency** following the division of the synchronous area into several synchronous regions or during system restoration.

9.2 Action to be taken before appointing a Frequency Leader

MANAGEMENT OF THE FREQUENCY RESTORATION CONTROLLER FOR THE LFC AREA

In the event of frequency deviations greater than 200 MHz, the frequency restoration controllers in the LFC area will be automatically switched to **frozen mode**, allowing the Elia operator to assess the situation and take manual control. This means that the active power set points of the PGMs participating in an aFRR remain unchanged. The secondary controller remains passive and no ACE is automatically set until it is released.

RESPONSE OF THE FREQUENCY RESTORATION CONTROLLER FOR THE LFC AREA

In the event of frequency deviations greater than 200 MHz and up to the frequency ranges defined in SOGL Article 154(6), the PGMs must, if required, increase or reduce their power output (both positively and negatively) up to their minimum or maximum capacity, technical limitations permitting.
The corresponding FCR response must have the same droop adopted for the normal and alert states and must in no way jeopardise the stability of the PGMs supplying FCRs.

ACTIVATION OF LIMITED FREQUENCY SENSITIVE MODE (LFSM)

When LFSM is activated, the FCR providing units' LFSM response shall resume from the overall FCR activation as of LFSM intervention.

ADDITIONAL MEASURES INVOLVING THE FREQUENCY RESTORATION CONTROLLER FOR THE LFC AREA

Elia can manually or automatically override the output signal of the frozen mode of the frequency restoration controllers for the LFC area to speed up system stabilisation. These measures must be applied with caution to avoid congestion.
Pre-agreed coordinated actions in normal and alert states intended to restore the frequency must be respected here.

ADDITIONAL TSO MEASURES

In the event of frequency deviations greater than 200 MHz, Elia is authorised to manually and/or automatically activate additional measures as per the System Defence Plan.

9.3 Appointing a Frequency Leader

During system restoration, when the Continental Europe synchronous area is divided into several synchronised regions, the TSOs of each synchronised region shall appoint a Frequency Leader.

During system restoration, when the Continental Europe synchronous area is not split but the system frequency exceeds the frequency limits applicable to the alert state (see section 5.2), all TSOs within the Continental Europe synchronous area shall appoint a Frequency Leader.

The TSO with the highest estimated real-time K factor is appointed the Frequency Leader.

When the real-time situation allows, **Amprion** will be appointed Frequency Leader in the Continental Europe synchronous area.

The K factor of a control area or block is expressed in megawatts per Hertz (MW/Hz) and indicates, for a frequency deviation of 1 Hz, the expected response of the FRR control in terms of the adjustment of active power in the control area or block.

Table 3 lists the K factors of various TSOs.

Country Short	Country	TSO	P (MW)	K factor (MW/Hz)
DE	Germany	Amprion	662	5892
FR	France	RTE	608	5407
ES	Spain	REE	389	3462
IT	Italy	Terna S.p.A.	321	2854
PL	Poland	PSE-Operator	166	1474
NL	The Netherlands	TenneT	111	986
BE	Belgium	Elia	97	867
CZ	Czech Republic	CEPS	91	808
CH	Switzerland	swissgrid	74	654
RO	Romania	Transelectrica	63	560
AT	Austria	VERBUND APG	62	552
GR	Greece	HTSO/DESMIE	59	521
PT	Portugal	REN	50	443
RS	Serbia	JP EMS	43	386
BG	Bulgaria	ESO-EAD	43	379
HU	Hungary	MAVIR Zrt	42	370
SK	Slovak Republic	SEPS	29	259
DK-W	Denmark West	Energinet.dk	26	234
SI	Slovenia	ELES	15	130
BA	Bosnia-Herzegovina	ISO BiH	13	117
HR	Croatia	HEP-OPS	12	110
UA	West Ukraine	NDC-WPS Ukrenergo	8	82
MK	FYROM	MEPSO	7	60
AL	Albania	OST	6	53
ME	Montenegro	EPCG	2	20

Table 3: K factors of TSOs

The TSOs in the Continental Europe synchronous area may agree to appoint another TSO as Frequency Leader, taking the following criteria into account:

(a) The quantity of active power reserves available, especially FRRs;

(b) The capacity available on the interconnectors;

(c) The availability of TSO frequency measurements in the synchronised region or the Continental Europe synchronous area; and

(d) The availability of frequency measurements on critical elements in the synchronised region or the Continental Europe synchronous area.

The **TSO appointed as Frequency Leader will announce** their appointment **to the other TSOs** in the synchronous area as quickly as possible.

The Frequency Leader shall play this role until:

(a) another Frequency Leader is appointed for the synchronised region in question;

(b) a new Frequency Leader is appointed following a resynchronisation of the synchronised region in question with another synchronised region; or

(c) the Continental Europe synchronous area has been fully resynchronised, the system frequency falls within the standard frequency range and the LFC managed by each TSO in the synchronous area has been restored to normal operating mode as per SOGL Article 18(1).

