



# DESIGN NOTE ON RESTORATION SERVICES

**ELIA - Market Development**

20/12/2018 – version updated after public consultation

## PURPOSE OF THE DESIGN NOTE

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Between November 2017 and August 2018 Elia has performed an in-depth study of the black start service for the Belgian electricity system based on simulation studies, information received from producers, and a comparison with other European countries. The study takes into account the impact of the new European guidelines and motivates reconsidering the design of the black start ancillary service.

Just like all other ancillary services, Elia strives at continuously improving the product design of the services in order to attract new technologies and providers, and in order to increase the efficiency of the procurement procedure. The current contractual period for black start services ends in December 2020. The review of the service design is part of a long-term roadmap for implementation of a new framework by 2021.

ELIA extended the scope of the study after request of the national regulator CREG<sup>1</sup> in the incentives set in the framework of the incentive regulation mechanism as specified in article 27 of the tariff methodology for 2016-2019<sup>2</sup>.

The study brings forward two reports, which are publicly consulted together between 8 October and 19 November 2018, as a formal submission to the CREG is planned by the end of the year:

- **Part 1: Study on the review of the black start ancillary services**

The study analyzed the technical capabilities of production units in Belgium (thermal and intermittent) for black start and houseload operation, the market models used in other European countries to procure the black start service, and the determination of needs for black start services in Belgium in order to achieve the objectives of the restoration plan. The study serves as a basis for a review of the service design (part 2) and for future versions of the Restoration Plan.

- **Part 2: Design note on restoration services (the underlying document)**

Following the above-mentioned analyses ELIA has reviewed the design of the black start ancillary service (more broadly defined as “restoration service” in the Network Code on Electricity Emergency & Restoration). ELIA proposes a new design for the future organization of the black start service, which will serve as a basis for future versions of the Terms & Conditions to act as a Restoration Service Provider on a contractual basis (i.e., the new black start contract).

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<sup>1</sup> Creg decision (B)658E/45

<sup>2</sup> Artikel 27 van het besluit (Z)141218-CDC-1109/7 van de CREG van 18 december 2014 tot vaststelling van de tariefmethodologie voor het elektriciteitstransmissienet en voor de elektriciteitsnetten met een transmissiefunctie evenals de overeenkomst van 25 juni 2015 tussen de CREG en Elia System Operator nv over de modaliteiten voor de regulering met stimulansen voor Elia System Operator nv in de periode 2016-2019

## EXECUTIVE SUMMARY

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ELIA aims at minimizing the risk that at the time of need when in blackout there would be no means in the system for bottom-up restoration of the Belgian grid. For this purpose **ELIA contracts restoration services based on black start capabilities**.

The modalities for service delivery are described in the **Terms and Conditions for the Restoration Service Provider (T&C RSP)**, a document that is to be consulted publicly with the stakeholders before **submission for approval to the regulator** and/or another authority designated by the member state. The first version of the T&C RSP (to be submitted to the national regulator CREG by 18 December 2018) is based on the current black start contract. The underlying design note on ELIA's vision for the future organization of the restoration services and the feedback from its public consultation will serve as input for a second version of T&C RSP.

Future services for restoration of the system are provided to ELIA by a **Restoration Service Provider (RSP)**, a role introduced by the Network Code on Electricity Emergency and Restoration. The grid user takes on the RSP role or the RSP may be a third party who delivers the service to ELIA with the agreement of the grid user(s) of the asset(s) used in the service. An entity is free to combine the RSP role with other market roles.

The RSP is responsible for assuring that the contracted black start service meets the **technical, operational, and availability requirements** defined by ELIA. The technical requirements include a list of mandatory equipment, capabilities to respect frequency and voltages limits, and capabilities for the production of active power and the absorption of reactive power. Operationally the RSP is to make sure that the required procedures, communication channels, and trained personnel are continuously available.

ELIA will contract the service after a **public procurement procedure**. ELIA will transparently call for potential providers and bilaterally discuss with each selected RSP candidate its evaluation of the proposed solutions for restoration, including the connecting (closed) distribution system operator(s) if relevant. The evaluation may result in a stricter definition of some technical requirements for a specific restoration service. ELIA will select the offers most preferable to cover the system restoration needs from both a technical and economic perspective. ELIA reports the outcome of the procurement procedure to the CREG—for evaluation of the reasonableness of the prices—and to the Federal Public Service Economy. **Contracts have a duration of several years**, but ELIA determines the precise duration during the procurement phase as depending on the situation of potential providers. Participation to the service is generally **voluntary**; only in case of a lack of capabilities that is putting the system security at risk, can the member state impose the provision of the service. When possible ELIA aims to allow sufficient time for the procurement procedure and for the implementation phase, as the installation of new black start capabilities requires substantial planning and investments.

New services must be **tested** for prequalification before the start of the contract. During the contract period, 3-yearly compliance tests are to be executed to verify the functioning of the service. Failed tests have an impact on the settlement (unavailability and penalties).

ELIA will remunerate the RSP for the technical installation and for the operational availability of the service. The cost-plus **remuneration** is divided into a **capital cost** (if new capability), an **operational cost**, and an **opportunity cost** (if energy storage requirement). The operational and opportunity costs are variable depending on the daily availability of the service. Availability is determined by the status of the generating site, the self-starter, and (in some cases) a minimum energy volume. Excessive unavailability of the service leads to

penalties. Failed prequalification tests set the status of the service at unavailable; failed compliance tests set the status of the service at unavailable depending on the cause of the failure and the number of tests.

This table provides a summary and comparison of the current and the new design for black start services. Changes are highlighted in orange.

Current black start design	New design proposal
<b>Scope of contracted restoration services</b>	
Black start only No houseload operation or islanding	Black start only No houseload operation or islanding
<b>Context</b>	
<p>CREG evaluates reasonableness of offered prices (Electricity Law article 12quinquies on ancillary services and royal decrees)</p> <p>Non-regulated Restoration Plan Non-regulated contract No market rules during period of ELIA controlled dispatch after a blackout</p>	<p>CREG evaluates reasonableness of offered prices (Electricity Law article 12quinquies on ancillary services and royal decrees)</p> <p><b>More regulation:</b> E&amp;R Network Code imposes regulatory approval of Terms &amp; Conditions to act as Restoration Service Provider, and of the Rules on suspension and restoration of market activities. The member state may also impose approval of the Restoration Plan.</p>
<b>Needs determination</b>	
<p>5 black start services:</p> <ul style="list-style-type: none"> <li>- 1 for 380 kV backbone restoration</li> <li>- 4 for zonal restoration</li> </ul>	<p><b>4</b> (or 5) black start services:</p> <ul style="list-style-type: none"> <li>- 1 for 380 kV backbone restoration</li> <li>- <b>3</b> (or 4) for zonal restoration</li> </ul>
<b>Contract signatory</b>	
ARP (CIPU holder)	<p><b>Restoration Service Provider (RSP)</b> = grid user or a 3<sup>rd</sup> party offering a service in agreement with the grid user (possible RSP <b>aggregating assets</b> of different grid users) Attention for <b>interdependencies</b> with other roles (e.g., Outage Planning Agent)</p>
<b>Procurement</b>	
<ul style="list-style-type: none"> <li>- Public procurement</li> <li>- Contract duration of 5 years (1 or 2 years in case of a Royal Decree)</li> <li>- Fixed contract periods to offer</li> <li>- CREG evaluates the reasonableness of offered prices</li> </ul>	<ul style="list-style-type: none"> <li>- Public procurement</li> <li>- Contract duration of <b>multiple years</b>, to be determined in the procurement phase</li> <li>- Impact of Royal Decrees to be confirmed</li> <li>- <b>Flexibility in offer of contract periods</b></li> <li>- CREG evaluates the reasonableness of offered prices</li> </ul>

<b>Technical requirements</b>	
CIPU assets only (typically $\geq 25\text{MW}$ and TSO-connected)	<b>PGM &amp; storage units, type B/D/C, possible connected to TSO/CDSO/DSO grid</b>
1 or more power units connected behind the same connection point	1 or more power units Self-starting site and generating site may be located behind <b>different (near-by) connection points</b>
Strictly defined requirements equal for all services: <ul style="list-style-type: none"> <li>- Equipment</li> <li>- Voltage regulation and Mvar absorption capability</li> <li>- Block load capability</li> <li>- Minimum energy requirement for (pump) storage</li> <li>- Fuel supply</li> <li>- Start-up times (1.5 – 3 hours)</li> <li>- Number of start-ups (min. 3)</li> <li>- Availability during activation (24h)</li> </ul>	Strictly defined requirements for: <ul style="list-style-type: none"> <li>- Equipment</li> <li>- Voltage regulation</li> <li>- Block load capability</li> <li>- Fuel supply</li> <li>- Start-up times (1.5 – 3 hours)</li> <li>- Number of start-ups (min. 3)</li> <li>- Availability during activation (24h)</li> </ul> <b>Minimum requirements (but may be increased after simulation tests) + may be different for each of the 380kV and zonal services:</b> <ul style="list-style-type: none"> <li>- <b>Mvar absorption capability</b></li> <li>- <b>MW installed capacity</b></li> <li>- <b>Minimum energy requirement for (pump) storage</b></li> </ul>
<b>Technical tests</b>	
5 test types possible	5 test types possible
Simulation test by the provider before the contract	<b>Prequalification test in coordination between the RSP and ELIA before the start of the contract</b>
Compliance test minimum once during a contractual period Surprise test possible	Compliance test once every <b>3 years</b> <b>Clarifications</b> on the impact of test success or failure. <b>No more surprise tests</b>
<b>Availability requirements</b>	
Availability of the service based on <ul style="list-style-type: none"> <li>- availability of the generating unit</li> <li>- MWh storage requirement</li> </ul>	Availability of the service based on <ul style="list-style-type: none"> <li>- availability of the generating unit</li> <li>- <b>availability of the self-starter</b></li> <li>- MWh storage requirement</li> </ul>
1 on 3 black start service allowed in planned outage at a time	<b>1</b> black start service allowed in planned outage at a time

<b>Settlement</b>	
<p>1 cost for availability of the service</p> <p>Additional remuneration for tests (if successful)</p>	<p><b>Cost for availability split in 3 components:</b></p> <ul style="list-style-type: none"> <li>- <b>Capital cost</b></li> <li>- <b>Operational cost</b></li> <li>- <b>Opportunity cost</b></li> </ul> <p><b>No remuneration for tests</b></p>
<p>Remuneration depends on availability: if partial availability during the day, availability before 2pm taking into account</p>	<p>Remuneration depends on availability:</p> <ul style="list-style-type: none"> <li>- <b>Remuneration in proportion to available quarter-hours per day</b></li> <li>- <b>If the service was available for at least half the day</b></li> </ul>
<p>Availability control and penalty in case of excessive unavailability</p> <p>Penalties (equivalent 1, 2, 3 months of total costs) starting from 73 days of unavailability</p>	<p>Availability control and penalty in case of excessive unavailability</p> <p>Penalties (equivalent 1, 2, 3 months of <b>operational and opportunity</b> costs) starting from <b>40 days</b> of unavailability</p> <p><b>Contract stop possible in case of more than 120 days of unavailability</b></p>
<b>Premature ending of the contract</b>	
<p>Possible</p> <p>End on 30 September of the year following the announcement</p>	<p>Possible</p> <p>End on 30 September of the year following the announcement</p> <p><b>Additional penalty for premature ending</b></p>

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## 1. Introduction

Even though ELIA continuously strives to maintain and operate the grid to transmit the electricity needed by consumers and producers, ELIA must also prepare for the possibility of severe disruptions. In case of an operational unavailability of (a part of) the transmission system (a “blackout”) ELIA traditionally relies on either inter-TSO cooperation or on the black start ancillary service to restore the system. **The review of the black start ancillary service is the subject of this design note<sup>3</sup>.**

**Two evolutions** drive the redesign of the black start ancillary service:

- The **changing production park**: given the technical requirements to restore the system, typically large thermal production units are equipped to deliver the black start ancillary service. Evolutions in technology and markets are however changing the competitiveness and availability of these units, putting under pressure an efficient procurement of the ancillary service as organized today and a sustainable readiness to deliver the service.
- The **new European guidelines**, especially the Network Code on Electricity Emergency and Restoration (which entered into force end 2017 with specific implementation requirements by December 2018), has redrawn attention to the black start ancillary service (or put broader “restoration services”) and requires a review of some design elements.

In addition, the study by **ELIA in response to the incentives set by the CREG for 2018** highlights needs and opportunities for a renewed black start mechanism. The study identifies potential improvements in the restoration plan and the ancillary service taking into consideration the capabilities of the future production park (period 2020-2030). Also a benchmark study of how other European TSOs organize the service shows some examples for a possible redesign.<sup>4</sup>

**The purpose of the black start/restoration ancillary service is to ensure a continuous (24/7) readiness of a minimum amount of power units with the technical capabilities to restore the system after a blackout.** The contract focuses on assuring the presence of the technical capabilities and the availability of the power units rather than on the activation itself. Different design elements reflect this focus as elaborated on in this document.

### Document structure

Before elaborating on the details of the service design, the document describes the **purpose of the restoration ancillary service (chapter 2)** as well as the broader **regulatory and contractual framework** in which the ancillary service is to be organized in the future (**chapter 3**). ELIA makes use of restoration services when the system is in the particular state of system restoration, namely after the occurrence of a blackout and in a period in which markets are suspended. ELIA limits the scope of restoration services on a contractual basis to those based on **black start capabilities**. The activation of restoration services are one of several measures that ELIA can take. The broader range of measures in restoration state are described in the Restoration Plan. The “Rules for suspension and restoration of market activities” (a new regulated document) explain the impact of the restoration state on the

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<sup>3</sup> Annex 1 gives a summary of the design of the Black Start Ancillary Service up to 2020.

<sup>4</sup> The report of this study is available on the ELIA website as published for consultation together with this design note.

markets and the settlement in the phase of TSO controlled dispatch<sup>5</sup>. Chapter 3 explains the link between these documents and the restoration services, within the context of the new European Guidelines and the Belgian legislation.

**Chapter 4** summarizes the needs for black start services in the Belgian system and their geographical distribution. The “Study on the Review of the Black Start Ancillary Services” (reference [6]) elaborates on the determination of the needs.

**Chapter 5** details the **technical requirements** needed to be able to offer the service. The technical requirements concern, for example, the installation of equipment, active and reactive power capabilities, and maximum start-up times for activation. The service may consist of several power units that, as an aggregation, are able to deliver the service according to the requirements. Throughout the contractual period, ELIA monitors the availability of each black start service. A service is regarded as technically available when the involved power units, the black start capability itself, and of the minimum energy or fuel levels that in some cases would be required for delivering the service are available.

After this contextual and technical scope of what the service entails, an elaboration of the aspects of procurement follows and the conditions of the contract.

The **Restoration Service Provider (RSP)** will deliver the restoration service to ELIA on a contractual basis. The role of the RSP and its relationship vis-à-vis other roles (such as the Outage Planning Agent or a Voltage Service Provider) is explained in **chapter 6**.

**Chapter 7** describes the **procurement of the service via a public call for participation**. The chapter also looks at the information shared in the offer with regards to contractual period and the cost of the service (split in 3 components: capital cost, operational cost, opportunity cost). The timeline for the entire procurement process is laid out as well as an insight in the selection criteria that would be used.

As said, the focus of the contract is on technical and availability requirements. **Chapter 8** describes how ELIA **remunerates** for the service depending on its **availability**. In case of excessive unavailability, in addition to not being paid for the service, **penalties** apply.

ELIA verifies whether the offered service abides the technical requirements via **tests: prequalification tests** before the start of the contract and 3-yearly compliance tests during the contractual period, as explained in **chapter 9**. Failed tests have an impact on remuneration and add penalties.

Finally, an overall **conclusion** to the document **summarizes the elements of the proposed new design** for restoration services.

## 2018 Study on the review of the black start ancillary services

In 2018, ELIA performed a “Study on the review of the black start ancillary services” in response to the incentive set by the CREG<sup>6</sup>. The study includes a review of the needs and technical requirements for the ancillary service and a benchmark of market models in some

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<sup>5</sup> ‘TSO Controlled Dispatch’ can be defined as “a way to operate the transmission system in which TSO-connected grid users execute without undue delay the instructions issued by the TSO”. Within ELIA this situation is commonly referred to as “Central dispatch”. However in order to avoid confusion with the definition ‘central dispatching model’ of Regulation 2017/2195, the term ‘TSO Controlled Dispatch’ is used here.

<sup>6</sup> See reference [6] “Study on the Review of the Black Start Ancillary Services”

European countries leading to recommendations for a redesign of the service, as elaborated in this design note. The study also reflects on the impact of capabilities for household operation, and therefore discusses bottom-up restoration services in the broader context (of which black start services are one specific type). However, both the European benchmark study and the technical analysis for the Belgian system explain that TSOs, regardless of the presence of household operation capabilities in the system, only contract one type of bottom-up restoration services, namely those based on black start capabilities.

To restore the Belgian system after a full blackout **at least four black start units** are needed to reach the restoration target set in the Restoration Plan (a re-energization of 90% of the ELIA connection points within 24 hours, with some stricter intermediary deadlines for clients with a higher criticality level). As the active power injection and reactive power absorption depends on the specific restoration path, the technical requirements are not identical for all restoration services.

**One black start service targets the restoration of the 380kV backbone.** As the restoration path includes the re-energization of several substations and the nuclear plants, the technical requirements of the black start unit ranges up to **an installed capacity of at least around 85 to 140 MW and a reactive power absorption capacity of at least 50Mvar.**

**Three additional black start services target the restoration in specific regions (North-West, North-East, and South).** Considering the closer electrical distance to the critical loads and the support of non-black start units started along the restoration path, **the MW and Mvar requirements are less stringent** than for the 380kV backbone (around 65 to 115 MW installed capacity and around 50 Mvar absorption capability).

The backbone unit and the regional units serve as each other's back-up in case of unavailability due to maintenance or due to the blackout itself.

With respect to the type of power units to deliver black start services, **the study confirms the usefulness of gas turbines and hydro units. Nuclear units are not capable** of delivering the service. **Intermittent production is technologically not ready to re-energize the grid (regardless of questions on availability at the moment of the blackout)**, although innovative evolutions for black start services on wind offshore units show potential on the longer term.

The **benchmark study brought forward few trends** in the procurement of black start services of European TSOs. Some TSOs source via a public tender (with a settlement based on the price bid in the offer or a regulatory approved price), some via bilateral agreement (negotiated prices with or without regulatory approval), and others use mandatory requirements (unpaid). In general TSOs do show the need for **flexible procurement** (e.g. being able to choose between a tender or a bilateral agreement depending on the situation) and a **risk averse attitude** (procurement of more than one black start service in a zone to serve as back-up). The remuneration can include costs for investments, operational availability, tests, studies, warming costs, and activation costs. The **contracts are typically of longer duration** ranging from 3 years, to 10-15 years, to lifetime duration (in case of mandatory services).

## 2. Purpose and scope of Restoration Services

Restoration of the system is fortunately only needed in exceptional circumstances. The system is usually in a state of normal operation or in a state in which the potential risks remain controllable. Only when operational security limits are violated (and depending on the severity) the TSO must take action to restore the system, as described in the new European guidelines. The European Guideline on System Operation (SOGL) defines five system states (see Figure 1), out of which the European Network Code on Electricity Emergency and Restoration (NC E&R) focuses on the emergency, blackout, and restoration states.

A TSO can activate measures from the restoration plan when the system is in emergency state or in blackout state (as visualized in Figure 1).<sup>7</sup> Specifically, restoration services provided on a contractual basis have a role in the “re-energization” component of the restoration plan.