9.4 Managing frequency following a frequency deviation

If a Frequency Leader has not been appointed:

- The first PGM that energises an island (either a PGM in houseload mode, in island mode or a BS module) must always have control over frequency with the dead band switched off to avoid excessive frequency deviations when loads are switched on:
    - The frequency is set to 51 Hz;
    - After each power increase, the operators of the PGM in question must reset the frequency to 51 Hz;
    - Continuous care must be taken to ensure that the PGM has sufficient margin to withstand the next power increase. As a general rule of thumb, avoid exceeding 70% of the nominal active power output during the initial phases of island restoration.
- The power of the first PGM will be used to supply high priority SGUs, including the ancillary services of other PGMs. After a certain length of time, other PGMs will be connected to the system and will be able to inject power;
- Once several PGMs are connected to the island, only one PGM per island will be able to control the frequency, preferably the PGM with the highest inertia;
- The other PGMs will switch to power control and must follow the instructions of the Elia RCC (for PGMs connected to the <380 kV network) or NCC (for PGMs connected to the 380 kV network) to adjust the active power set point;
- If the active power output of the PGM in control of frequency exceeds 70% of its nominal value, the other PGMs will be asked to increase their control value, thus automatically reducing the active power of the PGM in control of frequency.

- The **target frequency** will be reduced from 51 Hz to 50 Hz as soon as the following conditions are met:
    - There is enough margin to increase or reduce the active power reserve on the PGM that has control over frequency so that it can handle the expected PV injection; AND
    - Resynchronisation with another independent region is planned, even if there is only one PGM in the island in question;

    OR

    - Two PGMs are operating with P > 200 MVA.

If a **Frequency Leader** has been appointed:

- Elia will deactivate the frequency restoration controller for the LFC area;
- The Frequency Leader will manage the manual activation of FRRs in the synchronous area with a view to adjusting the frequency of the synchronous area to align with the rated frequency, taking into account the operational security limits under SOGL Article 25;
- Every TSO in the synchronous area will support the Frequency Leader when requested to do so.

9.5 Managing frequency following the splitting of a synchronous area

- Each synchronous area will appoint a Frequency Leader.
- Elia will suspend the manual activation of FRRs.
- The Frequency Leader must establish, after consulting the other TSOs in the synchronous area, the operating mode to be applied to the frequency restoration controller for the LFC area operated by Elia.
- Frequency deviations are managed by the Frequency Leader according to the above procedure.
- Once the frequency in the different synchronous areas is sufficiently stable, these areas must be resynchronised in accordance with the resynchronisation procedure.
- The Frequency Leader manages the manual activation of FRRs in the synchronous area with a view to adjusting the frequency of the synchronous area to align with the target frequency possibly set by the Resynchronisation Leader and taking into account the operational security limits under SOGL Article 25.
- If a Resynchronisation Leader is not appointed for the synchronous area, the Frequency Leader must attempt to adjust the frequency to align with the rated frequency.
- Every TSO in the synchronous area will support the Frequency Leader when requested to do so.
- The FCR remains activated. LFSM may be activated, depending on the frequency deviation.

9.6 Calculating the maximum load to be reconnected

The following rules of thumb shall apply when calculating the maximum load blocks to be reconnected, provided that sufficient energy reserves are available on the PGMs:

- Total load in an independent area < 1000 MW: maximum admissible load block: 5 MW;
- Total load in an independent area > 1000 MW and where the area is not connected to the neighbouring country: maximum load block: 10 MW;
- The Elia control area is connected to the Netherlands or France and total load in the synchronous region > 2000 MW: maximum admissible load block: 20 MW;
- The Elia control area is connected to the Netherlands or France and total load in the synchronous region > 5000 MW: maximum admissible load block: 50 MW;
- Elia is connected to the entire Continental Europe synchronous area: maximum acceptable load block: 100 MW.

Elia will give the system enough time to stabilise before authorising the reconnection of successive load blocks.

10 The resynchronisation procedure

10.1 Appointing a Resynchronisation Leader

During system restoration, if it is possible to resynchronise two synchronised regions without jeopardising the operational security of the transmission systems, the Frequency Leaders of said synchronised regions shall appoint a Resynchronisation Leader after consulting as a minimum the TSO(s) identified as potential resynchronisation leaders. Each Frequency Leader shall notify as soon as possible the TSOs in its synchronised region of the appointment of the Resynchronisation Leader.

For each pair of synchronised regions to be resynchronised, the Resynchronisation Leader is the TSO that:

- has at least one operational substation equipped with an asynchronous coupling device at the border between the two synchronised regions to be resynchronised;
- has access to the frequency measurements of the two synchronised regions;
- has access to voltage measurements at the substations located either side of the potential resynchronisation points; and
- can control the voltage of potential resynchronisation points.

Where more than one TSO satisfies these criteria, the TSO with the most potential resynchronisation points between the two synchronised regions shall be appointed Resynchronisation Leader, unless the Frequency Leaders of the two synchronised regions agree to appoint another TSO as Resynchronisation Leader.

The appointed Resynchronisation Leader shall fulfil this role until:

- another Resynchronisation Leader is appointed for both synchronised regions; or
- the two synchronised regions have been resynchronised and resynchronisation is complete.

The substation chosen by the Resynchronisation Leader:

- must be equipped with a device allowing the resynchronisation of two asynchronous regions (a parallel switch device, or PSD);
- is preferably located a sufficient distance from the PGMs.

Elia could use the following substations to resynchronise with: [confidential information]

10.2 The resynchronisation strategy

During resynchronisation, the Resynchronisation Leader must take into account the following **maximum limits**:

- **150 MHz** for the frequency difference;
- **15°** for the phase angle.

- No limit is set for voltage differences because large voltage differences induce reactive current flows that have virtually no impact on generator torque. Except in extreme cases, voltage differences have only a limited impact on power flows in transmission equipment.

Before resynchronisation

- The Resynchronisation Leader:

(a) sets, in accordance with the aforementioned maximum limits:

  a. the **target frequency** for resynchronisation;
  b. the **maximum frequency difference** (150 MHz) between two synchronised regions;
  c. **the maximum exchange of active and reactive power**;
  d. the **operating mode** to be applied to the frequency restoration controller for the LFC area.

(b) **selects the resynchronisation point** taking into account the operational security limits in the synchronised regions;

(c) **determines and prepares all action needed** for the resynchronisation of two synchronised regions at the resynchronisation point;

(d) determines and prepares a **range of actions to be carried out subsequently** to establish additional connections between the synchronised regions; and

(e) assesses whether synchronised regions are ready for resynchronisation.

When performing these tasks, the Resynchronisation Leader consults:

  - the Frequency Leaders of the synchronised regions in question;
  - if relevant, the TSOs operating substations used for resynchronisation.

- Each Frequency Leader notifies the TSOs in its synchronised region of the scheduled resynchronisation without undue delay.

- One of the two Frequency Leaders must suspend its automatic frequency control mode.

Once all conditions have been met, the Resynchronisation Leader implements the resynchronisation by activating the predetermined measures.

Figure 4 provides a schematic overview of the resynchronisation procedure.

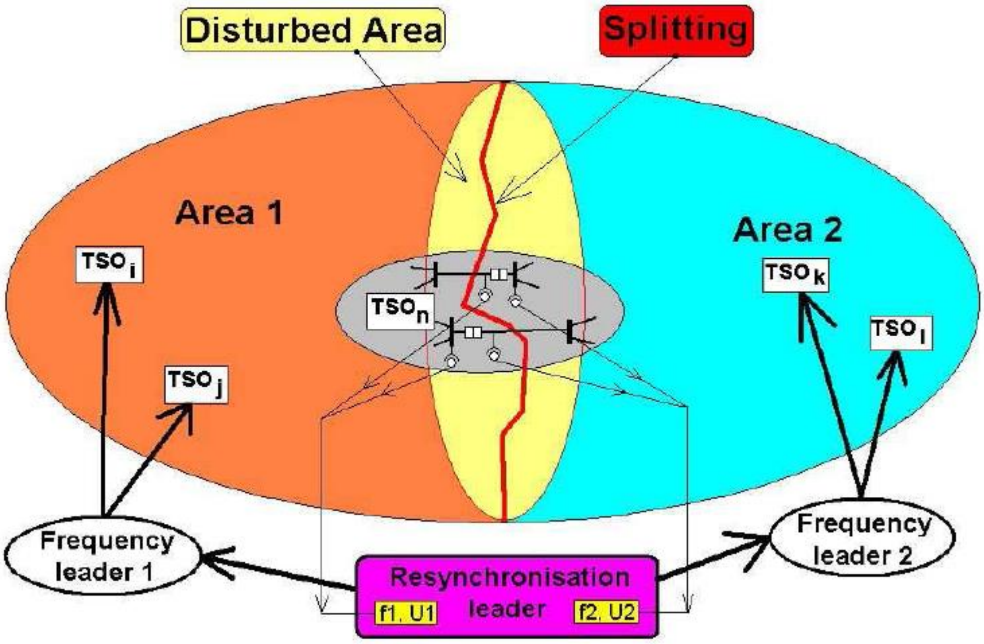

Figure 4: Resynchronisation procedure

11 Exchange of information in blackout or restoration state

The exchange of information if the transmission system is in a blackout or restoration state is determined in accordance with NC E&R Articles 38 and 40.

11.1 Blackout Elia notification

11.1.1 Elia blackout notifications sent to relevant stakeholders

The Blackout Elia notification is intended to inform relevant stakeholders that the system is in a blackout state (see section 5.4) and to provide updates on the restoration procedure.

If the blackout criteria are met, Elia must notify the other TSOs by setting the system state to 'blackout' in EAS.

Receiving a Blackout Elia notification warns grid users that they must **be ready to obey Elia's instructions without undue delay**.

When the system returns to normal or alert state, Elia issues a notification indicating that the system is no longer in a blackout state.

Elia sends the Blackout Elia notification to the following entities:

- Distribution system operators;
- Restoration service providers;
- Balance responsible parties;
- Nominated energy market operators;
- Regulatory authorities;
- Public authorities;
- Balancing service providers;
- Significant grid users;
- Coreso (RSC);
- Fluxys Belgium (gas transmission system operator);
- Other relevant entities.