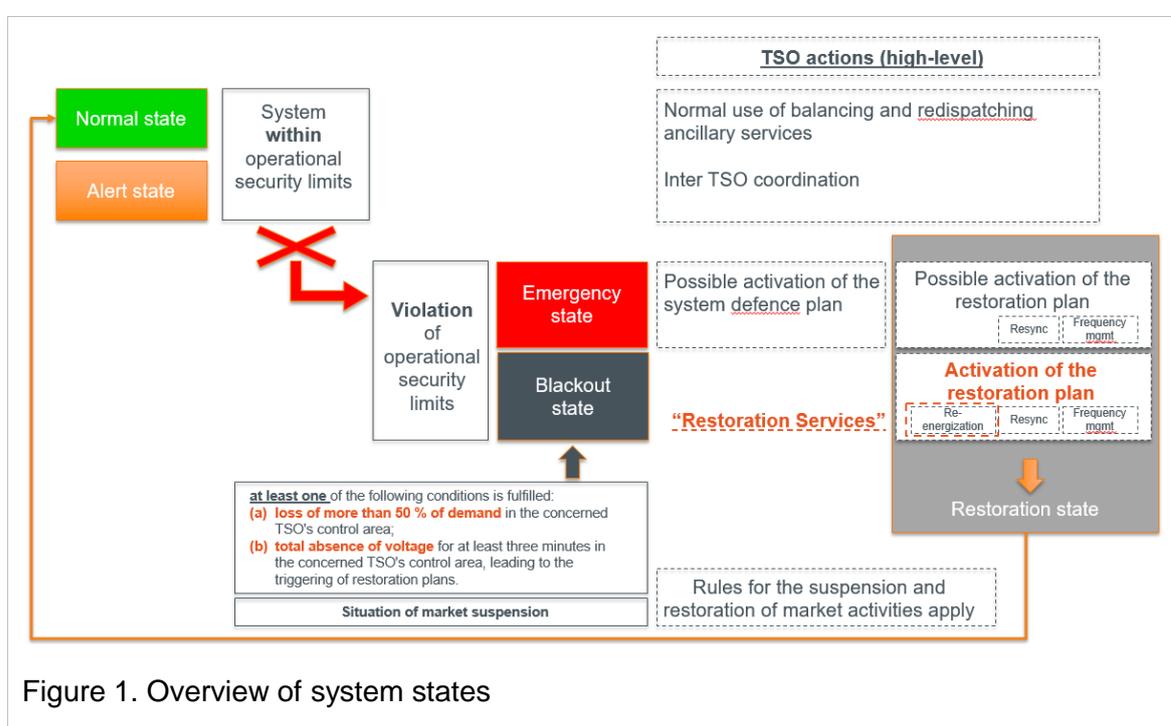


Figure 1. Overview of system states

### European Guideline on Electricity Transmission System Operation

**Definition (36) - ‘system state’** means the operational state of the transmission system in relation to the operational security limits which can be normal state, alert state, emergency state, blackout state and restoration state;

**Definition (5) - ‘normal state’** means a situation in which the system is within operational security limits in the N-situation and after the occurrence of any contingency from the contingency list, taking into account the effect of the available remedial actions;

<sup>7</sup> Note that in this situation also “The rules for suspension and restoration of market activities” apply.

**Definition (17) - ‘alert state’** means the system state in which the system is within operational security limits, but a contingency from the contingency list has been detected and in case of its occurrence the available remedial actions are not sufficient to keep the normal state;

**Definition (37) - ‘emergency state’** means the system state in which one or more operational security limits are violated;

**Definition (22) - ‘blackout state’** means the system state in which the operation of part or all of the transmission system is terminated;

**More specifically in Article 18(4):** A transmission system shall be in the **blackout state** when at least one of the following conditions is fulfilled:

- (a) loss of more than 50 % of demand in the concerned TSO's control area;
- (b) total absence of voltage for at least three minutes in the concerned TSO's control area, leading to the triggering of restoration plans.

**Definition (38) - ‘restoration state’** means the system state in which the objective of all activities in the transmission system is to re-establish the system operation and maintain operational security after the blackout state or the emergency state;

**Definition (5) - ‘restoration plan’** means all technical and organisational measures necessary for the restoration of the system back to normal state;

### **European Network Code on Electricity Emergency and Restoration**

**Article 3 - Definition (2) - ‘restoration service provider’** means a legal entity with a legal or contractual obligation to provide a service contributing to one or several measures of the restoration plan;

**Article 3 - Definition (7) – ‘top-down re-energisation strategy’** means a strategy that requires the assistance of other TSOs to re-energise parts of the system of a TSO;

**Article 3 - Definition (8) – ‘bottom-up re-energisation strategy’** means a strategy where part of the system of a TSO can be re-energised without the assistance from other TSOs;

**Article 4.4** The **terms and conditions to act as defence service provider and as restoration service provider** shall be established either in the national legal framework or on a contractual basis. If established on a contractual basis, each TSO shall develop by 18 December 2018 a proposal for the relevant terms and conditions, which shall define at least:

- (a) the characteristics of the service to be provided;
- (b) the possibility of and conditions for aggregation; and
- (c) for restoration service providers, the target geographical distribution of power sources with black start and island operation capabilities.

### **Article 23 - Design of the restoration plan**

[...] 4. In particular, the restoration plan shall include the **following elements**:

- [...] (f) the number of power sources in the TSO's control area necessary to re-energise its system with bottom-up re-energisation strategy having black start capability, quick

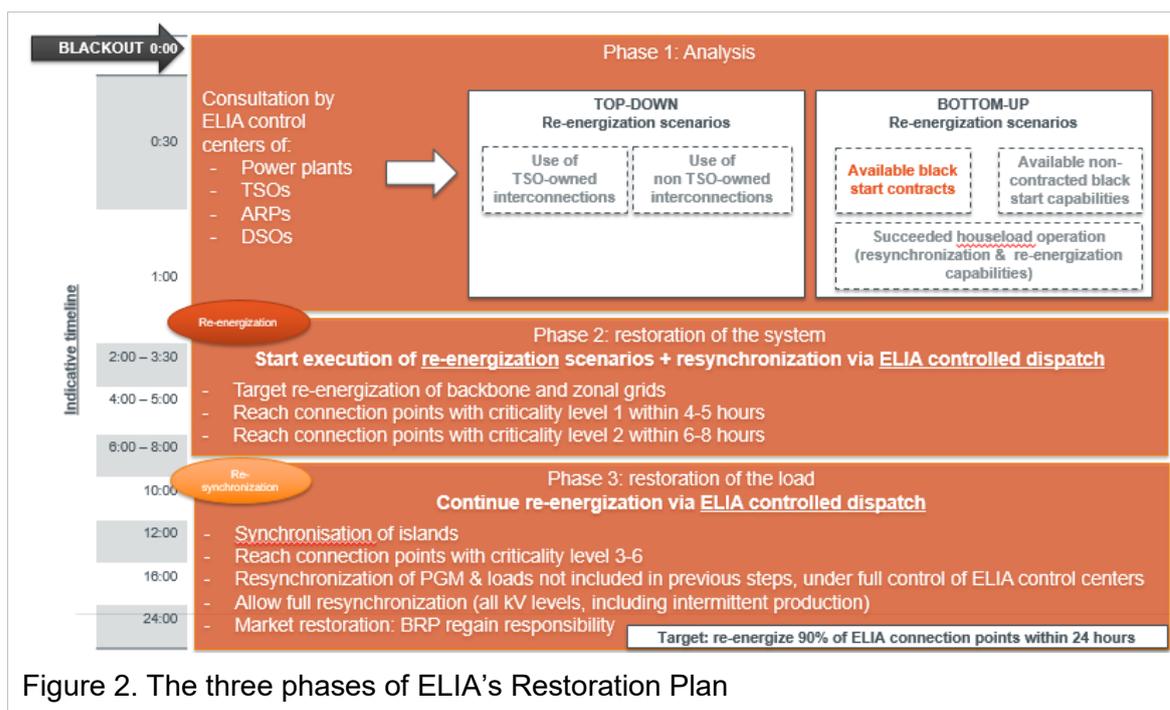
re-synchronisation capability (through houseload operation) and island operation capability; and [...]

5. The restoration plan shall include at least the **following technical and organisational measures** specified in Chapter III:

- (a) **re-energisation procedure**, in accordance with Section 2;
- (b) **frequency management** procedure, in accordance with Section 3; and
- (c) **resynchronisation** procedure, in accordance with Section 4.

[...]

**Restoration services can be provided based on a legal or a contractual obligation and contribute to one or several measures of the restoration plan (NC E&R article 3).** The purpose of the restoration plan is to restore the system to the normal state. As described in article 23 of the Network Code on Electricity Emergency and Restoration (for the full article see Annex 4) the plan includes lists of measures to be executed by the TSO, by (C)DSOs, and by identified significant grid users<sup>8</sup> (SGUs), and specifically three procedures, namely, a **re-energization procedure**, a frequency management procedure, and a resynchronization procedure. The last two procedures include TSO and inter-TSO actions. The restoration services discussed in this design note are used in the re-energization procedure.



Concretely in case of a blackout, ELIA will activate the restoration plan as depicted in figure 2. The goal is to re-energize critical branches in the grid as soon as possible in order to gradually re-supply demand and reconnect other power units to further support the restoration of the system. After a diagnosis phase, ELIA will decide which re-energization scenarios to follow, and proceed in coordination with other TSOs, (C)DSOs, identified SGUs,

<sup>8</sup> "Identified significant grid users" are those grid users significant according to NCER (article 2) and subject to mandatory requirements imposed via national regulation or via European connection codes for generators (*RfG*), demand facilities (*DCC*), or HVDC.

and Restoration Service Providers. **After execution of the re-energization procedures**, ELIA's control centers are able to resynchronize the remaining parts of the grid and therefore temporarily enter in a **mode of "TSO controlled dispatch"**, coordinating production and load in close collaboration with other system operators and clients. ELIA will elevate the mode of TSO controlled dispatch only when the system, loads, and markets have been stably restored, as elaborated in the rules on suspension and restoration of market activities.

**The TSO can execute the re-energization in the first phases after a blackout either top-down or bottom-up (or by using a mix of both).** The chosen strategy depends on the scope of the blackout (partial or full blackout, depending on the percentage of lost load; whether or not neighboring control areas are affected; and whether or not neighboring TSOs can assist in the restoration without putting themselves at risk):

- A **top-down strategy** means that the 'dead' grid can be put under voltage via re-energization from a neighboring grid. The strategy requires the assistance of other TSOs (as defined in NC E&R, definition 7).
- A **bottom-up strategy** means that the 'dead' grid is re-energized using capabilities within the TSO's own control area and therefore without assistance from other TSOs (as defined in NC E&R, definition 8). Bottom-up re-energization can rely on power units connected within the dead grid that are either able to do a 'black start', power units that were able to disconnect from the grid and trip to the houseload operation before the blackout, or re-energize a dead part of the grid by resynchronizing with an island that remained in operation (partial blackout).
  - o The **black start capability** is "the capability of recovery from a power-generating module from a total shutdown through a dedicated auxiliary power source without any electrical energy supply external to the power-generating facility," (as defined in RfG, definition 45). There is currently **no legal obligation** for existing Power Generating Modules (PGM) in Belgium (according to the Federal Grid Code) or for future PGM (according to RfG, article 15.5.a) to install black start capabilities.
  - o The **houseload operation capability** refers to "the operation which ensures that power-generating facilities are able to continue to supply their in-house loads in the event of network failures resulting in power-generating modules being disconnected from the network and tripped onto their auxiliary supplies," (as defined in RfG, definition 44)<sup>9</sup>. **PGM type C and D subject to RfG (article 15.5.c) are obliged to be capable to trip to houseload operation.** There is no legal obligation for existing Power Generating Modules (PGM) in Belgium (according to the current Federal Grid Code).

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<sup>9</sup> Only if the installation includes the capability to re-energize a dead grid, can a PGM with houseload operation capability be useful for bottom-up re-energization.

Note that re-energization based on houseload capability is only feasible on PGM that were in operating mode at the moment of a blackout. The success in tripping to houseload operation depends on the circumstances at the time: whether the system pro-actively detects the grid disruption and the unit can disconnect from the grid on time, and the level of production of the unit at that moment. A higher production level causes a bigger shock and therefore has a higher risk of failure of houseload tripping.

- On a larger scale **island operation capability** refers to the “independent operation of a whole network or part of a network that is isolated after being disconnected from the interconnected system, having at least one power generating module or HVDC system supplying power to this network and controlling the frequency and voltage,” (defined in RfG, definition 43). According to RfG (article 15.5.b) the TSO may require PGM type C and D to be capable of operating in an island within the limits defined for frequency and voltage. The **current Federal Grid Code (article 62) confirms that PGM in Belgium are required** to remain in operation as long as the normal operational limits on the site are respected.

Therefore, re-energization procedures based on **houeload or islanding capabilities** follow from **legal obligations**. Re-energization procedures based on **black start capabilities** can only be provided **on a contractual basis**.

Considering the design of the restoration plan, at the moment of a blackout the TSO can utilize any re-energization capability present in the system. The presence of houeload operation and islanding capabilities follows from legal obligations, however, and at the moment of a blackout their availability is not certain. Black start capabilities are generally not present in the Belgian system (or limited) if not procured on a contractual basis.

The successful and quick execution of the re-energization procedure smoothens the process and shortens the duration of the restoration of the system to the normal state (and thereby also the societal costs of the blackout). As explained in the report on the determination of needs (part of the “Study on the review of the black start ancillary services”, reference [6]), **the default capabilities present in the system are insufficiently reliable for ELIA to construct a restoration approach. Therefore, ELIA aims to assure the availability of the minimum needed re-energization capabilities via the procurement of black start services.** The amount of contracted services is as result also independent of the presence of other re-energization capabilities in the system (via bottom-up houeload or islanding, or via top-down approaches). **This vision with respect to restoration services is also noticeable at other TSOs. A benchmark study** of the black start service in some European countries shows that houeload operation and islanding are generally not considered as sufficiently reliable for a TSO in the design of a Restoration Plan.

**The restoration services provided on a contractual basis to ELIA will therefore be limited to those using black start capabilities.** The next chapters in this design note explain the specific requirements to offer the service and the modalities for ELIA to procure and use them.

## SUMMARY

For the ancillary service in support of system restoration, as today, ELIA will keep contracting bottom-up re-energization services using a black start capability in correspondence to the minimum identified need. Given the uncertainties on availability at the moment of a blackout, ELIA does not contact restoration services based on houeload operation or islanding capability.

Power Generating Modules (PGM) type C and D are to remain in operation if located in a disconnected island (existing obligation in Belgium and confirmed in the RfG Network

Code). PGM C and D subject to the RfG Network Code are to install houseload operation capability (existing PGM do not have this legal obligation). As explained in this chapter (and more extensively elaborated in the “Study on the review of the black start ancillary services”) the presence of PGM with houseload operation capabilities or islanding capabilities does not affect the number or the terms and conditions of contracted black start services.

### 3. Regulatory and Contractual Framework

The European Network Code on Electricity Emergency and Restoration (NC E&R) elaborates on the measures and services when the system is in the state of emergency or restoration. Part of this is the introduction of the role of Restoration Service Provider and the terms and condition that include the specific characteristics and modalities of restoration services provided on a contractual basis. ELIA adopted these principles in its proposal for the new Federal Grid Code (see Annex 2).

In accordance with the NC E&R, ELIA will submit to the CREG for approval a set of documents on the topics of emergency and restoration by 18 December 2018.

In parallel ELIA will submit the report of a study on black start services performed in 2018 as requested in the incentive set by the CREG (deadline 20 December 2018).

As discussed with the stakeholders during the Working Group System Operation & European Market Design, ELIA has concentrated the public consultation of all the above-mentioned documents in the same period to provide the relevant parties a complete overview of the current situation and the vision for future adaptations (see Table 1 at the end of section 3.1).

The running contractual period for the black start ancillary service will end in December 2020. With the intent to organize the service in the future based on a new design, implementing the new principles of the European guidelines and the conclusions of the “Study on the review of the black start ancillary services” (reference [6]), ELIA in this document proposes the new principles for the future design. After public consultation of the design proposal, ELIA will translate these new principles into a new contractual framework.

#### 3.1. Regulations and contracts

Concretely, the regulatory and contractual framework for the restoration ancillary service will be as follows:

##### European Guidelines and Network Codes

The European Guideline on Electricity Transmission System Operation contains the list and criteria of the system states, including the triggers for the blackout state and restoration.

The Network Code on Requirements for Grid Connection of Generators describes the requirements (whether or not mandatory) for black start, islanding, and resynchronization (houseload operation) capabilities, as well as the conditions under which the member state can impose black start capabilities on a generator.

The Network Code on Electricity Emergency and Restoration elaborates on all topics related to the emergency and restoration states, including mandatory and voluntary services. The terms and conditions for restoration services provided on a contractual basis are to be submitted for approval to the relevant regulatory authority, or another entity designated by the member state.

##### Electricity Law

Article 12quinquies of the current Electricity Law requires an evaluation by the federal regulator CREG of the prices offered for the black start ancillary services. If the prices are deemed to be manifestly unreasonable, then the King can via Royal Decree impose the provision of the service at a certain price for a maximum duration of two years.

## **Federal Grid Code**

ELIA's proposal for the new Federal Grid Code confirms the principles laid down in the European network codes that terms and conditions for restoration services on a contractual basis will be elaborated on in a regulated document.

## **Restoration Plan**

As required by the NC E&R, ELIA creates the Restoration Plan in consultation with relevant stakeholders (significant grid users, (C)DSOs, regulatory authorities, neighboring TSOs and TSOs in the synchronous area) and notifies them as well as the Regional Security Coordinator (CORESO) of the final version and the implementation plan.

One of the measures included in the Restoration Plan involves the use of contracted Restoration Services. The Restoration Plan also includes the determined need for restoration service, meaning "the number of power sources in the TSO's control area necessary to re-energise its system with bottom-up re-energisation strategy having black start capability, quick re-synchronisation capability (through houseload operation) and island operation capability" (art. 23.4 of the NC E&R). The geographic target distribution of the services should, however, be described in the Terms and Conditions to act as Restoration Service Provider.

## **Terms & Conditions for the Restoration Service Provider (T&C RSP)<sup>10</sup>**

Today the contract for the black start ancillary service is signed between ELIA and the Access Responsible Party (ARP) who is also the signatory of the CIPU contract<sup>11</sup> in which the black start units are included.

In the future, the contract between ELIA and the Restoration Service Provider will be included in the Terms & Conditions to deliver the service. As described in article 4.4 of the NC E&R, the characteristics of restoration services are detailed in the Terms & Conditions together with the rules for aggregations and the target geographical distribution of the contracted services.

Starting from December 2018 the Terms & Conditions are to be submitted for approval to the CREG or to another authority designated by the member state, after being publicly consulted with the stakeholders by Elia. The first version of the T&C RSP (consulted at the same time as this design note) will be based on the current black start contract. The next version of the T&C RSP will reflect the design proposed in this note, possibly adapted in response to feedback of the stakeholders during consultation.

## **The rules for suspension and restoration of market activities**

Once the start-up of the black start service succeeds, ELIA continues with the restoration plan and enters a phase of TSO controlled dispatch. During the period of TSO controlled dispatch, ELIA commands generators (with and without black start services) to follow a certain set point of active and reactive power: the modalities for these actions are explained

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<sup>10</sup> The NC E&R also introduces the Terms & Conditions to act as a Defense Service Provider on a legal or contractual basis. This role provides measures activated in the Defense Plan when the system is in emergency state. Re-energization procedures (part of the Restoration Plan) are not activated when the system is in emergency state but when in blackout state. Therefore Restoration Service Providers and Defense Service Providers do not operate in the same situations.

<sup>11</sup> The contract for the "Coordination of Injection of Production Units".

in the restoration plan and in the “Rules for suspension and restoration of market activities”, and will not be included in the T&C RSP.

## SUMMARY

In the future, the Terms and Conditions for the Restoration Service Providers (T&C RSP) will reflect the design of the black start ancillary service. The first version of the T&C RSP will be based on the current black start contract and the current geographical distribution of needs.

The ancillary service contract will be updated in order to be compliant with the new regulation on European and Belgian level. The study of ELIA on the review of the black start needs and the proposal for an updated design (described in this note) as well as the feedback from the public consultation will serve for an update of the T&C RSP.