Elia will seek out the most appropriate communication channels for sending notifications to multiple stakeholders simultaneously (e.g. website, SCADA-to-SCADA protocols, email, text message, RSS). The relevant entities will be required to sign up to these information services in advance. Wide-scale rollout is scheduled for 2019 and Elia will notify stakeholders of the practical arrangements over the course of the year.

11.1.2 Elia blackout notification sent to public authorities (confidential)

11.2 Market Suspension Elia notification

Should Elia decide to suspend market activities pursuant to the 'Rules for suspension and restoration of market activities' and the 'Rules for the settlement of balancing energy imbalances in the event of the suspension of market activities' (hereinafter referred to as the 'Market Rules'), Elia must apply the communication procedure set out in these Market Rules as per NC E&R Article 38.

The Market Suspension Elia notification is intended to send information to the following entities at the same time:

- Distribution system operators;
- Restoration service providers;
- Balance responsible parties;
- Nominated energy market operators;
- Regulatory authorities;
- Public authorities;
- Balancing service providers;
- Significant grid users;
- Coreso (RSC);
- The TSOs of the capacity calculation regions to which Elia belongs:
    - CORE: 50Hertz, Amprion, APG, Creos, CEPS, ELES, HOPS, Mavir, PSE, RTE, SEPS, TenneT Germany, TenneT NL, Transelectrica, TransnetBW
    - CHANNEL: National Grid, RTE, TenneT NL
- Fluxys Belgium (gas transmission system operator);
- Other relevant entities.

The Market Suspension Elia notification is activated **manually** and indicates the date and time of the suspension of market activities in accordance with NC E&R Article 35.

During the restoration process, the entities listed above will regularly be provided with information on:

- the progress of the transmission system restoration process;
- the best estimate of the date and time at which restoration will be complete;
- the date and time at which the transmission system was returned to normal or alert state.

Elia will, in due course, provide the following information necessary to prepare for the restoration of market activities:

- The date and time at which Elia intends to switch from 'TSO-controlled dispatching' to market-controlled system dispatching on day D at time T;
- The time on day D-1 for the submission of schedules for all 24 hours of day D;
- The time on day D-1 at which the results of the market coupling will be published;
- Other information, if necessary.

All notifications will be published on Elia's **website**. If a notification or update on the website is not possible, Elia will send a notification via email, or by any other available means, to at least the parties directly involved in the suspended market activities.

Elia will seek out the most appropriate communication channels for sending notifications to multiple stakeholders simultaneously (e.g. website, SCADA-to-SCADA protocols, email, text message, RSS). The relevant entities will be required to sign up to these information services in advance. Wide-scale rollout is scheduled for 2019 and Elia will notify stakeholders of the practical arrangements over the course of the year.

11.3 Market Restoration Elia notification

The Market Restoration Elia notification will be sent to the same entities via the same communication channels as the Market Suspension Elia notification (see section 11.2).

The Market Restoration Elia notification is activated **manually** and is intended to notify the entities listed in section 11.2 of the restoration of market activities. These entities will also be informed of the date and time of the restoration of market activities.

11.4 Grid Restoration Elia notification

The Grid Restoration Elia notification is intended to notify grid users that the system is in a restoration state in accordance with NC E&R Articles 38(3)(d) and 40(2).

These notifications contain the following information:

- The date and time at which the system entered a restoration state;
- The cause of the restoration state (blackout or system split);
- Updates on restoration.

If the restoration criteria are met (see section 5.5), Elia must notify the other TSOs by setting the system state to 'restoration' in EAS.

Receiving a Grid Restoration Elia notification warns grid users that they must **be ready to obey Elia's instructions without undue delay**.

When the system returns to normal or alert state, Elia issues a notification indicating that the system is no longer in a restoration state.

Elia sends the Grid Restoration Elia notification to the following entities:

- Distribution system operators;
- Restoration service providers;
- Balance responsible parties;
- Nominated energy market operators;
- Regulatory authorities;
- Public authorities;
- Balancing service providers;
- Significant grid users;
- Coreso (RSC);
- Fluxys Belgium (gas transmission system operator);
- Other relevant entities.

Elia will seek out the most appropriate communication channels for sending notifications to multiple stakeholders simultaneously (e.g. website, SCADA-to-SCADA protocols, text message, email, RSS). The relevant entities will be required to sign up to these information services in advance. Wide-scale rollout is scheduled for 2019 and Elia will notify stakeholders of the practical arrangements over the course of the year.

If the restoration state is caused by **system split**, Elia will send the following information as a minimum to the following parties:

- Neighbouring TSOs:
    - The scale and boundaries of the synchronised region(s) to which its control area belongs;
    - Restrictions on the operation of the synchronised region;
    - The maximum duration and quantity of active and reactive power that can be supplied over the interconnectors; and
    - Any other technical or organisational restrictions.
- The Frequency Leader of its synchronised region:
    - Restrictions intended to maintain island operation;
    - The additional load and generation available; and
    - The availability of operational reserves.

12 Communication requirements

The exchange of information is key to guaranteeing the operational security of the transmission system during every state, including emergency, blackout and restoration. To be able to collect all the necessary information from all stakeholders involved in any system state, it is important to establish reliable communication between all actors in the event of blackout/restoration when the public communication network is no longer operational.

Elia will make every effort to send the notifications referred to in section 11 to stakeholders in good time.

Elia will ensure maximum operational security of the communication channels it manages during the various system states. Elia provides for several communication channels to keep in touch with stakeholders, including:

- public communication networks;
- data communication links that run parallel to the high-voltage grid and are managed by Elia;
- the Iridium public satellite telephone network, which is also used by a number of grid users.

As there is no guarantee that a public satellite telephone network will continue to operate in the event of a blackout, Elia has started to develop its own private satellite network.

In accordance with the recitals of the NC E&R, Elia will endeavour to obtain priority telecommunications status from its communication service providers for the use of public communication networks.

However, Elia accepts no liability for the operation of communication channels managed by external parties when the system is in a state of emergency, blackout or restoration.

During the re-energisation procedure in particular, it is essential for the safety of people and equipment and for system stability that Elia can communicate with DSOs and SGUs prior to the re-energisation of a substation and that Elia can provide instructions as to the maximum load that can be withdrawn from the grid or the maximum admissible volume of (distributed) energy sources that can be injected, and so on.

Pursuant to NC E&R Article 41, every DSO and SGU identified in accordance with section 4.1, every RSP and Elia must have, by 18 December 2022 at the latest, a voice or data communication system with sufficient equipment redundancy and backup power sources to allow the exchange of information necessary for restoration for at least 24 hours in the event of a total absence of external power supply or failure of the voice communication system equipment.

Interoperability between the voice communication systems of the DSOs and SGUs identified in section 4.1 and RSPs, as well as Elia's own voice communication system, must be guaranteed, and it must be ensured that Elia's incoming call can be identified by the other party and answered immediately.

Voice communication implemented by Elia and DSOs includes in-house communication, mutual communication as well as communication with other sites involved in restoration, such as substations, backup control rooms, regional (control) centres, crisis centres, and so on.

Every DSO and SGU identified in section 4.1 as well as all RSPs must ensure that an operator is available 24/7 who has the right skills and level of responsibility to ensure that incoming calls from the TSO are answered immediately and will result in the proper action being taken.

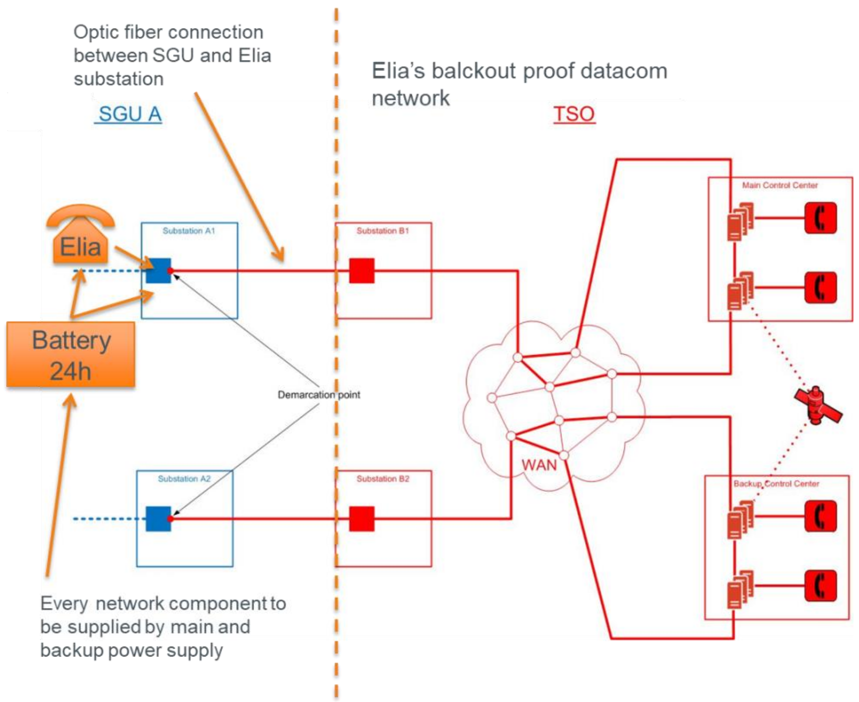

Figure 5: Example of redundant communication infrastructure between an SGU and Elia

Figure 5 provides an example of how to achieve the necessary level of redundant communication infrastructure, i.e. with sufficient backup devices.

There are three types of active grid equipment:

1. Operator network equipment: transmission systems, CWDM/DWDM systems;

2. Data network equipment: routers, switches, network servers (e.g. DNS, NTP, DHCP);

3. Voice network equipment: PBX, servers, VoIP communication systems, dispatching telephone consoles, telephones.

To achieve redundancy when it comes to active network equipment, each type of active network equipment must be installed at least twice in the system for the central elements (main/backup control centre). Installation is related to the availability of the function and services in question, rather than the location of the equipment.