**Table 1. Overview of E&R related documents and timing of public consultations and submission for approval**

	Public consultation 8/10 – 19/11/2018	Submission to relevant authorities December 2018	Next steps	
<b>Restoration related</b>	Design note on Restoration Services	✓	✓	Translation in new contractual framework: T&C RSP version 2
	“Study on the review of the black start ancillary services” (reference [6])	✓	✓	Implementation in future Restoration Plan and T&C RSP
	Terms & Conditions for Restoration Service Providers (T&C RSP) version 1	✓	✓	Version 2: public consultation and submission to CREG
	Design of Restoration Plan, in compliance with NCER art 23.		✓	Implementation of the approved design by TSO and stakeholders
<b>Other</b>	Terms & Conditions for Defense Service Providers (T&C DSP)	✓	✓	[dependent on the outcome of the steps in 2018]
	Design of System Defense Plan, in compliance with NCER art 11.		✓	Implementation of the approved design by TSO and stakeholders
	Rules for suspension and restoration of Market activities	✓	✓	[dependent on the outcome of the steps in 2018]
	Rules for imbalance settlement during market suspension	✓	✓	[dependent on the outcome of the steps in 2018]
	Test Plan			Design of test plan to be submitted for approval by December 2019

## 4. Target geographical distribution of black start services

As elaborated in the “Study on the review of the black start ancillary services” (reference [6]), ELIA determines a **minimum need of four black start services** to restore the Belgian grid from the bottom up.<sup>12</sup> In compliance with the NC E&R (art. 4.4) the terms and conditions on restoration services must include a description of the target geographical distribution of power sources with black start capabilities.

ELIA **geographically** defines the needs for restoration of the Belgian system after a blackout as follows:

- **1 black start service** is used to restore the **380kV backbone**. The technical requirements related to active and reactive power are set to re-energize the 380kV axis between Doel and Gramme (North East via Van Eyck or South West via Courcelles).
- **3 black start services** are used to re-energize **regional islands** in the North West (following the axis from Zeebrugge towards Mercator), North East (Drogenbos – Zandvliet – Van Eyck – Lixhe), and South (below Drogenbos and Lixhe).
- The backbone service provides a back-up in case a regional service is unavailable.
- The regional services provide a back-up in case the backbone service or another regional service is unavailable.

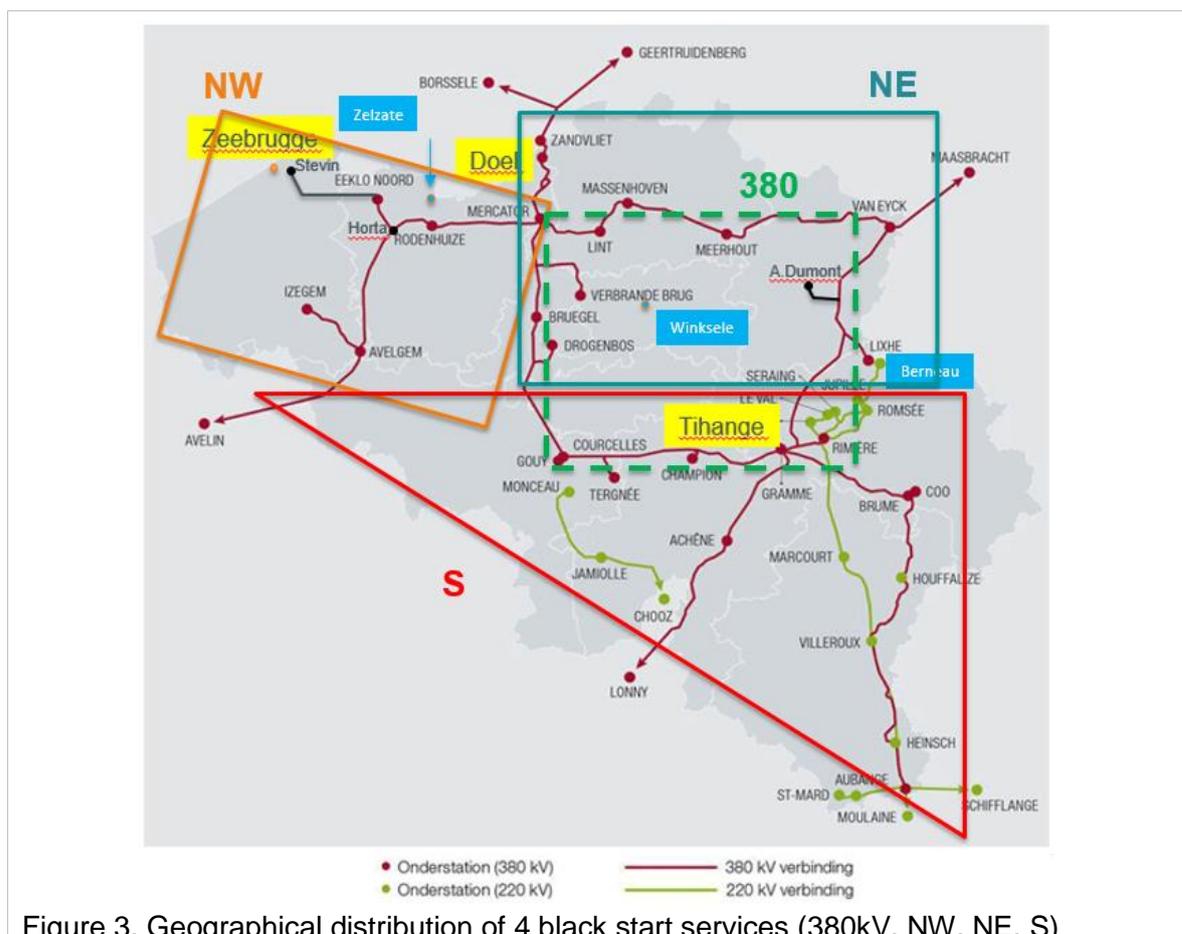


Figure 3. Geographical distribution of 4 black start services (380kV, NW, NE, S)

<sup>12</sup> If insufficient to restore the entire system, ELIA may procure a fifth black start service.

## 5. Technical Requirements to Deliver the Service

This design note elaborates on services that are part of a bottom-up re-energization strategy based on black start capabilities. The capability to re-energize a dead grid is not widely installed because it requires substantial investments in equipment and in operational management. This chapter gives an overview of assets, the components of the service, and the specific technical requirements, and the determination of the availability of the service throughout the contractual period.

### 5.1. Asset types with black start capabilities

The current black start service can only be provided by units subject to a CIPU contract (typically large units connected directly to the ELIA grid). The Network Code on Requirements for Grid Connection of Generators (NC RfG) indicates that the black start capability is technically possible on **PGM type C and D** (articles 15.5 and 16.1), as well as to **AC-connected offshore power park** modules (article 27). The network code for PGM applies also for pump-storage units.<sup>13</sup>

The Network Code on Electricity Emergency and Restoration (NC E&R), however, broadens the assets in scope of restoration services to include **smaller PGM** of type A and B, and also **energy storage units** of the concerned significant grid users can be used, as part of **aggregations of assets** that together deliver the service (see articles 2.1, 2.3, 2.5 and 4.4).

The European codes also refer to **black start capabilities of HVDC systems**: this capability requires that the HVDC can re-energize a busbar on the TSO side that has been struck by a blackout in the assumption that the other TSO side is still re-energized (see article 37 in the HVDC code, see annex 4). It concerns a conditional black start (depending on the system state of the other TSO) in a top-down strategy, and therefore **not the type of restoration service discussed in this document**.

Note that although theoretically possible to self-start, **offshore wind farms are today not capable of delivering a black start service to the TSO** (issue of re-energizing the cable between the offshore platform and the onshore station within the voltage limits). In general, intermittent production is currently insufficiently reliable to meet the technical requirements described in this chapter.<sup>14</sup>

### 5.2. Components of bottom-up re-energization with black start capability

The determination of needs for black start services focuses on the creation of specific restoration paths towards the critical loads in the system. Therefore, the technical requirements include both requirements for the start-up of the unit and requirements for supporting the re-energization of a part of the grid further away from the unit's connection point.

In order to execute a re-energization procedure, the service requires technical capabilities in order to (1) self-start and get the generating site in operation, and (2) operate the generating site to re-energize a dead grid and bring a specific path towards critical loads under voltage.

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<sup>13</sup> Throughout the design note the term "PGM" will further include AC-connected offshore power park modules and pump-storage units without making the distinction unless if relevant.

<sup>14</sup> For an elaboration of the readiness of different production types to deliver black start services, see the ELIA study from 2018 (reference [6]).

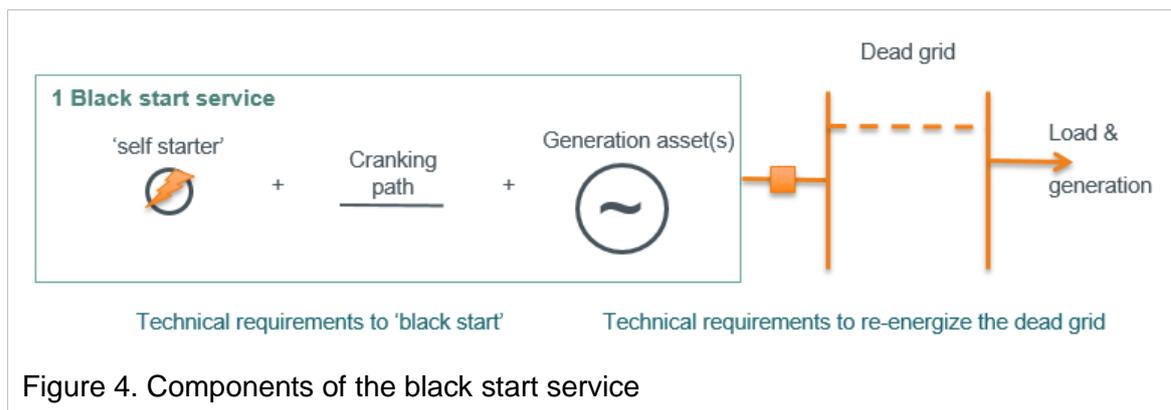


Figure 4. Components of the black start service

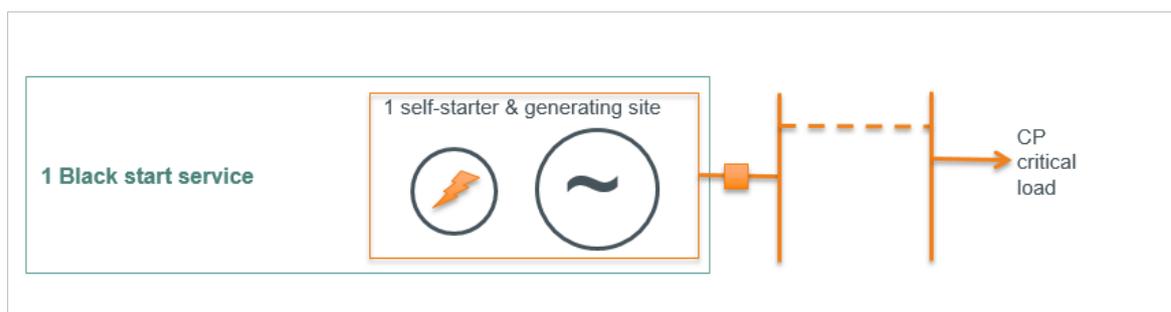
In essence, a restoration service based on black start capability consists of 3 components (see Figure 4):

1. The **black-starter or self-starter (e.g., diesel generator or battery)**, i.e., an asset that can start up without supply from the grid. The self-start must be able to start-up the auxiliaries of a larger generating unit. The power needed is usually relatively small (a few MW).
2. The **cranking path between the self-starter and the main generating unit(s)**. The self-starter may be located on the same site as the unit (no cranking path), or on a different site (requiring a part of the TSO/CDSO/DSO-grid to make the connection).
3. The **main generating site**, which actually re-energizes the grid and thereby concretely delivers the black start service. The generators' capabilities must be strong enough to deal with the MW and Mvar flows of the restoration. The generating site may consist of 1 or more power and storage units.

A service may even consist of an **aggregation of sites**, with the self-starter site located behind a different connection point than the generating site, and possibly even a medium-sized generating site in between. Figure 5a illustrates some examples of allowed configurations. Assets in an aggregation must, however, operate in a similar way to a single power unit providing a restoration service, and thereby as a whole conform to the technical requirements described in this chapter. When offering the service to ELIA, the Restoration Service Provider must demonstrate the feasibility of a cascaded black start service based on a study. ELIA (or other relevant system operators involved) will give the provider the list with criteria that must be proven and if needed information of the grid to perform simulations.

As aggregations would require the use of a part of the grid (ELIA grid or a (C)DSO grid) the proposed service would (even more than other service proposals) be subject to a study and approval of the relevant system operator(s).

ELIA will not accept configurations with one self-starter site re-energizing more than one generating site behind different connection points (as depicted in figure 5b) as this would add too much complexity in coordination at a critical moment.



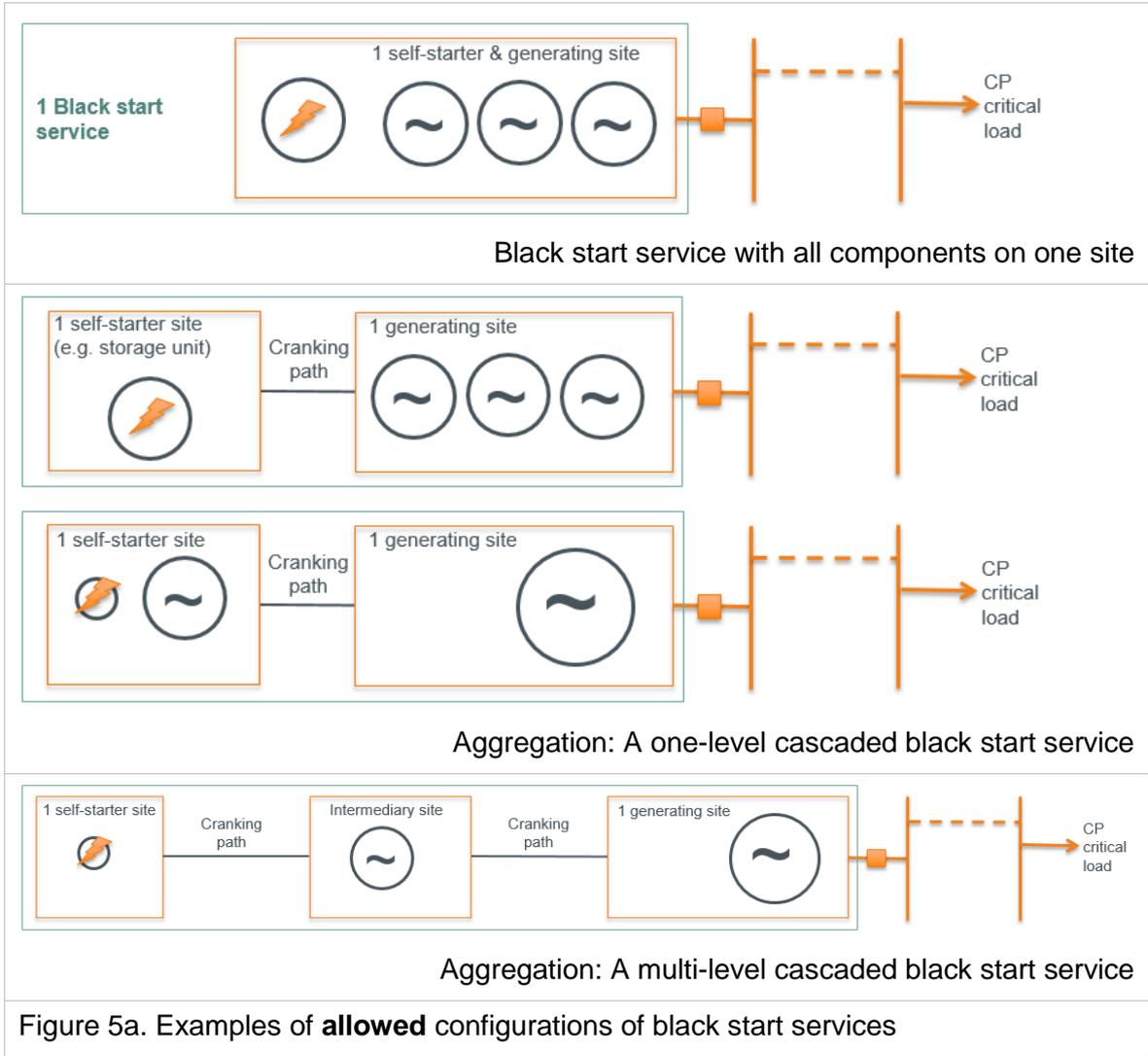
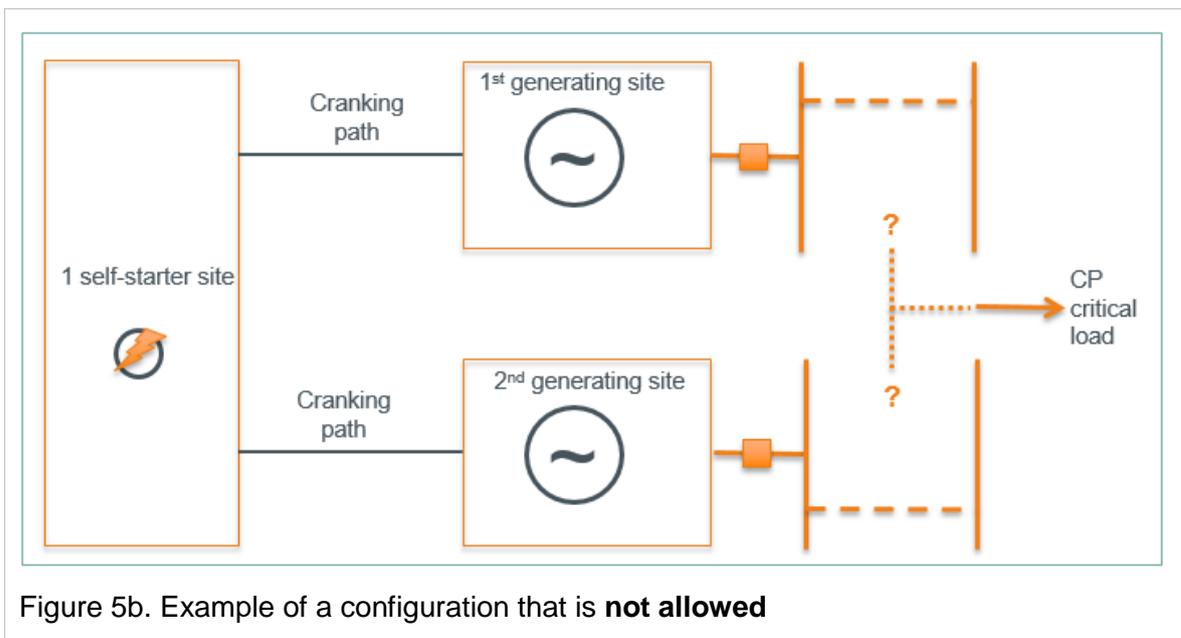


Figure 5a. Examples of **allowed** configurations of black start services



### 5.3. Minimum technical capability requirements

During the first phases of restoration and re-energization procedures, the conditions of the (dead) grid and potential instability when restarting, call for **stringent requirements with respect to the technical characteristics of assets contributing to the restoration**. These technical requirements are listed in this section. Most technical requirements are defined for the service as a whole; some are explicitly specified for the self-starter site.

The Network Code RfG list some requirements for assets with black start capability. The more extended list of requirements set by ELIA is explained below.

#### Network Code on Requirements for Grid Connection of Generators

##### Article 15.5 on black start capability requirements for PGM type C (and also applicable for type D)

- (iii) a power-generating module with black start capability shall be capable of starting from shutdown without any external electrical energy supply within a time frame specified by the relevant system operator in coordination with the relevant TSO;
- (iv) a power-generating module with black start capability shall be able to synchronise within the frequency limits laid down in point (a) of Article 13(1) and, where applicable, voltage limits specified by the relevant system operator or in Article 16(2);
- (v) a power-generating module with black start capability shall be capable of automatically regulating dips in voltage caused by connection of demand;
- (vi) a power-generating module with black start capability shall:
  - be capable of regulating load connections in block load,
  - be capable of operating in LFSM-O and LFSM-U, as specified in point (c) of paragraph 2 and Article 13(2),
  - control frequency in case of overfrequency and underfrequency within the whole active power output range between minimum regulating level and maximum capacity as well as at houseload level,
  - be capable of parallel operation of a few power-generating modules within one island, and
  - control voltage automatically during the system restoration phase;

#### Equipment

- Automatic system whereby each of the assets of the black start service guarantees a stable and coordinated contribution to the service.
- Voltage regulator in order to regulate voltage and reactive power both automatically and manually.
- Speed regulator that can control the frequency for each of the assets used to provide a restoration service:
  - o With a static error of less than 10 mHz. It must be possible for the normal power control and this frequency control to be used without there being an insensitive zone in respect of the frequency measured. It must be possible for

the frequency set-point under steady state operating conditions to be controlled within the aforementioned range.