Passive network equipment comprises physical lines between different actors in the communication network.

There are two ways to achieve redundancy when it comes to passive network equipment:

- Meshed communication network with at least two communication channels between two given nodes;

- Two direct lines between entities that need to communication with each other: two main lines or one main line and one backup line.

In this case, the two lines must be 'geographically separate' to prevent, for instance, a common point of failure.

All active network equipment must have resilient main and backup power supplies.

This means that a 24-hour backup power supply is required for the network operations centre and for each site hosting active network equipment in the communication chain, e.g. control rooms, server sites, substations hosting the equipment that transmits the signal over the network, routers and/or switches.

As for backup power supplies, it is up to the party in question to choose what to use, e.g. batteries and/or diesel generators.

For those entities for which communication during system restoration is essential, Elia recommends installing in their control room a VoIP telephone connected via fibre optic cables to the nearest Elia substation, where it can be connected to Elia's data communication network. The grid user must provide redundancy and backup power sources for all active communication components connected at its sites.

13 Glossary

ACE: Area Control Error, a signal expressing the difference between a country's actual and scheduled exchanges in real time, adjusted by a proportion of the actual frequency deviation. ACE = $\Delta P + K\ \Delta f$, where ΔP is the area imbalance, K is the power/frequency parameter of the control area and Δf is the system frequency deviation.

Active power: The electrical energy, expressed in watts, that can be converted into other forms of energy, e.g. mechanical, thermal or acoustic energy. This value is equal to 3 U I cosine (phi), where U and I are the effective values of the fundamental components of voltage and current and where phi represents the phase difference between the fundamental components of voltage and current.

aFRR: Automatic Frequency Restoration Reserve

AGC: Automatic Generation Controller, controller for restoring the frequency of the LFC area.

AGSOM: Agreement on Grid and System Operation Management. Bilateral agreement between neighbouring TSOs established in accordance with the SAFA. An AGSOM serves as the basis for a high-level reciprocal agreement intended to allow the parties to carry out all necessary grid management tasks and to ensure the operational security of the grid. This agreement covers, among other things, the procedures to be applied in an emergency state.

Amprion: One of Germany's four transmission system operators.

AR: arrêté royal, a Belgian royal decree.

Black start: A generation unit's ability to re-energise an inactive busbar on the grid and provide active power without drawing energy from the grid in order to restart the grid after a collapse.

BMAP: Bidding Market Platform

Bottom-up re-energisation strategy: Strategy where part of a TSO's system can be re-energised without the assistance of other TSOs.

BRP: Balance Responsible Party

BSP: Balancing Service Provider

CA: Cooperation Agreement. Elia has concluded an agreement with every DSO, setting out the cooperation between the two.

Capacity curve: Diagram depicting a PGM's operational capacity (MW-MVAr).

CCP: Centre de Crise Principal, Elia's main crisis unit.

CDSO: Closed Distribution System Operator

CGCCR: Centre Gouvernemental de Coordination et de Crise, Belgium's governmental coordination and emergency centre.

CIGRE: Conseil International des Grands Réseaux Électriques, the International Council on Large Electric Systems.

CIPU: Coordination of Injection of Production Units

Clearing: The automatic or manual interruption of all outgoing feeders in a high-voltage substation.

Control area: Area in which the system operator continuously controls the balance between electricity consumption and generation, taking into account active power exchange between control areas.

CREG: Commission de régulation de l'électricité et du gaz, the Belgian Federal Commission for Electricity and Gas Regulation.

DG Energy: The General Directorate for Energy within the Federal Public Service Economy.

Distribution transformer: A transformer that injects electricity into the distribution system.

DSO: Distribution System Operator. In this document, the term 'DSO' refers to the operator of a public distribution system. For the avoidance of doubt, closed distribution systems connected to the transmission or distribution system must not be interpreted as a DSO sub-category in this document.

DSP: Defence Service Provider, a legal entity having a legal or contractual obligation to provide a service contributing to one or more measures of the System Defence Plan.

DWDM: Dense Wavelength Division Multiplexing, a data communication technology.

EAS: ENTSO-E Awareness System, application used by all ENTSO-E TSOs to notify one another of the state of their system and to exchange other information.

Electricity system: All equipment, including all interconnected grids, connection facilities and grid user facilities connected to these grids.

EMS: Energy Management System, the management system used for real-time grid monitoring, remote control and security analysis.

Energy coordinator: Operational department of the access responsible party coordinating generation units located in Belgium.

FCR: Frequency Containment Reserve, operational reserve used to contain the frequency within a predetermined range after an incident. Decentralised response of speed controls on individual generators. Activation time: 10 to 30 seconds.

FGC: Federal Grid Code, Royal Decree of 22 April 2019 establishing a federal technical regulation for the management of and access to the electricity transmission system.

FRCE: Frequency Restoration Control Error, the control error for the frequency restoration process, equal to the ACE of an LFC area.