- Based on a droop, the adjusting slope of which can be set at between 2 and 12 % and the dead band of which can be set at between 10 to 200 mHz

The generating assets must be able to shift operational model using one or other of the speed regulator operating modes.

- Synchronoscope, the operation of which must be possible to bypass during paralleling.
- A single interface with ELIA so that ELIA can clearly monitor in real-time the status of the asset(s) included in the service.
- In accordance with NC ER article 41 the RSP must assure the installation of a voice communication system with sufficient equipment redundancy and backup power supply sources for at least 24 hour. This requirement is valid for all communication between the different sites of a cascaded black start service. The system should therefore provide a link between ELIA's national or regional dispatching center and the control room of the generating site, or between the different sites included in the service. For communication with PGM smaller than 25MW, ELIA may agree to a data communication system instead of a voice communication system if the RSP can assure service quality in the offer.

### Block load

The generating unit should be capable of instantly accepting an offtake of at least 10 MW (with a  $\cos \phi \geq 0.8$  inductive):

- without the frequency of the island deviating from the 47.5 - 51.5 Hz range (for a time of operation period of 30 minutes or more), even temporarily;
- without the voltage at the connection point being lower than the shaded operating range indicated in figure 6, even temporarily;
- able to cover the temporary currents and voltages at the connection point arising from the restoration of power to the elements mentioned above.

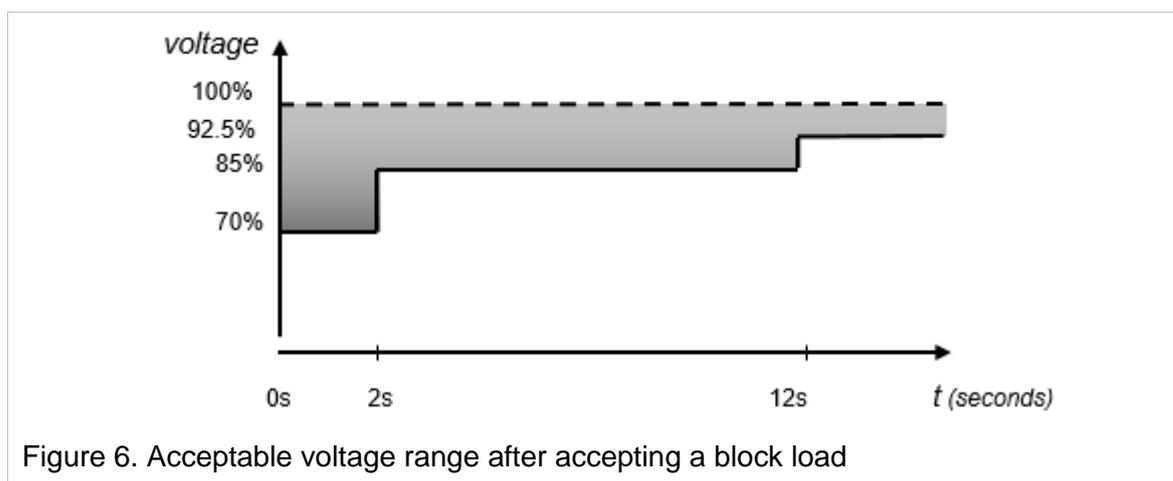


Figure 6. Acceptable voltage range after accepting a block load

### Reactive power absorption capability

The assets used to provide a black start service must be able to handle the connection of grid elements generating a significant amount of reactive power under low loaded operating conditions and be able to absorb the reactive power generated by the grid elements during restoration. The "Study on the review of the black start ancillary services" (reference [6])

indicates that the current requirement of 30 Mvar absorptive capability might be too low in some regions and for some re-energization procedures. The Mvar absorption requirement in the zone may, however, also (partly) be covered by shunt reactors installed by ELIA for purposes of grid development, which would allow to reduce the absorption requirement for the specific black start service contracted in the concerned zone.

In the future, an indicative reactive power absorption capability of minimum 50 Mvar is required, although depending on the location of the service this may still be insufficient. Therefore, the acceptability of the offer would depend on the results of a simulation study performed by ELIA verifying whether an offered black start service can perform the restoration procedure in the zone (i.e., re-energization of critical loads and non-black start units).

### **Active power requirements**

As explained in the chapter on the determination of restoration needs in the “Study on the review of the black start ancillary services” (reference [6]), the main goal of a specific black start service is to re-energize the critical connections. This includes energizing high priority significant grid users and the auxiliary services for starting non-black start production units. Also an active power margin must remain available to compensate for grid losses and to cope with the fluctuations in offtake of reconnected grid users. Based on the estimated active power needs for a specific restoration path, ELIA will set requirements with respect to installed capacity (or minimum storage volume) in accordance to the determination of needs as described in the restoration plan. .

### **Fuel supply**

The requirement on installed capacity alone is insufficient. The necessary fuel must be available to assure that the needed power can be produced.

Once the voltage has been restored (on the high voltage side of the step-up transformer), the service must remain in a position to operate for at least 24 hours whilst being subject to offtake fluctuations. There must be sufficient supply of fuel to start the service and last in operation.

For gas-driven power units ELIA must have the guarantee that there is no clause in the contract with the gas provider that permits gas supply interruptions.

Pump storage plants are used in many European countries for black starting the system. Soon after their startup, non-black start units are synchronized along the restoration path to prevent exhausting the stored water volumes at the pump storage plant. The requirement for maintaining 24-hour operations is not applicable to pump storage plants. ELIA will nonetheless set a requirement on minimum stored energy volumes (MWh) specifically for the restoration scenario for which it would be contracted.

For all other types of fuel, a stock of fuel in situ is required to enable the main generator to remain in operation for three consecutive days at full power.

### **Timing**

The assets used to provide a restoration service must be able to execute the re-energization procedure at least three times consecutively in order to cover a potential collapse of the island during the start-up of the service or later during the grid restoration phase.

The time between the request of ELIA to launch the black start service and the time when the main generating site is available to accept load (the “start-up time”) must be equal to or less than

- 1,5 hours if the main generating site was operating just before the blackout occurred ('hot start')
- 3 hours if the main generating site was not in operating mode just before the blackout occurred ('cold start')

### **Specific requirements for the 'self-starter site'**

The relevance of the requirements listed below depends on the configuration of the black start service. In case the self-starter is, for example, a diesel generator on the site of the main generating unit, then ELIA does not specify requirements for the diesel generator itself. In other cases, however, where the self-starter is located on another site, then additional requirements may be necessary to include in the contract. If units or paths on a CDSO or DSO grid are involved, the requirements should be set in agreement between the RSP, ELIA, and the relevant system operator.

#### **Reactive power absorption capability**

The start-up and re-energization of a cranking path to reach the main generating unit may require a certain Mvar absorption capability. The RSP must specify this in the offer made to ELIA; ELIA will verify the value in a simulation study to determine the acceptability of the offer.

#### **Energy requirement**

The self-starter needs a minimum supply of primary energy to start-up without energy offtake from the external grid. If there is a risk that this requirement is not met at all times—for example, when the self-starter is a battery that is also included in a contract for balancing reserves—then a minimum energy volume (MWh) for the black start service must be contractually agreed on and monitored.

The energy requirement on the self-starter depends on the dimensioning of the auxiliary of the generating site included in the black start service. Therefore, the RSP must determine the minimum energy volume needed to assure availability of the entire service when offering to ELIA. The RSP must show this to ELIA based on a feasibility study. ELIA will verify whether the offered service complies with the objectives of the restoration plan. Based on the simulation study ELIA decides on the acceptability of the offer. The final value for the selected service will be formalized in annex to the contract.

## **5.4. Technical availability of the service throughout the contractual period**

The core philosophy of the contract for black start services is to ensure readiness for restoration if needed. The focus is therefore on the availability of the service.

As one black-start restoration service consists of different components and specific requirement, the availability of the service depends on the availability of each of these components.

**The following aspects affect the availability status of the service as used in the settlement of the contract:**

- I. The availability of the generating site
- II. The availability of the self-starter site

- III. The availability of stored energy volume needed for the restoration procedure (not in each contract)

All three components must satisfy the availability requirements for ELIA to recognize the restoration service as a whole as available.

If a service contains a cranking path between the self-starter site and the generating site that uses a part of the TSO/CDSO/DSO-grid, then the RSP will not be held liable for the unavailability of the path. The unavailability of the cranking path will however be taken into consideration in the coordination of outage planning.

ELIA monitors via the Outage Planning procedure the availability across black start services. **Maximum 1 contracted black start service will be allowed to be in planned unavailability at a particular moment.**

- If more than 1 black start service provided by the **same RSP** is in planned unavailability, then ELIA will command **the RSP to arrange an amendment** of the outage plan without compensation. The Outage Planning Agent and the RSP have to coordinate among them (directly or via the grid User).
- If more than 1 black start service provided by **different RSP** is in planned unavailability, then **ELIA will request to the concerned Outage Planning Agent(s) an amendment** of the outage plan for 1 or more of the concerned power units in accordance with the T&C for the Outage Planning Agent. ELIA will remunerate the Outage Planning Agent if required.

Also the change of the status of a black start service to 'unavailable' following a forced outage or a failed test (see chapter 9) would imply changing the maintenance planning of another black start unit if necessary and if feasible.

#### **5.4.1. The availability of the generating site**

ELIA uses the information provided by the Outage Planning Agent to monitor and coordinate the availability of the power units.

ELIA determines the availability status of the black start service for day D ex post based on the real-time outage information valid on day D (info per quarter-hour).

##### **Availability status**

For the black start service to be available, the status of the power units must be "available" or "testing" when the test serves as a compliance test in execution of the black start contract.

##### **Active power capability restrictions**

Even if the status of a power unit is available, its active power capability may be restricted. Given the technical requirements for a minimum power level to be produced when executing the black start service, the active power capability restriction may affect the availability of the restoration service.

Although via the outage planning procedure ELIA may have information on availability on power unit level, ELIA may determine the availability of the service on PGM (or power plant) level.

For example:

- A CCGT consisting of two gas turbine and a steam turbine may be able to provide a black start service as long as one gas turbine is in service. Therefore, a planned maintenance on the steam turbine does not affect the availability assessment of the restoration service on the CCGT. The RSP can plan a maintenance of the gas turbines sequentially, thereby assuring that always one of the two gas turbines is available to guarantee the availability of the black start service. Each gas turbine serves as a back-up for the other.
- However, a black start service making use of a smaller CCGT that requires the installed capacity of both gas turbines in order to respect the requirement on minimum active power will be considered as unavailable if one of the gas turbines is unavailable.

The rules for availability assessment of the generating site of a particular black start service (minimum number of power units, available installed capacity) are formalized in annex to the contract between ELIA and the RSP.

The same rules would apply on intermediary generating units or sites used in case of a cascaded black start service.

#### **5.4.2. The availability of the self-starter (black start capability)**

Even when the main generating site is available, the capability to perform the black start may not be (e.g., the storage unit or the diesel generator needed to black start may be in maintenance or defect).

If the self-starter unit is not subject to obligations for outage planning, the RSP is responsible for, without delay, informing ELIA of the unavailability (planned or unplanned) of the black start capability.

#### **5.4.3. The availability of minimum stored energy volume**

As explained in the technical requirements, the execution of a re-energization procedure may require some assets included in a black start service to maintain a minimum stored energy volume at all times. Without the stored energy, the service could not be used at the moment of a blackout. This is typically a requirement when (pump) storage units are involved.

Pump-storage units can only execute a re-energization procedure provided that the upper forebay contains sufficient water. Batteries can only do so given a minimum state of charge. As the energy volume fluctuates throughout the day depending on the production scheme of the unit, the availability assessment of the black start service requires a day-to-day monitoring of the available energy volume.

The minimum stored energy volume required for the black start service (whether on the level of the generating site or of the self-starter site) will be formalized in annex to the contract between ELIA and the RSP.

## SUMMARY

The technical requirements call for the use of large generating sites for the delivery of black start services but the new design (in response to the new European network codes) creates the potential to aggregate assets to achieve the same objective.

Many technical requirements are applicable to all services (e.g., installment of specific equipment), but some requirements are related to a specific restoration path. Values on the active power installed capacity, reactive power absorption capabilities, and energy volumes are to be defined in detail in the contract between ELIA and the RSP.

A centralization of the different components of the black start service behind one connection or access point reduces the complexity of the service. The future production park will however be more decentralized. Therefore, in the new design ELIA would allow the proposal for black start services using a self-starter and a main generator that are not located behind the same connection point.

A restoration service is available in case all its components are available: the self-starter, the generating site (incl. availability of the minimum active power capability), and (if required) a minimum stored energy volume. As ELIA contracts services to cover the minimum need, ELIA monitors that maximum one black start service is not available at a time.

## 6. Responsible Party: Restoration Service Provider (RSP)

The signatory of the service contract with ELIA is the **Restoration Service Provider (RSP)**, as introduced by the NC ER. This section elaborates on the role of the RSP: how an entity is assigned as RSP, its responsibilities, and possible interdependencies with other roles (such as the Outage Planning Agent).

### 6.1. The role of Restoration Service Provider

#### European Network Code on Electricity Emergency and Restoration

**Definition (2) - ‘restoration service provider’** means a legal entity with a legal or contractual obligation to provide a service contributing to one or several measures of the restoration plan;

**Article 2.4.** Type A and type B power generating modules referred to in paragraph 3 [i.e., non-significant grid users], demand facilities and closed distribution systems providing demand response may fulfil the requirements of this Regulation **either directly or indirectly through a third party**, under the terms and conditions set in accordance with Article 4(4) [i.e., “The terms and conditions to act as defence service provider and as restoration service provider ...].

#### ELIA Proposal for the new Federal Grid Code (Dutch version)

Afdeling VI.I.II. - Ondersteunende diensten voor herstel

Art. 253. § 3. De hersteldienst wordt rechtstreeks **geleverd door de netgebruiker** die aan die dienst deelneemt in de hoedanigheid van aanbieder van hersteldienst zoals bepaald in artikel 2§2 van de Europese netcode E&R **of via aan derde** die in dat geval aanbieder van hersteldienst is volgens een aanduidingsprocedure die beschreven staat in de modaliteiten en voorwaarden bedoeld in artikel 252§2 van dit besluit.

Restoration services are to be offered and provided by a **‘Restoration Service Provider’ (RSP), a new role introduced in the NC E&R.** The European Network Code does not explicit additional rules or limitations regarding the appointment of the RSP. The code does acknowledge the potential involvement of a third party (other than the grid user or owner of the asset) to deliver the service. The involvement of a third party may be particularly useful when the service is provided by an aggregation of several assets (therefore possibly of different grid users), a situation which is even more likely to occur (but not only) in case the aggregation includes smaller assets.

**The role of the RSP can therefore be taken on by the grid user or by a third party with the agreement of the grid user(s) of the asset(s) involved.** This is also reflected in article 253 of ELIA’s proposal for the new Federal Grid Code. Note that the restoration service can include multiple assets, potentially belonging to different grid users, in which case the RSP is a type of ‘aggregator’, leading a ‘consortium’ of grid users to perform the service.

## 6.2. The appointment of Restoration Service Provider

A grid user RSP can offer restoration services to ELIA directly. A third party RSP offering restoration services to ELIA must do so in agreement with the involved grid user(s):

- The offer of restoration services to ELIA must include an approval by the grid user(s) of the asset(s) included in the service.
- If ELIA contracts the service, the T&C RSP must be signed by the entity taking on the RSP role. In case the RSP is a 3<sup>rd</sup> party, the signed agreement of the grid user(s) of the included assets will be added to the contract.

In current national or European legislation, there are **no general obligations to have the black start capability installed** for existing or for future assets. In the general case, only contracted assets need to fulfill the requirements for the service. **Thereby, the RSP is only appointed when the service is actually being offered and/or contracted.**

The NC RfG indicates one exception for future assets: in case of insufficient availability of restoration services in the system and therefore, to ensure system security, **the member state can on case basis impose the installment of a black start capability**. The obligation for the technical capability therefore **also implies the obligation to offer the service to the TSO<sup>15</sup>**. The legal obligation has no influence on the terms and conditions of service provision (for example, technical requirements, availability requirements, remuneration and penalties).

### Network Code on Requirements for Grid Connection of Generators

**Article 15.5.** Type C power-generating modules shall fulfil the following requirements relating to system restoration:

(a) with regard to black start capability:

(i) black start capability is not mandatory without prejudice to the member state's rights to introduce obligatory rules in order to ensure system security;

(ii) power-generating facility owners shall, at the request of the relevant TSO, provide a quotation for providing black start capability. The relevant TSO may make such a request if it considers system security to be at risk due to a lack of black start capability in its control area;

[The same applies for PGM type D (art. 16)]

[Point (ii) also applies for HVDC: see art. 37 of the European Network Code on Requirements for Grid Connection of High Voltage Direct Current Systems and Direct Current-connected Power Park Modules]

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<sup>15</sup> Logically if for reasons of system security the technical capability is legally imposed this would imply a shortage of offers and thereby the legal obligation would automatically result in the actual provision of the service. This may however change over the lifetime of the involved asset; if the availability of restoration capabilities in the system would increase the obligation to offer the service may (or may not) persist but not automatically lead to a selection for a contract.

### 6.3. Interdependencies with other roles

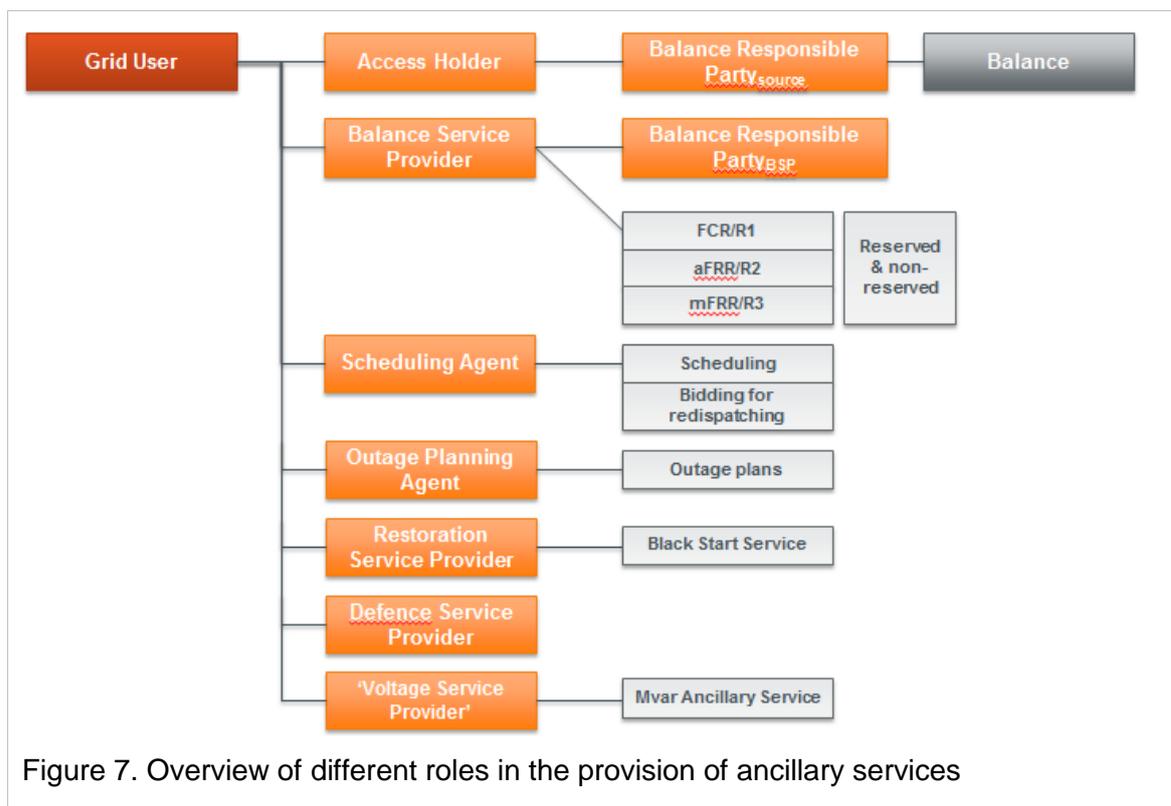


Figure 7. Overview of different roles in the provision of ancillary services

As explained in the note on “Future Roles and Responsibilities for the Delivery of Ancillary Services” (reference [7]) the same or different entities can provide different ancillary services to ELIA, the RSP being one of them. The grid user is responsible to coordinate among them.