Frequency Leader: TSO tasked with managing system frequency in a synchronised region or synchronous area in order to return system frequency to rated levels.

Frequency relay: Relay that issues a command in the event of excessively low frequency (e.g. discharge).

Frequency restoration controller for the LFC area: Process implemented within the Elia EMS, which processes FRCE measurements every 4 seconds and provides automated instructions to the aFRR providers connected via telecommunication connections.

FRR: Frequency Restoration Reserve, operational reserve used to return frequency and system imbalance to normal levels. Centralised control. Automatic or manual activation within 15 minutes.

High priority significant grid user: A significant grid user for whom special conditions apply when it comes to disconnection and re-energisation.

Houseload operation: State of a PGM where a PGM that is disconnected from the transmission system in the event of a blackout can continue to operate, supplying its own in-house load.

HVDC: High-Voltage Direct Current, interconnector transporting energy by means of high-voltage direct current.

Island operation: Independent operation of all or part of a system that is isolated after being disconnected from the interconnected grid, comprising at least one PGM or HVDC network supplying power to this system and controlling the frequency and voltage.

LFC area: Load-Frequency Control area. For Belgium, this corresponds to Elia's control area.

LFDD: Low Frequency Demand Disconnection, also known as automatic load shedding at low frequency.

LFSM-O: Limited Frequency Sensitive Mode - Overfrequency, operating mode used in a PGM or HVDC system where the generation of active power is reduced in response to a change in system frequency above a certain value.

LFSM-U: Limited Frequency Sensitive Mode - Underfrequency, operating mode used in a PGM or HVDC system where the generation of active power is increased in response to a change in system frequency below a certain value.

'Load-Shedding Plan' Ministerial Decree: Ministerial Decree of 3 June 2005 establishing the load-shedding plan for the electricity transmission system and as amended from time to time.

Load-shedding plan: The 'Load-Shedding Plan' Ministerial Decree setting out the load-shedding plan for the electricity transmission system, which comprises the manual demand disconnection procedure and the LFDD system.

mFRR: Manual Frequency Restoration Reserve

Minister of Economy: Federal minister or secretary of state for the economy.

Minister of Energy: Federal minister or secretary of state dealing with energy-related issues.

MOG: Modular Offshore Grid, currently an offshore high-voltage substation to which four wind farms are connected.

Multiple-incident situation: A situation involving multiple incidents. Refers to the physical state of the electricity system that, starting from a reference state and ending upon the elimination of transient phenomena, is caused by the simultaneous loss of a generating unit and another component of the electricity system, such as a grid component or a generating unit.

MV substation: Medium-voltage substation, a substation with a rated voltage below 30 kV.

NC DCC: Network Code on Demand Connection, network code governing the connection of distribution systems and demand facilities. Commission Regulation (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection (for distribution systems and demand facilities).

NC E&R: Network Code on Emergency and Restoration, network code governing the emergency state and restoration of the grid. Commission Regulation (EU) 2017/2196 of 24 November 2017 establishing a network code on electricity emergency and restoration.

NC HVDC: Network Code on High-Voltage Direct Current. Commission Regulation (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high-voltage direct current systems and direct current-connected power park modules.

NC RfG: Network Code on Requirements for Generators, network code setting out the requirements for the connection of electricity generation facilities. Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators.

NCC: Elia's National Control Centre

NEMO: Nominated Electricity Market Operator

NGESO: National Grid Electricity System Operator, the electricity system operator for Great Britain.

NLL: Nemo Link Limited, the company operating the HVDC interconnector between Belgium and the UK.

Non-selective load shedding: Manual or automatic interruption of direct or indirect connections between the transmission system and the systems of other operators within Elia's control area by opening the circuit breakers on the transformers connected to these systems.

NRA: National Regulatory Authority. CREG is the NRA in Belgium

OGE: On-duty Grid Engineer

PAS: Power Application Software, a part of the EMS used to analyse security in near real time.

PGM: Power Generating Module

PPM: Power Park Module, a unit or group of units that generate electricity, connected to the system either non-synchronously or by means of power electronics and that have a connection point to a transmission, (closed) distribution or HVDC system.

PSD: Parallel Switch Device, device used to synchronise systems in parallel, allowing two asynchronous regions to be resynchronised.

PSOS: Power System Operation and Stability, an entity within the Elia NCC that specialises in analysing electrical systems.

PST: Phase Shifting Transformer

RCC: Regional Control Centre

Reactive power: The value, expressed in var, equal to 3 U I sine (phi), where U and I are the effective values of the fundamental components of the voltage and current and where phi represents the phase difference between the fundamental components of voltage and current.

REE: Red Eléctrica de España, Spanish transmission system operator.

Re-energisation: Action of reconnecting generation and load to supply power to parts of the system that have been disconnected.

Regional regulations:

The Flemish Region:

- Grid Code of 5 May 2015 governing the distribution of electricity in the Flemish Region
- Decree of the Flemish Government of 8 January 2016 approving the Grid Code governing the distribution of electricity in the Flemish Region

The Walloon Region: Decree of the Walloon Government of 26 January 2012 on the amendment of the Grid Code governing the management of and access to the local electricity transmission system in the Walloon Region

The Brussels-Capital Region: Decree of the Government of the Brussels-Capital Region of 23 May 2014 on the Grid Code governing the management of and access to the electricity distribution system in the Brussels-Capital Region

RES: Renewable Energy Source

Restoration Plan: All technical and organisational measures required to return the system to its normal state.

Resynchronisation Leader: TSO tasked with resynchronising two synchronised regions.

Resynchronisation point: Device connecting two synchronised areas, usually a circuit breaker.

Resynchronisation: The act of synchronising and reconnecting two synchronised regions at the resynchronisation point.

RSC: Regional Security Coordinator

RSP: Restoration Service Provider, a legal entity having a legal or contractual obligation to provide a service contributing to one or more measures of the System Restoration Plan.

RTE: French transmission system operator.

RTU: Remote Terminal Unit, control unit that pools a substation's signals and sends them from the substation to the control centre.

SCADA: Supervisory Control And Data Acquisition, part of the EMS.

SE: System Engineer, Elia NCC operator responsible for monitoring the system in real time.

Selective load shedding: Manual or automatic interruption of feeders in TSO or DSO substations not classified as feeders for high priority SGUs.

SGU: Significant Grid User, a category of grid users as per NC E&R Article 2(2).

Shortage procedure: Procedure whose legal basis is described in the 'Load-Shedding Plan' Ministerial Decree.

SO: System Operator, operator within Elia's NCC in charge of monitoring balancing reserves.

SOGL: System Operation Guideline. Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation.

Structural injecting cables: As described in the 'Load-shedding Plan' Ministerial Decree.

SVC: Static VAR Compensator, device used to compensate for reactive power.

Swissgrid: Swiss transmission system operator.

Synchronised region: Part of a synchronous area covered by interconnected TSOs having a common system frequency and which is not synchronised with the rest of the synchronous area.

TenneT NL: Dutch transmission system operator.

Terna: Italian transmission system operator.

Top-down re-energisation strategy: Strategy where the assistance of other TSOs is required to re-energise parts of a TSO's system.

Total load: The total load for the purposes of the LFDD system calculated using the following formula:

TOTAL LOAD = Σ GROSS GENERATION + IMPORTS – EXPORTS – ENERGY STORAGE – HOUSELOAD OPERATION

NB: All values in the formula are used as positive values.

TSO: Transmission System Operator, responsible for operating the high-voltage grid and for the transmission of electricity. A TSO's responsibilities involve providing access to the grid, monitoring flows and ensuring uninterrupted management of the balance between generation and consumption.

TSO-controlled dispatching: A way of operating the transmission system, for example at a time when certain market segments are interrupted and the grid users connected to the TSO adopt the instructions and set points issued by said TSO without undue delay.

Unexpected phenomena: Phenomena that occur when the system is in an emergency state or are caused by an interruption in electricity generation, transmission or demand (such as frequency fluctuations, voltage drops, congestion, etc.) which cannot be compensated quickly or adequately enough by an increase in generation in the relevant part of the control area, by an increase in electricity supply to the relevant part of the control area or by demand-side management.

14 List of substations key to the procedures in the Restoration Plan (confidential)

15 List of measures and implementation deadlines

15.1 List of measures and implementation deadlines applicable to TSOs and their facilities

	Measure	Deadline
1	Install backup diesel generators in substations key to the restoration procedure	31 December 2022
2	Implement the Blackout Elia, Market Suspension Elia, Market Restoration Elia and Grid Restoration Elia notifications	Date of ministerial approval + 1 year
3	Upgrade the 'restoration code' rules in the EMS according to this new Restoration Plan	Date of ministerial approval + 1 year

15.2 List of measures and implementation deadlines applicable to identified SGUs and their facilities

	Measure	Deadline
1	Install means of communication that can withstand blackouts as per section 12 of the Restoration Plan	18 December 2022
2	Implement a process ensuring the proper receipt of the various notifications sent by Elia as per section 12 of the Restoration Plan. Elia, in consultation with stakeholders, will define the practical arrangements in the coming months.	Date of ministerial approval + 1 year

15.3 List of measures and implementation deadlines applicable to DSOs and their facilities

#	Applicable to	Measure	Deadline
1	All DSOs	Implement a process ensuring the proper receipt of the various notifications sent by Elia as per section 11 of the Restoration Plan. Elia, in consultation with stakeholders, will define the practical arrangements in the coming months.	Date of ministerial approval + 1 year

16 Related documents

This section provides an overview of the related documents referenced in this Restoration Plan. Some of these documents are only available in-house. Elia does not seek the Minister of Energy's approval for these documents. The competent authorities may ask to consult these documents for information purposes.

16.1. Documents only available in-house (confidential)

16.2. Documents available to external parties

The current balancing rules: https://www.elia.be/en/electricity-market-and-system/system-services/keeping-the-balance

Annex 1: List of identified SGUs pursuant to Article 23(4)(c) of the Network Code on Emergency and Restoration (confidential)