**With respect to the provision of restoration service ELIA has detected no critical interdependencies or conflicts between the roles** that would require ELIA to add specific criteria for the delegation of the RSP role to a 3<sup>rd</sup> party. There is no reason to oblige or object to the merge of the RSP role with other roles taken on by the same entity.

**There are nonetheless some interdependencies between the RSP and other roles in the delivery of the services, as listed in the overview below.** The interdependencies between the RSP and other roles mostly concern an impact on the availability of the service. During execution of the Restoration Plan, most responsibilities are suspended and ELIA controls the dispatching of production and load to restore the system. Therefore, typically the other roles are not active at the time that the restoration services are being executed. The coordination with the different roles in the period of restoration is described in the *Restoration Plan* and in the *Rules for Market Suspension and Restoration*.

Note that as long as the CIPU contract is used (pre-iCAROS<sup>16</sup> implementation), for units subject to a CIPU contract the same entity takes on the roles of the Balance Responsible Party (BRP), Balancing Service Provider (BSP), Scheduling Agent, Outage Planning Agent, Voltage Service Provider, and (in case of a black start contract) the Restoration Service Provider. The change from CIPU to the iCAROS framework (and the timing) does not immediately pose issues for the implementation of the new black start design.

<sup>16</sup> iCAROS (Integrated Coordination of Assets for Redispatching and Operational Security) aims to develop a new EU Network Code compliant approach for the coordination of assets for system operations & market procedures

<p><b>Balance Responsible Party (BRP)</b></p>	<p>No BRP balancing responsibility when the markets are suspended in accordance with the “rules for suspension and restoration of market activities” (which is the case when in blackout).</p> <p><i>During test: unit not available for self/reactive balancing. No correction by ELIA of the BRP perimeter due to limited impact in terms of injected active power.</i></p>
<p><b>Balancing Service Provider (BSP)</b></p>	<p>During activation of the restoration plan there are no balancing activations (market suspension), but flexibility may be used for system &amp; load restoration (measures of the restoration plan).</p> <p><i>During test: no balancing bids</i></p>
<p><b>Outage Planning Agent</b></p>	<p>Availability status provided by the Outage Planning Agent determines the availability and therefore the settlement of the restoration service.</p> <p>ELIA may request an amendment to the outage planning to avoid simultaneous unavailability of black start services.</p> <p><i>During test (type 1-4, see chapter 9): Availability status “Testing”.</i></p>
<p><b>Scheduling Agent</b></p>	<p>During execution of the restoration plan DA/ID markets are suspended (“TSO controlled dispatch”). No role for the Scheduling Agent while the RSP is executing a re-energization procedure.</p> <p><i>During test: no schedule or redispatching bids</i></p>
<p><b>Voltage Service Provider</b></p>	<p>ELIA controlled dispatch (of both active and reactive power) during restoration state.</p> <p><i>During test: unit not available for voltage regulation services</i></p>
<p><b>Defence Service Provider (DSP)</b></p>	<p>DSP active during execution of the Defence Plan, not during execution of the Restoration Plan.</p> <p><i>No tests for restoration services when defence plan is activated and the DSP is active.</i></p>

## 6.4. Requirements for the Restoration Service Provider

### 6.4.1. General requirements

Any RSP offering black start services must abide the general requirements for market entities taking on a role in the provision of ancillary services to ELIA (qualification procedure). This means:

- give proof of a sound financial and economic situation
- fulfilment of the obligations related to the payment of social security contributions in accordance with the legal provisions
- fulfilment of the obligations related to the payment of taxes in accordance with the legal provisions
- situation of non-bankruptcy
- Graydon > 1 or Multiscore (for Belgium) > 20

The qualification must be proven when the RSP submits its candidacy for service delivery to ELIA and must remain throughout the contractual period. The RSP must without delay inform ELIA when the grounds for its qualification change.

### 6.4.2. Specific requirements

Specifically for the provision of restoration services, the RSP must respect the requirements listed below.

Most importantly, during execution of the restoration plan ELIA must be able to coordinate with the parties having control over the unit when in blackout and restoration state. This party must not be the RSP but it is the responsibility of the RSP to assure the correct provision of the service during the contract period and the correct and efficient activation of the restoration service at the time needed.

When offering the service to ELIA and, if selected, throughout the contractual period the RSP engages to take on the following responsibilities. For a new contracted capability, compliance will be verified through the organization of a prequalification test before the start of the contract. The requirements are as follows:

- assure **compliance of the black start service offered by the RSP to the technical requirements** as stipulated by ELIA (see Chapter 5)
- have the **agreement of the grid users** of the assets utilized to provide the service to ELIA, formalized in the RSP's offer to ELIA as well as in annex to the contract between ELIA and the RSP when selected
- assure (direct or via the grid user) a **correct coordination with other roles** and providers appointed on the assets utilized to provide the black start service to ELIA (e.g., Outage Planning Agent, Scheduling Agent)
- without delay **inform ELIA of the technical unavailability of the self-starter** utilized to provide the black start service (e.g., unavailability of a diesel 'black start' generator does not necessarily imply an unavailability of the PGM) (see Chapter 5)
- assure **available online and offline communication** channels to be able to deliver the service, as stipulated by ELIA
- assure the **availability of human resources** in accordance with the availability requirements of the contract (considering the unforeseeable character of a blackout,

this means 24/7 availability of human resources to respond to ELIA signal to start-up the black start procedure)

- assure the **required training of personnel** to be able to deliver the black start service and follow the instruction of ELIA and assure that personnel has the necessary means available on-site to deliver the service (e.g., 'Blackout' and 'Black Start' procedures)
- provide **documentation** at the request of ELIA, such as, a detailed description of behaviour of the assets included in the black start service under steady state and transitional operating conditions, an up-to-date version of a technical questionnaire, 'Blackout' and ' Black Start' procedures
- assure the **organization of prequalification tests** in coordination with ELIA prior to entry into force of the contract as stipulated by ELIA (see Chapter 9)
- assure the **organization of compliance tests** in coordination with ELIA during the contractual period as stipulated by ELIA (see Chapter 9)

## SUMMARY

The NC E&R introduces the role of the Restoration Service Provider (RSP). The grid user directly takes on the RSP role or a third party RSP does, in approval with the grid user(s) of the concerned asset(s). The RSP role is appointed in the procurement phase.

The RSP is responsible for assuring a proper execution of the terms and conditions for availability of the service, for tests, and for activation.

There are limited interdependencies between the RSP and other roles. An entity is allowed to combine the RSP role with other roles in the provision of ancillary services.

## 7. Procurement of the black start service by ELIA

Contrary to the current Federal Grid Code, ELIA's proposal for the new code does not impose a specific procurement method but refers to the Terms & Conditions for the RSP where the procurement method will be formalized.

### ELIA Proposal for the new Federal Grid Code (Dutch version)

Afdeling VI.I.II. - Ondersteunende diensten voor herstel

Art. 252. § 2. De transmissienetbeheerder bepaalt op transparante en niet-discriminerende wijze in de modaliteiten en voorwaarden van toepassing op de aanbieders van hersteldiensten, [...], de voorwaarden voor deelname alsook het mechanisme om deze diensten op te stellen [...].”

This chapter describes the drivers and the proposal of ELIA for the organization of the procurement of black start services. Several aspects support a procurement based on a public call to participate to the service giving ELIA the opportunity to discuss possible black start services with candidate providers. Those same aspects call for a non-straightforward selection of the potential black start services by ELIA. The chapter further gives a closer look on the offer of a service with respect to period and price, and on the timeline of the entire procurement process. Finally the chapter explains the circumstances in which participation to the service may be obliged, and the rules in case of premature ending of the contract.

### 7.1. Determining factors for black start procurement method

Compared to other ancillary services, the black start service shows some peculiarities that support a midway solution for a procurement that is neither mandatory nor fully market based.

- **Legal framework:** There is no general obligation on PGM for the installation of black start technical capabilities. The member state can only impose the installation for reasons of system security (RfG article 15.5.a).
- **Technical characteristics:** The technical requirements for black start services are **substantial**.

There are **no intrinsic incentives** for producers to install the capability without the prospect of cost recovery via a service contract.

The amount of assets (potentially) equipped to deliver the service is limited to **large assets or large aggregations** of smaller assets.

An asset with a self-starting capability does not by default satisfy the needs of ELIA, for example, in terms of geographical distribution or **possibilities to create a useful re-energization scenario**.

- **Definition of needs based on restoration approach (backbone/zonal) and purpose of the restoration plan (targets for critical loads):**

‘Geographically’ defined needs further **limit potential candidates** per target area and influence the **specific technical requirements** (as dependent on the target area).

**The comparison of potential candidates is not straightforward** as dependent on the exact location and technical capabilities of the offer (e.g., an asset with a further electrical distance from a critical load should be able to absorb more reactive power).

- **Societal impact:** The costs of the black start services need to be weighed against the costs of a blackout.

**It may be useful** to have **more technical capabilities** in the system than strictly needed.

Consequently, the black start service in Belgium cannot rely on general obligation (for technical capability or for service provision). However, the technical and locational characteristics also prevent the use of a purely market based procurement mechanism:

- The number of potential suppliers is limited with a risk of concentrated market power.
- The service is non-standardized (given the customization to the specific location and restoration path). Beside the price, technical aspects are considered in the selection.

The ideal procurement of black start services allows RSPs to respond voluntarily to a public call of ELIA to express interest in participation to the service (a public, transparent procedure) while allowing ELIA to set certain requirements on case-by-case basis and to make a selection among the offered services that best cover the needs in the most efficient way, both from an economic as from a technical perspective.

## 7.2. Setting technical requirements before and during the procurement procedure

When launching a call for participation, the most critical information for potential candidates concerns the terms and conditions for the service and a description of the need for ELIA, in this case the zones for which ELIA searches a restoration.

The **Terms & Conditions to act as Restoration Service Provider** are publicly consulted and submitted for approval to the designated authority. Therefore they are publicly known before starting a new procurement round.

Although the T&C RSP define the minimum requirements, the possibility to restore the grid using a specific offered black start service will have to be confirmed based on a simulation study of the offered service during the procurement phase. **The result of the simulation study may be that for an offer to be labelled as ‘acceptable’ specific technical requirements are defined on case-by-case basis.**

Concretely, most technical requirements listed in chapter 5 are fixed and not subject to case-by-case review, all except:

- **The principle of cascaded black start services:**

A black start service may consist of different sites, requiring the use of a public cranking path between them. ELIA cannot clearly define general requirements in the terms and conditions to assess the acceptability of offers with such a construction. The RSP must show the feasibility of the service to ELIA when offering. ELIA will then evaluate the potential of the offered service to contribute to system restoration, together with other relevant system operator(s) if the cranking path would make use of non-ELIA grids.

- **Reactive power absorption capability:**

The reactive power absorption capability is determined in consideration of the grid that must be re-energized. The longer the electrical distance between the black start service and the critical connections (kilometers of cables or lines), the more reactive power is produced by the grid and therefore the higher the reactive power absorption capability required by the black start service. A restoration path existing of cables also requires more reactive power absorption capability by the black start service than a

restoration path consisting of overhead lines. Shunt reactors or other compensation devices can mitigate the reactive power absorption requirements by the black start service.

The precise required reactive power absorption capability of a specific black start service therefore depends on the location of the unit. ELIA will set a minimum requirement of 50 Mvar in the T&C RSP but during procurement phase ELIA will perform a simulation study for each offered service to verify whether the service can be accepted or whether this requires setting a higher value for reactive power absorption capability in order to reach the objective of the restoration plan. If the final offer does not comply with this higher set value, ELIA has the right to label the offer as non-acceptable. The final value for the selected service will be formalized in annex to the contract.

### 7.3. Public procurement procedure

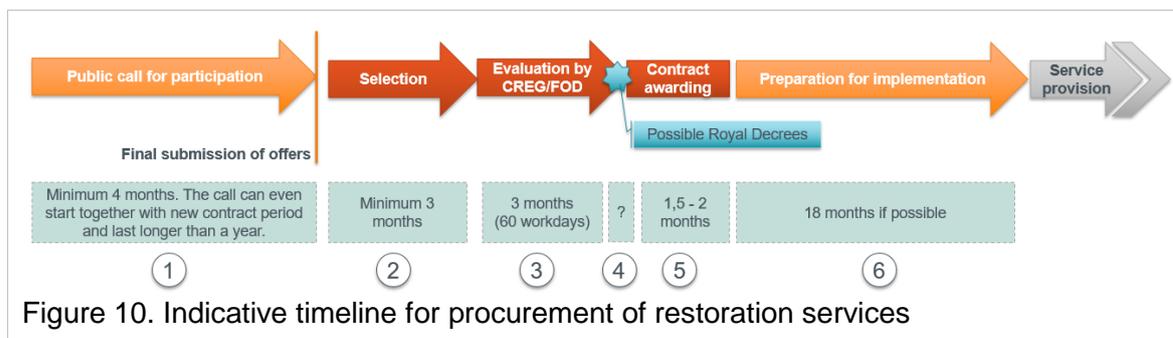
When ELIA plans to procure restoration services, ELIA will launch a public call for expression of interest to participate. A new procurement process needs to be started in the following situations:

- i. The foreseen end of the running contract period may create opportunities for new providers, but the result may also be that the current provider again gains the contract for a next period.
- ii. Premature ending of the running contract, for example due to the unexpected decommissioning of the site currently providing the service.
- iii. Increased needs for restoration service, requiring the additional procurement of the service.

ELIA should have the right to negotiate a contract bilaterally without the organization of a public call in case of urgency, for example if the running contract ends prematurely due to an incident (rendering a service unavailable immediately) or due to the failure of tests (as explained in chapter 9).

The entire duration between the public call for participation and the start of service provision should allow sufficient time for both ELIA and the RSP candidates for preparing and evaluating offers, for acquiring the necessary permits, and for implementing the operations and capabilities needed for the service. This is especially the case for services based on new black start capabilities yet to install. For services using existing capabilities, especially those under contract in the previous contract period, not as much time is needed. The entire process is illustrated in figure 10.

ELIA may start the procurement process for the next contract period shortly after the start of the running contract period, as the need for the service is sufficiently stable through time.



## 1. Public call for participation: RSP candidacies and offers (minimum 4 months)

ELIA launches a call for expression of interest for restoration services.

When launching the public call, ELIA shares the following information:

- Terms & Conditions for the Restoration Service Provider
- Start date of the service
- The locational boundaries (1 or more zones for which ELIA wants to contract a black start unit)
- Indicative target contract period
- Criteria for the selection of the restoration service(s), reflecting the goal of procuring the optimal black start service in terms of both economic and technical elements

The **RSP has at least one month time to send to ELIA its candidacy** and a list of possible services and included assets. The RSP must have the agreement of the grid user(s) of the assets included on the list. The list must contain only complete service proposals, meaning all components of the black start service (self-starter site, cranking paths, possible intermediary sites, and the main generating site) must be included. The RSP must demonstrate permission from the relevant system operator(s) for the use of the grid(s) in a service proposal to respond to the public call for participation. The RSP may include variations to a service in the list: for example, a generating site started by using an on-site diesel generator as one variation and the same generating site started by a battery located on another site as another variation.

ELIA checks (during a period of maximum 1 month) whether the **RSP is qualified** to provide the service (see section 6.4.1) and makes a **high-level assessment of possible restoration scenarios** using the described services/assets.

An RSP whose candidacy ELIA has approved, will provide at the request of ELIA all the technical information necessary to perform a **more detailed simulation study**. This includes providing ELIA a report of a feasibility study by the RSP of the proposed service.

ELIA will carry out a simulation study that will **evaluate the acceptability of the offered services and whether or not more stringent technical requirements must be set** to provide the service (as explained in previous sections). With each RSP separately, ELIA will discuss the acceptability of offers. For offers making use of a non-ELIA grid, the relevant system operator (CDSO/DSO) will be involved in the discussions and evaluation of the offer. As explained previously in this stage especially the technical requirements with respect to reactive power absorption capability and to cascaded black start services can be set more strictly than the minimum requirements included in the T&C RSP.

To stimulate the creation of new black start capabilities in the system, the period to prepare an offer should be long enough for the RSP to search for opportunities and to perform studies and simulations.

In the **final phase** in the call for participation, ELIA invites the selected RSP candidates to **submit offers in accordance with the discussions and recommendations of the simulation study** by ELIA. At this time, ELIA discloses the final target contract period that must be taken into account in the offers. **ELIA will set the target contract period** based on information received from the RSP candidates in one zone or to align the contract duration of services in different

zones. Long contractual periods are desirable to spread the costs of large investments in new black start capabilities. However, the risk to submit binding offers for a long period may be assessed as too high for existing providers offering black start services on units with uncertain market potential. The provider may cover the risk by integrating in the offer the costs of large maintenance works to keep the plant open possibly only for black start services, needlessly and unintendedly elevating the costs for society. ELIA can only assess a reasonable contractual period after discussion with interested providers.

The call for participation ends with the submission of final offers for specific services, based on the results of the discussions and simulation studies. An offer submitted by the RSP must include the agreement of involved grid users and other relevant system operator(s) if needed.

## 2. Selection by ELIA and report to CREG and the Federal Public Service Economy (3 months)

ELIA evaluates the received offers and makes a selection of offers to award the contract. If the received offers are not in line with ELIA's expectations based on the discussion in the previous phase, ELIA may request clarifications or modifications to be explicitly added in the offer(s).

Considering the requirements and purpose of the black start ancillary service, the **comparison and selection of offers is not straightforward**. Two offers may be both acceptable but one may score a bit higher for some technical criteria than the other, or one may be located better taking into consideration the location of the other services to get a better spread across Belgium. All these factors as well as the offered price determining the total cost of the ancillary service will be taken into consideration by ELIA at this stage (see section 7.7).

As explained in the "Study on the Review of the Black Start Ancillary Services" (reference [6]), ELIA default searches for **4 black start units, although a 5<sup>th</sup> unit may be procured** if the total requirements for restoration of the entire system cannot be met with 4 units.

ELIA provides an overview of the offers and describes the selection for contracting in a report sent to the Federal Public Service Economy and the regulator CREG.

ELIA also indicates whether the voluntary offers allow ELIA to cover all the system needs for restoration. If this is not the case, ELIA includes in the report an overview of potential black start capabilities that have not been offered to ELIA (existing or potentially new capabilities).

## 3. Evaluation by CREG (3 months)

In compliance with article 12quinquies of the Electricity Law, the CREG evaluates the reasonableness of the prices included in all the offers.

## 4. Royal Decrees

In compliance with article 12quinquies of the Electricity Law a Royal Decree may be called upon in the following cases:

- CREG can evaluate the offered price of a selected service to be manifestly non-reasonable. The concerned offer can be replaced by an offer of which the price was not evaluated as manifestly non-reasonable in the selection, if ELIA agrees based on the other selection criteria for the service. If ELIA does not

agree with a replacement, then the contract price must be set via Royal Decree.

- If ELIA lacks restoration services, the King can via Royal Decree impose service delivery on an asset with existing capabilities or impose the installation of the capability and the service provision on an asset without existing capabilities<sup>17</sup>.

Contract subject to a Royal Decree are currently limited to a period of maximum 2 years.

### **5. Contract award (1,5 – 2 months)**

ELIA informs the RSP of the selection of the service and continues with the contracting (with or without waiting for a Royal Decree to set specific conditions for the contract). In this period, there is a standstill to allow RSP to respond to the selection.

The contract will be signed by ELIA and the RSP, and include a signed agreement by the grid users and the relevant system operator (CDSO/DSO) if needed.

### **6. Preparation period for implementation (if possible 18 months)**

The period between the contract award and the start of the service provision is the most critical step in the contracting timeline for services using new-to-install black start capabilities, is the duration between the “contract award” and the start of the service provision.

The goal is to assure a period of 18 months for the RSP to get the service ready for the start of the contract, including time for prequalification tests.

From the call for participation to the start of the service provision, the entire procurement process might take up to 3 years. It is however possible that ELIA has to proceed faster to contract a new service and that the procurement process will be shorter. When launching the procedure ELIA will share the calendar with the start and end dates of the different phases.

## **7.4. Additional information in offers and contracts**

In addition to the previously described information, during the procurement procedure information is exchanged between ELIA and potential RSP on the contractual period and on the price of the service.

### **7.4.1. Contractual period**

Considering the large investments and stable need, both for ELIA and for the RSP a longer-term procurement is preferable. The contract period should however not be too long in order to give frequent opportunity for potential new providers to participate to the service and existing assets to evaluate to shut down power plants without contract breach. It must also be feasible to submit an offer for the requested period that estimates the future costs in a reasonable manner.

Many factors influence the ideal target contract period, for example:

- The contract for new capabilities is ideally of longer duration to spread the costs of investments.

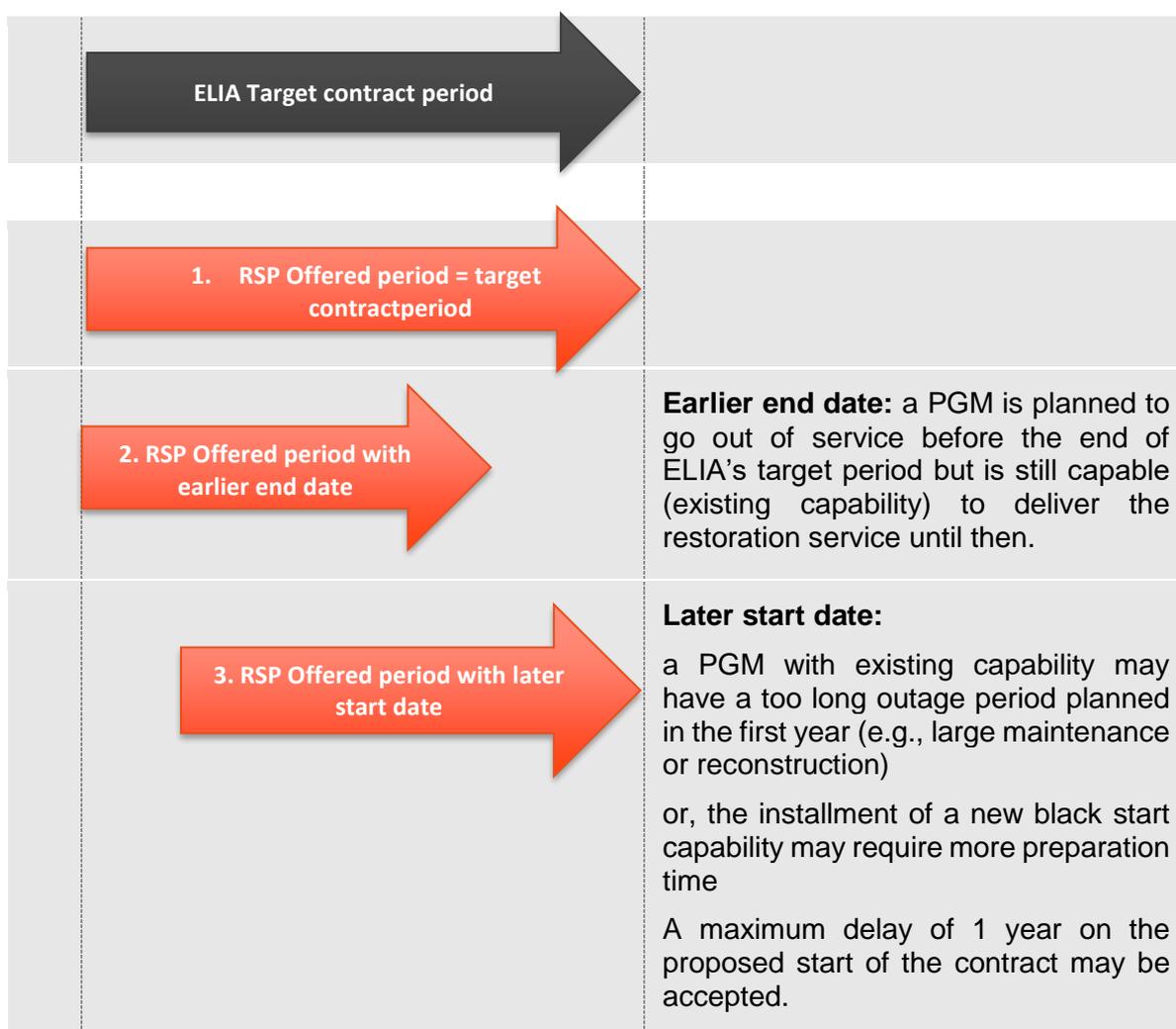
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<sup>17</sup> This last case implements article 15.5.a in the Network Code for Requirements for Generators (RfG).

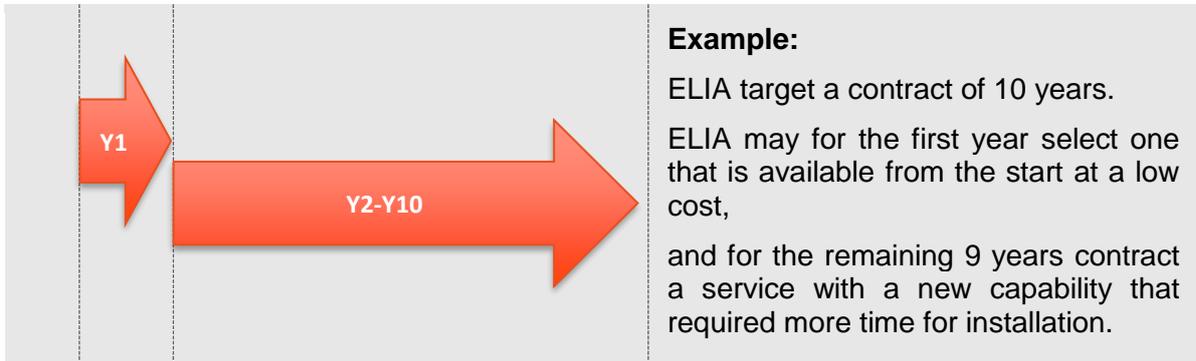
- For existing capabilities, the contract period can be relatively short. For units with existing capabilities the willingness to submit offers for a period of several years may depend on the market forecasts and the timing of large maintenance to keep the unit in the market or not. If ELIA sets the target contractual period too long, this may as a result lead to less offers.
- The contracts for restoration services influence one another as the services selected by ELIA depend on the location of the different service. Therefore, ELIA will aim to align the contract start and end dates of the contracts for the different zones.

ELIA will specify the contract period for which ELIA searches to procure the service in the public call for participation. During the call for candidates, ELIA will share an indicative target contract period. The discussions with the RSP will confirm whether the target period is realistic or not. In the call for final quotations, ELIA will specify the target contract period for which it expects to receive offers from all RSP offering for the same service (380kV or zonal). The contract period could range between 1 and 15 years but ELIA expects that mostly contractual periods of 3 to 8 years will be called for.

Regardless of the contract period targeted by ELIA, ELIA will allow the RSP to make an offer for a service for a deviating contract period as depicted below. The reasons for the deviation must, however, be explained and the offered contract period must show a best effort to be as close as possible to the period targeted by ELIA. Possible reasons are described in the next figure.



There is no need to block the deviating case. The combination of deviating cases may allow ELIA to cover the needs in a zone for the whole of the period at the lowest cost.



Allowing RSP to submit offers with deviating contract periods implies that each potential RSP must submit offers that are divisible in time. The final period included in the contract can deviate from the offered periods (see figure 8).

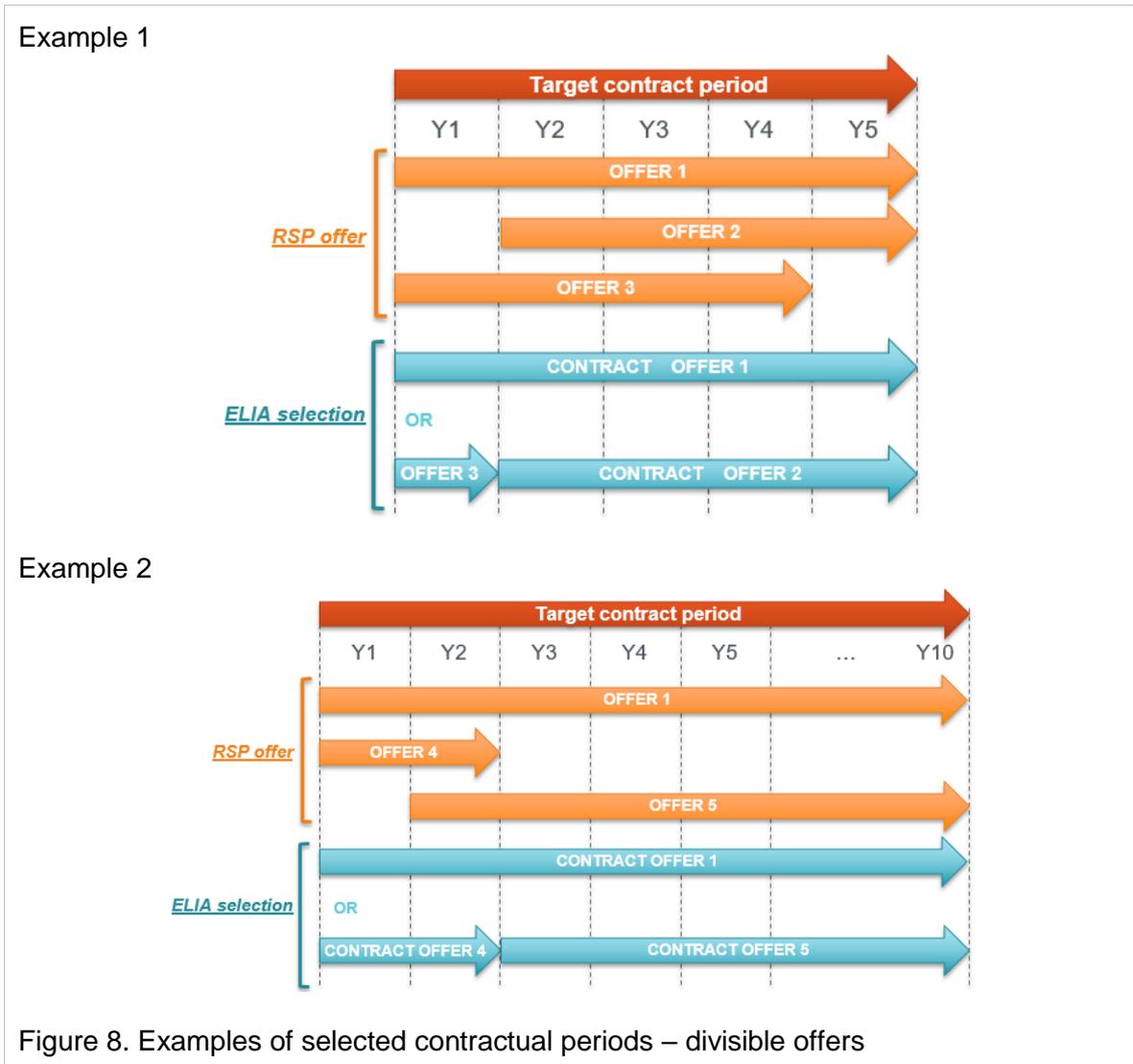


Figure 8. Examples of selected contractual periods – divisible offers

## 7.4.2. Offered prices and contracted costs

The requirements and investments for the non-mandatory black start capabilities result in too little market competition to reach perfectly competitive prices. However, the purpose of the procurement is also to attract potential providers who must be able to gain a profit margin for providing the service. Therefore, the pricing would be based on a **cost-plus approach**. The costs of the service and so the prices offered by the RSP must be reasonable, demonstrable, and directly linked to the black start service.

### Remuneration directly related to the black start capability:

The remuneration must be for a cost directly linked to the black start capability or operation, meaning that without the contract the cost would not be incurred.

### Reasonable remuneration:

The remuneration concerns an additional cost that cannot be recovered elsewhere.

### Demonstrable remuneration:

The RSP must be able to support the requested remuneration by documents (invoice, price offer of a contractor, cost simulations) justifying the amount at the moment of the price offer. The costs indicated in the offer can also be demonstrated based on past costs for similar investments or activities.

### Margin:

The margin at which the RSP is willing to offer the service.

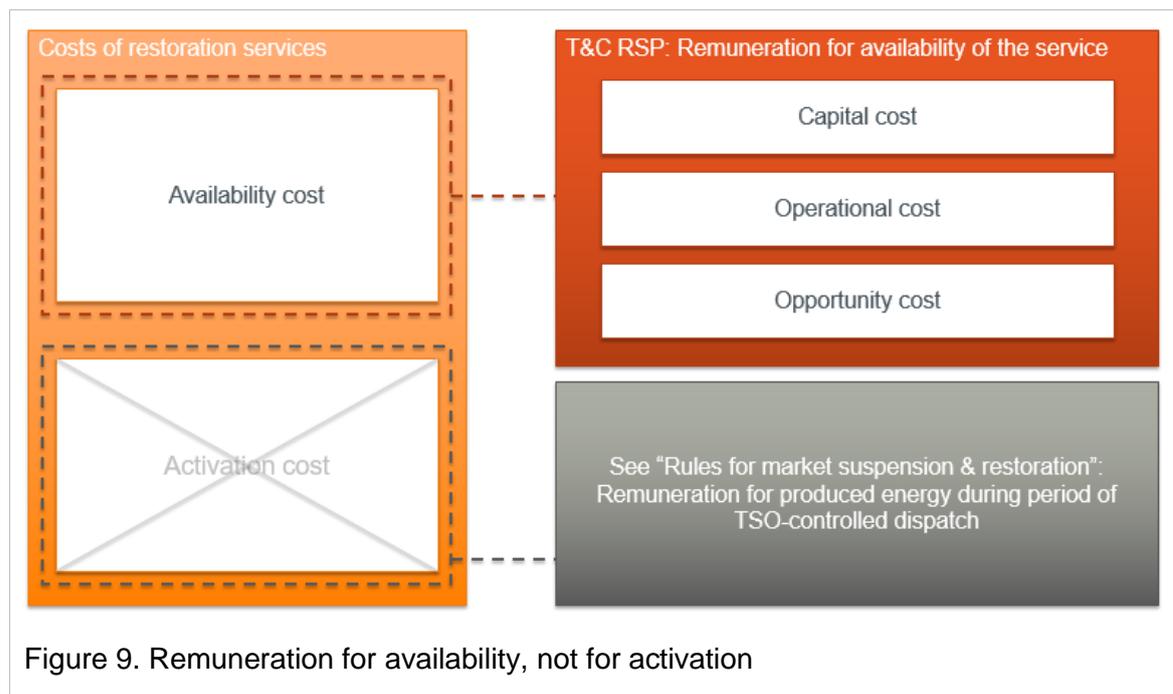
In compliance with articles 12quinquies of the Electricity Law, the offered prices including the margin are evaluated for reasonableness by the CREG before proceeding with contract awarding.

ELIA pays a remuneration to reward and stimulate the availability of the service as much as possible. The restoration ancillary service aims to assure that sufficient means will be available to restore the grid after a black out. The occurrence of a black out is much lower than the need for other ancillary services (such as balancing or voltage control), therefore the remuneration mechanism focuses on the reservation of the service rather than on the activation in time of need.

The costs during actual activation of the service—therefore when the system is in restoration state, markets are suspended, and production and demand is dispatched under control of ELIA—cover costs for the production of energy. These costs are remunerated according to the principles explained in the “Rules for market suspension and restoration” because the principles are the same for power units that start producing after performing a black start as for power units that start producing after resynchronizing with a re-energized grid.

This section describes the main price principles. The offered price must be expressed as one or more of the following **three components**:

- Cost for the capital investments in the technical black start capability (if relevant)
- Operational cost
- Opportunity cost (if relevant)



#### 7.4.2.1. Capital cost for the black start technical capability

The black start technical capability is not by default installed on a PGM. The capability requires the installation of different types of equipment, including a black start generator, and the delivery of permits (e.g. environmental permits needed for the installation of a diesel generator). The costs for these investments are high (up to several million euros) and generally not recuperated via other products as typically installed for black start purposes only. The full installment of the black start capability implies that the service was not contracted before. The investment may also involve the cost of replacing part of the black start capability equipment on a unit.

The RSP must indicate the amount of the capital cost in the offer when responding to the public call for participation to the service.

#### 7.4.2.2. Operational cost

The RSP incurs additional costs to be able to provide the black start service other than the investment of the technical capability. Specifically these costs reoccur on frequent basis and may reflect:

- Cost of 'normal' maintenance of the black start technical capability
- Cost of training of personnel
- Cost of 24/7 availability of personnel (if not needed for other purposes)
- Cost for creation of restoration procedures

The RSP includes the price offer for the operational cost expressed in € per day in the offer when responding to the procurement call. The offered price is constant during the whole contract period, but ELIA will apply a yearly indexation.

#### 7.4.2.3. Opportunity cost

The opportunity cost represents the opportunity losses of not being able to participate to markets or ancillary services due to the contractual obligations for restoration services. This involves the particular case of (pump) storage units in which a minimum energy volume must remain present in the unit for the black start service. The RSP must provide to ELIA the MWh available so ELIA can properly monitor the availability requirements (see chapter 5).

The RSP includes the price offer for the opportunity cost expressed in € per day in the offer when responding to the procurement call.

#### 7.4.2.4. Specific case: assets with limited energy amount used for black start

As explained assets with limited energy can be used to black start a larger generating site. In this case, the contract would include technical requirements with respect to the minimum energy volume that must remain available in the battery at all time (a minimum state of charge). The availability of the energy will be verified in the availability control.

The costs related to the service depend on whether the assets included are also used for market activities or other ancillary services. If so, the RSP can include an opportunity costs in the offer for the black start service. The opportunity cost can, however, not be combined with a remuneration of a capital cost for the installation of the self-starting storage unit.

### 7.5. Selection of providers

ELIA will evaluate the offers for restoration services according to the **criteria described in the “Bidding instructions and awarding criteria”, a document published together with the call for candidates**. During evaluation of the received offers, ELIA may request additional information to the RSP.

**ELIA will rate offers as acceptable when:**

- the offer is within the boundaries expressed in the call for offers:
  - In terms of contract period
  - In terms of location
- the offer is compliant with the technical criteria described in the T&C RSP (or when the deviations from those criteria are deemed acceptable by ELIA).
- the offer serves a useful restoration scenario that can contribute to the restoration plan, as shown based on a simulation study by ELIA.

**Among the acceptable offers, ELIA will make the selection of the service to contract** (if ELIA received more than one offer for the same zone) by taking into consideration the following criteria:

- **Technical usefulness, meaning the added value of the restoration scenario to the restoration of the system:**

ELIA evaluates the technical usefulness of the offered service based on the different technical requirements and based on the location of the service within the ELIA grid and therefore its impact on the construction of a cranking path to re-energize other grid users.
- **Costs of the service:**

The split of the cost in different component allows better comparing of offers. More expensive offers are not by default ranked less favorably.

- **Offered period:**

Deviating periods (with later start date or earlier end date) are not by default valued less as long as ELIA is able to cover the entire target period.
- **Expected unavailability of the service:**

ELIA will request information on planned unavailability of the different components of a black start service. For cascaded black start services requiring a part of the grid of ELIA or another relevant system operator, plans for investments or maintenance works affecting the cranking path will be taken into account when evaluating the value of the offered services for contracting during the targeted contract period.
- **Combination with Strategic Reserves:**

Although the provision of Strategic Reserves does not block the participation to the service, ELIA will only select a black start service in combination with Strategic Reserves if no other black start services for the concerned zone have been offered and deemed acceptable. This is to stimulate and support the participation to ancillary services of PGM that are still “in the market”.

ELIA will procure black start services that best contribute to the objectives of the restoration plan, aiming to keep the cost for society as low as possible, and making use of capabilities in the market.

## 7.6. Voluntary or mandatory participation to the service

### Network Code on Requirements for Grid Connection of Generators

#### Article 15.5 on black start capability requirements for PGM type C (and also applicable for type D)

- (i) black start capability is not mandatory without prejudice to the member state's rights to introduce obligatory rules in order to ensure system security;
- (ii) power-generating facility owners shall, at the request of the relevant TSO, provide a quotation for providing black start capability. The relevant TSO may make such a request if it considers system security to be at risk due to a lack of black start capability in its control area;

In general participation to the previously described procedure is voluntary, regardless of whether or not black start capabilities exist and of whether or not the service on an asset was provided in the past. The RfG Network Code (in article 15.5) describes the rules for exception.

There are **two possible exceptions**, as described in article 15.5 of the RfG Network Code.

- (i) **The member state may impose the installation of black start capability on a PGM for reasons of system security, at the moment of connection to the**

**grid or (long) after the PGM has entered into service<sup>18</sup>.** Considering the underlying reason, this capability obligation would logically also imply an obligation to deliver the service, at least at first instance.

As the obligation for a technical capability would have to be formalized (presumably via Royal Decree), ELIA suggests specifying there under which **conditions the grid user would have to enter into a contract with ELIA to deliver the service** (such as contract duration and price). This means that ELIA would without the organization of a public call enter into a contract (T&C RSP) with the grid user (or 3<sup>rd</sup> party RSP appointed by the grid user) for a contractual period defined by the member state. The situation would typically be one where the normal procurement procedure has led to no acceptable offers for the concerned zone.

- (ii) **When observing a lack of black start services in the system, ELIA may also request a grid user to provide a quotation for installing the black start capability on a PGM.** This implies a long-term forecast by ELIA of the black start capabilities that will be present in the system. ELIA may make a request independent of the organization of a public procurement procedure. The request for a quotation does not automatically imply a mandatory response to the call for participation when ELIA launches a procurement procedure nor a mandatory delivery of the black start service.

## 7.7. Rules for premature ending of a contract

Due to unexpected reasons that could not be foreseen when signing the contract and that render it impossible to continue the service until the end date of the contract, the contract can be ended prematurely. In this case, the contract will end on September 30 of the year following the announcement of the RSP.

A termination of the contract means that the RSP loses the remuneration of the share of capital costs that was originally scheduled to be paid by ELIA during the following years of the contract period.

The premature ending of a contract reduces the society's return on investment in restoration services present in the system. ELIA cannot allow a service to be contracted without the intent to provide the service throughout the agreed contract period. Therefore ELIA will charge a penalty in case the contract must be terminated prematurely:

*Penalty for premature contract termination*

*= equivalent of operational and opportunity costs for 1 year full availability*

$$x \frac{\text{remaining contract months}}{\text{total contracted period}}$$

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<sup>18</sup> As this possibility follows from the entry into force of the RfG Network Code, the obligation can only be imposed on a PGM subject to RfG.

## SUMMARY

Black start is non-typical among ancillary services: the lack of legal obligation for technical black start capability drive ELIA towards a public procurement with an open call towards interested market parties to participate, while the technical characteristics and the geographically defined needs for restoration limit the potential candidates.

ELIA will procure black start services via a public procurement procedure in which ELIA discusses more concretely the characteristics of potential services with the offering RSP. This allows for the creation of a (to the extent possible) competitive procurement while assuring that the offered services are properly customized to fit the needs for bottom-up restoration. Both the process of procurement and of selection of the services are not straightforward based on economic principles as the restoration needs result in technical requirements that cannot be perfectly generalized. Participation is generally voluntary; only in case of a lack of offered services and thereby a risk for system security can the member state impose the installation of the black start capabilities and of the service provision.

When time allows, ELIA will spread the procurement process to assure that RSP have sufficient time to prepare submission of an offer and to implement the service after contract award. The duration of the contracts may range from 1 to 15 years, to be determined during the procurement process depending on the specific situation and possibilities of potential candidates at that time. ELIA will allow potential RSP to offer shorter contract periods than the target period requested by ELIA, if for a good reason. ELIA may combine more than one service consecutively to cover the restoration need during the full target period.

The offers submitted by the potential RSP to ELIA must include the costs for operational expenses (€/day), a cost for capital investment (€) is also possible in case of a new or renewed technical capability, and in case of a requirement for maintaining a minimum energy volume at all times a cost to cover opportunity losses (€/day) can be included.

## 8. Availability: remuneration and penalties

As explained in the chapter on procurement, ELIA will remunerate the costs for capital investment, operational activities, and opportunity losses. In general ELIA pays for the availability of the service. Therefore, ELIA will also monitor service availability and, in case of excessive unavailability, charge an additional penalty to the RSP.

### 8.1. Capital costs

The RSP offers a **fixed price in €** to cover the costs for capital investments (installation of a new black start capability or a substantial renewal of an existing installation). ELIA remunerates these costs in **monthly settlement** spread across the **remaining years of the contract**.

In case of a new (or renewed) black start installation, ELIA will only start remuneration, including remuneration of the capital cost, after a successful prequalification test. A delay in the successful execution of the prequalification test will therefore result in a loss of the monthly remuneration of the capital cost in the months until the successful test.

### 8.2. Operational and opportunity costs

The RSP must offer a **variable price in € per day** to cover the costs for operational activities. In case of a service requiring a minimum energy volume, also a cost for opportunity losses may be included in the offer, also expressed as a variable price in € per day. ELIA will apply a **yearly indexation**.

ELIA pays the remuneration for operational and opportunity costs to the RSP via a **monthly settlement**. The remuneration depends on the real-time availability of the service throughout the concerned month. In case of a new (or renewed) black start installation, the service can only be considered as available (and therefore the remuneration of the operational and opportunity cost can only be started), after a successful prequalification test.

#### The operational and opportunity costs are remunerated as follows:

1. in proportion to the service availability during the day:

$$\frac{\text{number quarter hours with service availability on day } D}{96} \times \text{contracted price per day}$$

2. if the service was available for at least half the day (so 48 quarter-hours or more)

### 8.3. Penalties for excessive unavailability

For each year of the contract period ELIA determines the number of days that the restoration service was assessed as 'unavailable'. A 'normal' unavailability of the service (needed, for example, for regular maintenance of the power unit) is accepted within the terms of the contract, and therefore not penalized. Based on historical data on outage planning, ELIA sets the **acceptable unavailability for maintenance at a maximum of 40 days**.

In addition to not receiving a remuneration for days of service unavailability, an excessive unavailability of the service is penalized according to the scheme below. The higher the unavailability, the higher the penalty.

On day D outage information is available per quarter hour: a black start service will be considered as unavailable on day D when the service was considered available for less than 48 quarter-hours on day D.

Number of days of unavailability	Penalty
≥ 40	Equivalent of 1 month (30 full available days) operational and opportunity costs
≥ 80	Equivalent of 2 months
≥ 120	Equivalent of 3 months

If a black start service appears to have been **unavailable for 120 days or more during the last year, ELIA has the right to unilaterally stop the contract** and search for bilateral replacement of the service. A termination of the contract means that the RSP loses the remuneration of the share of capital costs that was originally scheduled to be paid by ELIA during the following years of the contract period.

## SUMMARY

ELIA remunerates the RSP for the technical and operational availability of the restoration service, following a cost-plus approach. The price offers and remuneration scheme are split in three components:

- A capital cost for new or renewed black start capabilities: the remuneration is spread in monthly settlement along the duration of the contract.
- An operational cost, remunerated in proportion to the availability of the service.
- An opportunity cost, remunerated in proportion to the availability of the service.

ELIA monitors the availability on a quarter-hourly basis. A service is regarded as available if available for at least half of the day (48 quarter-hours or more).

The RSP must pay additional penalties in case of excessive unavailability of the black start service (unavailability for more than 40 days per year): more days of unavailability result in a higher penalty. Excessive unavailability of more than 120 days during a year can result in the termination of the contract by ELIA.

## 9. Tests for prequalification and compliance

This chapter describes the organization of the test to prequalify for the service and the test to verify compliance.

ELIA differentiates between:

- tests to prequalify to deliver the service, and therefore to organize before the start of the contract;
- tests to verify on a frequent basis whether the contracted service is still compliant with the requirements, therefore to organize during the contractual period.

(See Annex 3 for some concrete examples of the planning of tests.)

The same principles apply for tests of cascaded black start services. In this case, ELIA will plan tests (in coordination with the RSP and other relevant system operators) only on days when the grid sections needed for the test can be made available for such test. The grid topology will be set in order to facilitate the execution of the test.

Note that ELIA will not remunerate the RSP for testing the service. The Network Code on Emergency and Restoration (in article 44) requires the test when delivering black start services. In case the system never enters in restoration state, the tests provide the only opportunity for ELIA to verify whether the quality of the service is in line with the contractual obligations.

### 9.1. Type of tests

There are 5 types of tests possible, testing only a small part or a larger part of the different aspects of the service<sup>19</sup>:

#### **Black Start inspection test**

The Black Start inspection test comprises an inspection of the Service Provider's installations used in the service and submission to ELIA's representatives of the 'Blackout' and 'Black Start' procedures by the operators who are on duty at that time. The operators then explain these procedures. The 'ancillary black start facilities' that do not affect the generating site are started in order to demonstrate that they are operating smoothly (auxiliary diesel generators, compressors, auxiliary boilers, etc.)

The generating site remains in status 'available' during the test to produce in accordance with market opportunities.

#### **Test type 1 – start-up & resynchronization**

The auxiliary facilities at the generating site are powered by the self-starting site performing a black start, rather than via the transmission system. The generating site is thus being started and is then connected to a transmission System that is already energized.

#### **Test type 2**

Test type 1 + the generating site must again switch on a busbar.

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<sup>19</sup> These are the tests included in the current black start contract.

### Test type 3 – start-up & re-energization

Test type 2 + re-energization of a dead grid (i.e. accept Mvars).

### Test type 4

Test type 3 + the generating site must also be able to accept MWs.

Additional specific tests are possible in mutual agreement between ELIA and the RSP.

During test types 1-4 the availability status of the concerned generating site is “Testing” (declared by the Outage Planning Agent).

## 9.2. Prequalification tests

Prequalification tests are required in case of the provision of a new restoration service. A prequalification test corresponds to **test type 2** described above.

The RSP is to organize the prequalification test in agreement with ELIA and other relevant system operators, before the planned start of the service. The prequalification test should take place **at the latest one month before the foreseen start of the contract** in order to allow sufficient time for retesting if needed.

### Three cases:

1. A new restoration service based on a **newly installed black start capability**: the black start capability must be tested by the RSP before the start of the contract. Typically this is a situation where ELIA would remunerate an investment cost to the RSP.
2. An existing restoration service with a **renewed installation**: the replacement or renewal of the black start capability would also require a successful prequalification test to be organized by the RSP before continuation of the running contract or before the start of the new contract.<sup>20</sup>
3. An existing black start capability that is not included in a black start contract just before the concerned contractual period: if no compliance test (see next) has been successfully executed in the last three years, the RSP must organize a successful prequalification test before the start of the contract.

**Outcome of the test:** A successful prequalification test is required in order to activate the settlement of the contract.

## 9.3. Compliance tests

Compliance tests serve to verify whether the technical capability on the assets functions correctly and/or whether the requirements for the service are in order (such as training of personnel and existing procedures at the site). A compliance test can include **any of the test types** described in section 9.1.

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<sup>20</sup> The replacement of the black start capability would imply an unavailability of the service (and therefore a period without remuneration by ELIA). The service can only be assessed as available after a successful prequalification test.

**Compliance tests are planned at the request of ELIA in agreement with the RSP** and other relevant system operators. The RSP is responsible for the coordination (via the grid user) with other roles, such as the Scheduling Agent, the Outage Planning Agent, and the Balancing Service Provider, when searching for a suitable date for the test (typically a day when the asset is not expected to participate to the energy markets and therefore opportunity losses are minimized). If during the test the availability status of the assets included in the service is “Testing” (which is the case of test types 1-4), the assets are not available for the day-ahead, intraday, or balancing market and therefore the information delivered by other roles to ELIA must be coherent.

If no date for the test can be agreed on with the RSP within 2 months after the request of ELIA, ELIA will unilaterally set a date for the test (taking into account the possibilities and limitations of other relevant system operators if required).

According to the European Network Code on Electricity Emergency and Restoration (article 44) **a compliance test of a black start capability must be organized at least every three years** when providing the restoration service.

ELIA would plan the tests as follows:

- In case of a service that was not contracted in the previous 12 months: test in the first year of the contract period
- In case of consecutive contract periods: test per 3 years and not per contract period
- In case of a failed test: organization of a new test within 2 months

#### **Outcome of the first compliance test**

A **successful** test has **no impact** on the contract.

In case the test **fails** and this failure cannot be attributed to a problem relating to the transmission or (closed) distribution system, the impact is as follows:

- **Depending on the cause** of the failure, the status of the **service is set at ‘unavailable’**. Service unavailability affects the settlement for the service (see Chapter 8), but does not relieve the RSP from the contractual responsibilities. If a blackout would occur before the organization of a successful test, ELIA will still send the black start command and discuss with the black start operator present at the time the possibilities of a successful start-up (if not perfectly predictable based on the reason for unavailability).

- A **second test** must be performed within 2 months after the first failed test.

- ELIA puts the **settlement** of the contract **temporarily “on hold” until a successful test**. The RSP is not allowed to send an invoice to ELIA in the period between a failed test and a successful test. The monthly capital, operational, and opportunity costs for the period since the first failed test will not be paid by ELIA until the execution of a successful test.

- The RSP must pay a **penalty** to ELIA for the failure of the first test. The penalty equals the equivalent of the operational and opportunity costs for 30 fully available days.

#### **Outcome of the second compliance test**

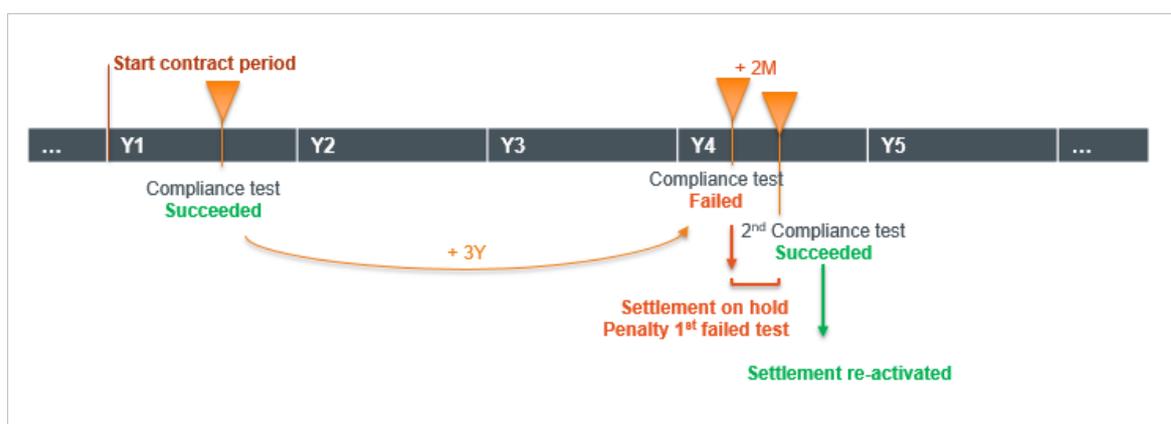
**If the second test is successful:**

- The settlement is **no longer on hold**. The RSP may send an invoice to ELIA.

- ELIA will **retro-actively settle** the period that the contract was on hold.

**Once ELIA reactivates the settlement after a successful test, the following rules are applied retro-actively:**

- If the failure of the test resulted in a change of the service status to unavailable, then the RSP will not be remunerated for operational or opportunity costs, but the remuneration of the capital cost is not affected.
- If the failure of the test did not result in a change of the service status to unavailable, then the RSP will be remunerated for operational and opportunity costs in accordance to the standard rules, and also the remuneration of the capital cost is not affected.



#### **If the second test fails:**

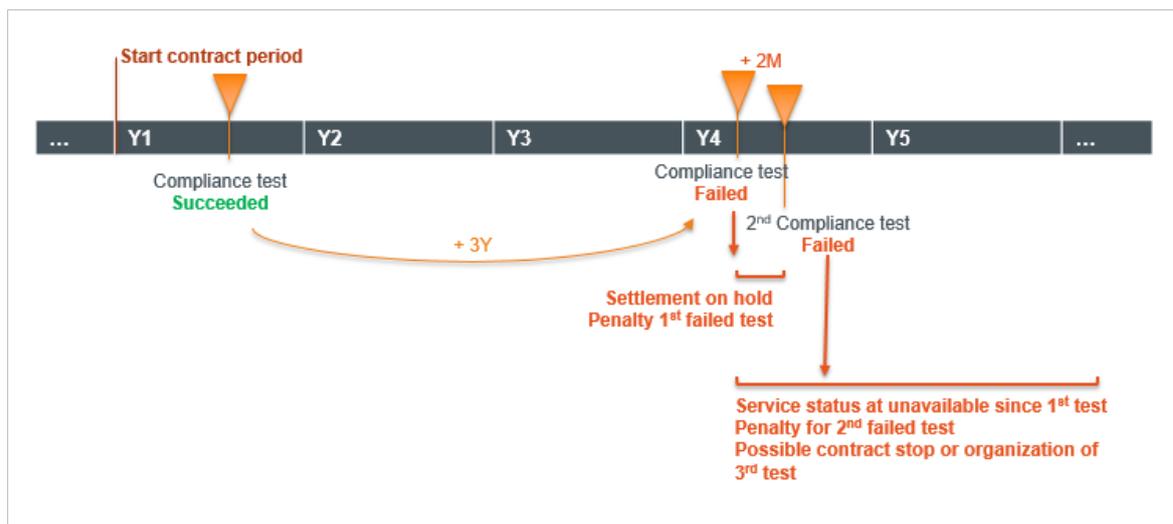
- **Regardless of the cause** of the failure, the status of the **service is set at 'unavailable' and this retro-actively since the first test date**. Service availability affects the settlement for the service (see Chapter 8).

- The RSP must pay an **additional penalty** to ELIA for the failure of the second test. The penalty equals the equivalent of the operational and opportunity costs for 60 fully available days.

- ELIA and RSP may agree to organize **an additional test** in case that there is a clear indication that the outcome of this new test would be successful. In case this test is successful, the scheduled remuneration plan will start again as of this moment.

- **In case of no agreement regarding additional test the contract is stopped and ELIA will** finalize the settlement of the period since the first test. The scheduled remuneration plan will not be executed. Therefore, the RSP risks losing the remuneration of the share of capital costs that was originally scheduled to be paid by ELIA during the following years of the contract period. ELIA will change the penalty for a premature ending of the contract (see section 7.8).

ELIA may arrange (with the same or with another RSP) a new contracted service for the zone bilaterally (without the organization of a public procurement procedure due to urgency).



## SUMMARY

A prequalification test for new contracted capabilities is needed before the start of a contract. Delayed prequalification tests imply that the RSP loses a part of the remuneration until the execution of a successful test.

A compliance test is needed on a frequent basis during the contract: once every three years plus possibly at the start of the contract (for a new service). Different types of tests are possible, ranging from a test of the self-starter to a test including the start-up of the generating site to a full test including re-energization of a dead grid (accepting MW and Mvar). Failed compliance tests have an impact on the settlement (remuneration on hold, possible impact on availability, penalties) and in extreme cases on the continuation of the contract.

## CONCLUSION

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ELIA contracts services for bottom-up re-energization of the Belgian system in case of a blackout. These services use black start capabilities present on a generating site or via an aggregation of assets resulting in the same **black start capability**.

In compliance with the **European Network Code on Electricity Emergency and Restoration** the contract between ELIA and the Restoration Service Provider (RSP) includes the terms and conditions for the service. Those **Terms and Conditions for restoration services on a contractual basis** require **regulatory approval** after public consultation with the stakeholders. This note describes the vision of ELIA for the future design of the service and therefore for the future version of the terms and conditions for the RSP.

The design note lists the following aspects for the delivery of black start services:

- **Technical requirements** that the power unit (or aggregation) must meet, including installation of equipment, communication, and specifically, for each service, minimum requirements for active power installed capacity and reactive power absorption capability. The requirements on active power capacity and reactive power absorption capability depend on the role of the service in the restoration plan, aiming at the re-energization of specific auxiliary loads (MW) and of a part of the dead grid (which produces a significant amount of Mvar).
- The **Restoration Service Providers (RSP)** offering the service to ELIA must therefore be the grid user or formally represent the grid user(s) of the assets included in the service. The RSP and grid users (if different) must be aware of some interdependencies with other roles for the provision of ancillary services, although none are blocking in the organization of the service. Most remarkable is the interdependency between the RSP and the Outage Planning Agent, as the settlement of the restoration service depends heavily on the availability of the involved power units.
- Considering the lack of obligations to install black start capabilities and the peculiar characteristics of restoration, **ELIA will procure the service via a public procedure**. The procurement combines bilateral discussion between ELIA and RSP candidates to define the technical aspects of the offered service with a competitive drive (even if limited) between the offers. As no two offered services are identical and the added value of each to the restoration plan is different, the selection of the service will not only be based on the offered price but also on technical measures. Both the procurement phase and the contract periods are of long duration.
- **Tests:** New services require **prequalification** before the start of the contract. During the contract each service must be tested for **compliance** with the requirements each three years. Failed tests have implications on the settlement of the contract (remuneration on hold or reduced due to impact on availability). The RSP must pay a penalty to ELIA in case of failed compliance tests. In extreme cases, failed tests may lead to an early termination of the contract.
- **Remuneration:** ELIA pays the RSP for **capital costs** (in case of installation of a new or renewed black start capability), **operational costs** (for 24/7 readiness of the service), and of **opportunity costs** (in case of MWh requirements, typically on services with storage units). The remuneration of the capital cost is spread through the duration of the contract. The remuneration of the operational and opportunity

costs depends on the result of prequalification and compliance tests and of the availability of the service. The service is considered as available if the self-starting unit, the generating unit, and (if relevant) the minimum energy required is available. The RSP receives a remuneration for the operational and opportunity costs in proportion to the service availability during the day (quarter-hour basis) and if the service was available for at least half the day.

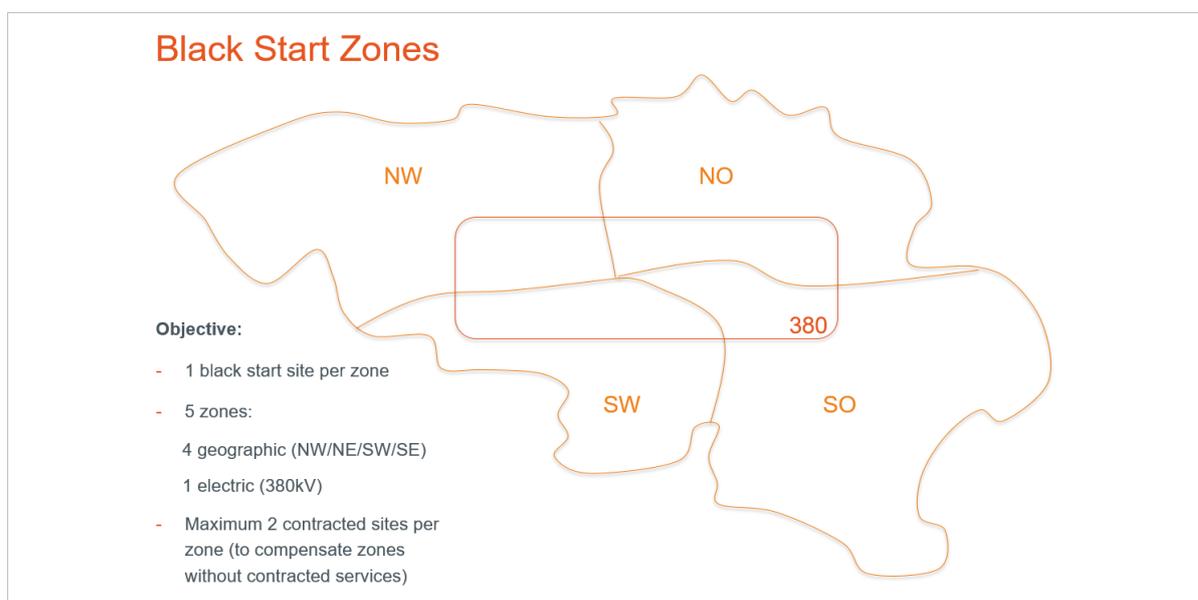
- The contract acknowledges a minimum period of unavailability per year to allow normal maintenance on the units included in the black start service. **Excessive unavailability**, however, is not accepted. The RSP must pay a **penalty** to ELIA if the service is unavailable for more than 40 days per year. The penalty increases if the service is unavailable for more than 80 days and even more in case of 120 days.

## References

- [1] European Commission (2017). “COMMISSION REGULATION (EU) 2017/2196 of 24 November 2017 establishing a network code on electricity emergency and restoration,” Official Journal of the European Union, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R2196&from=EN> (consulted 11/09/2018)
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- [3] European Commission (2016). “COMMISSION REGULATION (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators,” Official Journal of the European Union, <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0631&from=EN> (consulted 11/09/2018)
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- [5] Economische Zaken (1999). “29 APRIL 1999. - Wet betreffende de organisatie van de elektriciteitsmarkt,” 15/05/1999, n° 1999011160, p. 16264, [http://www.ejustice.just.fgov.be/cgi\\_loi/change\\_lg.pl?language=nl&la=N&cn=1999042942&able\\_name=wet](http://www.ejustice.just.fgov.be/cgi_loi/change_lg.pl?language=nl&la=N&cn=1999042942&able_name=wet) (consulted 11/09/2018)
- [6] ELIA (2018). “Study on the Review of the Black Start Ancillary Services,” Published for public consultation on 08/10/2018, <http://www.elia.be/en/about-elia/publications/Public-Consultation>
- [7] ELIA (2017). “Future Roles and Responsibilities for the Delivery of Ancillary Services,” Published for public consultation on 11/12/2017, [http://www.elia.be/~media/files/Elia/About-Elia/Publication/20171112\\_ICAROS-Design-Note\\_Future-roles-and-responsibilities.pdf](http://www.elia.be/~media/files/Elia/About-Elia/Publication/20171112_ICAROS-Design-Note_Future-roles-and-responsibilities.pdf) (consulted 19/09/2018)

## Annex 1. Design of the Black Start Ancillary Service up to 2020

<b>Procurement</b>	Voluntary participation Contract granted after a public tender
<b>Signatory</b>	CIPU Holder (Access Responsible Party)
<b>Assets</b>	CIPU productions only, may be aggregated to a 'production site' behind one connection point => 'Site-based' contract Combination with SGR possible
<b>Duration</b>	Long term contracts: 5 years (unless if Royal Decree: 1 or 2 years)
<b>Technical requirements</b>	Black-start generator on-site MW load support Mvar absorption capabilities Reaction time for cold (3h) & warm (1,5h) start ups Minimum fuel/energy supply ...
<b>Price</b>	Price offer with reasonableness evaluation by the CREG
<b>Settlement</b>	Pay-as-bid or Royal Decree price Remuneration for availability + Test costs
<b>Penalty</b>	In case of 'extreme' non-availability or in case of failed tests



## Annex 2. ELIA Proposal on Restoration Service for the new Federal Grid Code

### Afdeling VI.I.II. - Ondersteunende diensten voor herstel

Art. 251. Onder dienst voor herstel van een net verstaat men elke dienst bepaald door de transmissienetbeheerder conform de bepalingen van de Europese netcodes RFG en de E&R ter zake, die bijdraagt tot een of meerdere maatregelen van het herstelplan dat de transmissienetbeheerder heeft vastgelegd conform artikel 280. De “black-startdienst”, de dienst die wordt verstrekt door productiemiddelen met autonoom opstartvermogen zoals bepaald in artikel 2§45 van de Europese netcode RFG, is een van de mogelijke diensten voor herstel van het net.

Art. 252. §1. Zonder afbreuk te doen aan het herstelplan, bepaalt de transmissienetbeheerder de verschillende middelen bestemd om een dienst van herstel van het net te leveren na een spanningsinstorting ervan.

§2. De transmissienetbeheerder bepaalt op transparante en niet-discriminerende wijze in de **modaliteiten en voorwaarden, voor goedkeuring voorgelegd aan de commissie** conform artikel 4§4 van de Europese netcode E&R, de technische specificaties voor de levering van hersteldiensten, de voorwaarden voor deelname en het mechanisme om deze diensten op te stellen, die gelden voor de aanbieder van hersteldiensten.

De modaliteiten en voorwaarden zijn onder meer gebaseerd op **de richtlijnen die de bevoegde overheid vooraf heeft vastgelegd met betrekking tot de financiële aspecten** van de levering van elke hersteldienst.

Art. 253. § 1. Elke transmissiesysteemgebruiker van wie de elektrische installaties onderworpen zijn aan de technische vereisten betreffende de installaties van die uitrusting om een van de hersteldiensten te leveren conform artikelen 15.5.c en 45 van de Europese netcode RFG, is verplicht om op verzoek van de transmissienetbeheerder bij te dragen in de herstel dienst in overeenstemming met zijn technische kenmerken en dit binnen de technische grenzen van de installaties onderworpen zijn.

§ 2. **Elke netgebruiker kan vrij aan de transmissienetbeheerder voorstellen om deel te nemen aan een of meerdere diensten voor herstel van het net met een of meerdere van zijn installaties**, andere dan die bedoeld in § 1 en dit op voorwaarde dat hij beantwoordt aan de technische specificaties en deelnemingsvoorwaarden bedoeld in artikel 252 §2 van dit besluit, en met naleving van de eventuele technische en operationele beperkingen voor de levering van de dienst die zijn opgelegd door de distributienetbeheerder of beheerder van het gesloten distributienet of gesloten industrieel net waarop de betrokken installaties zijn aangesloten. Die beperkingen staan ook **beschreven in de modaliteiten en voorwaarden** die gelden voor de aanbieder van hersteldiensten. De eventuele coördinatie die nodig is met de betrokken distributienetbeheerder, beheerder van het gesloten distributienet of gesloten industrieel net, conform artikel 25§1 van de Europese netcode E&R, staat dan weer beschreven in het herstelplan.

§ 3. De hersteldienst wordt rechtstreeks **geleverd door de netgebruiker** die aan die dienst deelneemt in de hoedanigheid van aanbieder van hersteldienst zoals bepaald in artikel 2§2 van de Europese netcode E&R **of via aan derde** die in dat geval aanbieder

van hersteldienst is volgens een aanduidingsprocedure die beschreven staat in de modaliteiten en voorwaarden bedoeld in artikel 252§2 van dit besluit.

Art. 254. De aanbieder van hersteldiensten sluit met de transmissienetbeheerder **een of meerdere contracten voor de levering van hersteldiensten** af waarin hij zich verbindt tot naleving van de modaliteiten en voorwaarden bedoeld in artikel 252 van dit besluit. Deze contracten worden eveneens **voor goedkeuring voorgelegd aan de commissie**.

## Annex 3. Examples of the planning of tests

Example 1:



Tests of a completely new service: prequalification + compliance test within first year, renewed within 3 years

Tests of a new service on an existing capability without a compliance test in the last 3 years: prequalification + compliance test within first year, renewed within 3 years

Example 2:



Tests of a new service on an existing capability with a compliance test 2 to 3 years before the new contractual period: compliance test within first year, renewed within 3 years

Example 3:



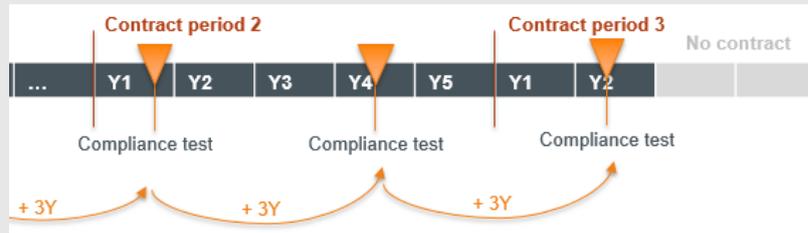
Compliance test of an existing service with several consecutive contractual periods

Example 4a:



Compliance test of an existing service with several consecutive contractual periods: no test in the last short contract period because of test in the last year of the previous period.

Example 4b:



Compliance test of an existing service with several consecutive contractual periods: test required in the last contracted year

## Annex 4. Overview of relevant articles in the European Guideline and Network Codes

### EUROPEAN NETWORK CODE ON ELECTRICITY EMERGENCY AND RESTORATION

**Article 3 - Definition (2)** - ‘restoration service provider’ means a legal entity with a legal or contractual obligation to provide a service contributing to one or several measures of the restoration plan;

**Article 3 - Definition (7)** – ‘top-down re-energisation strategy’ means a strategy that requires the assistance of other TSOs to re-energise parts of the system of a TSO;

**Article 3 - Definition (8)** – ‘bottom-up re-energisation strategy’ means a strategy where part of the system of a TSO can be re-energised without the assistance from other TSOs;

**Article 2.4.** Type A and type B power generating modules referred to in paragraph 3 [i.e., non-significant grid users], demand facilities and closed distribution systems providing demand response may fulfil the requirements of this Regulation either directly or indirectly through a third party, under the terms and conditions set in accordance with Article 4(4).

**Article 4.4** The terms and conditions to act as defence service provider and as restoration service provider shall be established either in the national legal framework or on a contractual basis. If established on a contractual basis, each TSO shall develop by 18 December 2018 a proposal for the relevant terms and conditions, which shall define at least:

- (a) the characteristics of the service to be provided;
- (b) the possibility of and conditions for aggregation; and
- (c) for restoration service providers, the target geographical distribution of power sources with black start and island operation capabilities.

#### **Article 23 - Design of the restoration plan**

1. By 18 December 2018, each TSO shall design a restoration plan in consultation with relevant DSOs, SGUs, national regulatory authorities or entities referred to in Article 4(3), neighbouring TSOs and the other TSOs in that synchronous area.

2. When designing its restoration plan, each TSO shall take into account, at least, the following elements:

- (a) the behaviour and capabilities of load and generation;
- (b) the specific needs of the high priority significant grid users listed pursuant to paragraph (4); and
- (c) the characteristics of its network and of the underlying DSOs networks.

3. The restoration plan shall contain at least the following provisions:

- (a) the conditions under which the restoration plan is activated, as provided for in Article 25;
- (b) restoration plan instructions to be issued by the TSO; and
- (c) measures subject to real-time consultation or coordination with identified parties.

4. In particular, the restoration plan shall include the following elements:

- (a) a list of the measures to be implemented by the TSO on its installations;
- (b) a list of the measures to be implemented by DSOs and of the DSOs responsible for implementing those measures on their installations;

(c) a list of the SGUs responsible for implementing on their installations the measures that result from mandatory requirements set out in Regulations (EU) 2016/631, (EU) 2016/1388 and (EU) 2016/1447 or from national legislation and a list of the measures to be implemented by those SGUs;

(d) the list of high priority significant grid users and the terms and conditions for their disconnection and re-energisation;

(e) a list of substations which are essential for its restoration plan procedures;

(f) the number of power sources in the TSO's control area necessary to re-energise its system with bottom-up re-energisation strategy having black start capability, quick re-synchronisation capability (through houseload operation) and island operation capability; and

(g) the implementation deadlines for each listed measure.

5. The restoration plan shall include at least the following technical and organisational measures specified in Chapter III:

(a) re-energisation procedure, in accordance with Section 2;

(b) frequency management procedure, in accordance with Section 3; and

(c) resynchronisation procedure, in accordance with Section 4.

6. The measures contained in the restoration plan shall comply with the following principles:

(a) their impact on system users shall be minimal;

(b) they shall be economically efficient;

(c) only those measures that are necessary shall be activated; and

(d) they shall not lead the interconnected transmission systems into emergency state or blackout state.

## EUROPEAN GUIDELINE ON ELECTRICITY TRANSMISSION SYSTEM OPERATION

**Definition (36)** - 'system state' means the operational state of the transmission system in relation to the operational security limits which can be normal state, alert state, emergency state, blackout state and restoration state;

**Definition (5)** - 'normal state' means a situation in which the system is within operational security limits in the N-situation and after the occurrence of any contingency from the contingency list, taking into account the effect of the available remedial actions;

**Definition (17)** - 'alert state' means the system state in which the system is within operational security limits, but a contingency from the contingency list has been detected and in case of its occurrence the available remedial actions are not sufficient to keep the normal state;

**Definition (37)** - 'emergency state' means the system state in which one or more operational security limits are violated;

**Definition (22)** - 'blackout state' means the system state in which the operation of part or all of the transmission system is terminated;

More specifically in Article 18(4): A transmission system shall be in the blackout state when at least one of the following conditions is fulfilled:

- (a) loss of more than 50 % of demand in the concerned TSO's control area;
- (b) total absence of voltage for at least three minutes in the concerned TSO's control area, leading to the triggering of restoration plans.

**Definition (38)** - 'restoration state' means the system state in which the objective of all activities in the transmission system is to re-establish the system operation and maintain operational security after the blackout state or the emergency state;

**Definition (5)** - 'restoration plan' means all technical and organisational measures necessary for the restoration of the system back to normal state;

## EUROPEAN NETWORK CODE ON REQUIREMENTS FOR GRID CONNECTION OF GENERATORS

**Article 15.5.** Type C power-generating modules shall fulfil the following requirements relating to system restoration:

(a) with regard to black start capability:

(i) black start capability is not mandatory without prejudice to the Member State's rights to introduce obligatory rules in order to ensure system security;

(ii) power-generating facility owners shall, at the request of the relevant TSO, provide a quotation for providing black start capability. The relevant TSO may make such a request if it considers system security to be at risk due to a lack of black start capability in its control area;

(iii) a power-generating module with black start capability shall be capable of starting from shutdown without any external electrical energy supply within a time frame specified by the relevant system operator in coordination with the relevant TSO;

(iv) a power-generating module with black start capability shall be able to synchronise within the frequency limits laid down in point (a) of Article 13(1) and, where applicable, voltage limits specified by the relevant system operator or in Article 16(2);

(v) a power-generating module with black start capability shall be capable of automatically regulating dips in voltage caused by connection of demand;

(vi) a power-generating module with black start capability shall:

— be capable of regulating load connections in block load,

— be capable of operating in LFSM-O and LFSM-U, as specified in point (c) of paragraph 2 and Article 13(2),

— control frequency in case of overfrequency and underfrequency within the whole active power output range between minimum regulating level and maximum capacity as well as at houseload level,

— be capable of parallel operation of a few power-generating modules within one island, and

— control voltage automatically during the system restoration phase;

**NETWORK CODE ON REQUIREMENTS FOR GRID CONNECTION OF HIGH VOLTAGE DIRECT CURRENT SYSTEMS AND DIRECT CURRENT-CONNECTED POWER PARK MODULES**

**CHAPTER 6 Requirements for power system restoration**

**Article 37. Black start**

1. The relevant TSO may obtain a quote for black start capability from an HVDC system owner.
2. An HVDC system with black start capability shall be able, in case one converter station is energised, to energise the busbar of the AC-substation to which another converter station is connected, within a timeframe after shut down of the HVDC system determined by the relevant TSOs. The HVDC system shall be able to synchronise within the frequency limits set out in Article 11 and within the voltage limits specified by the relevant TSO or as provided for in Article 18, where applicable. Wider frequency and voltage ranges can be specified by the relevant TSO where needed in order to restore system security.
3. The relevant TSO and the HVDC system owner shall agree on the capacity and availability of the black start capability and the operational procedure.