

# Black Start Strategy and Procurement Methodology 2020/21

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Background

# Background

## Document History<sup>1</sup>

Version	Date	Changes
Version 1.0	Aug 2017	Ofgem approved version
Version 2.0	April 2018	Ofgem approved version
Version 3.0	April 2019	Consolidated Strategy and Procurement Methodology – Ofgem approved version
Version 4.0	April 2020	Final approved version

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<sup>1</sup> Version 1.0 & 2.0 were under the NGET Transmission Licence.

## BACKGROUND

In accordance with National Grid Electricity System Operator Limited (“ESO”) Special Condition 4G, this Black Start Strategy and Procurement Methodology (“Methodologies”) sets out the Strategy and Procurement ESO will use to determine and procure sufficient Black Start Capability for the National Electricity Transmission System (NETS) on an ongoing basis in a manner which supports an efficient, coordinated, secure and economical Whole System.

There may be a requirement for this document to be resubmitted following any significant changes to legal, regulatory or ESO restoration approach and procurement.

The COVID-19 pandemic outbreak has raised concerns from various stakeholders in the industry regarding their operation, staffing levels, maintenance for existing providers and supply chains for new providers participating in the competitive events and the new services due to commence later in 2020. All of which may have an impact on the delivery of the Black Start Strategy and Procurement Methodology.

We are working closely with the industry to understand these risks and we will inform Ofgem and BEIS for consideration. The impacts of COVID-19 are still unknown on the Black Start Strategy and Procurement Methodology and will not be specifically identified in this document.

Unless the context otherwise requires, the words and expressions used in these Methodologies shall have the meanings ascribed to them under special licence condition 4G or the Grid Code as appropriate.

## Vision

Our vision is that by the mid-2020s, we will be running a fully competitive Black Start procurement process with submissions from a wide range of technologies connected at different voltage levels on the network, with Transmission Owners (TO) and Distribution Network Operators (DNO) playing a more active role in the Restoration Approach.

We are committed to meeting this vision, and in our Restoration Roadmap, published in May 2018, we set out that we would:

- improve transparency around Black Start services, including service requirements and costs
- remove barriers to entry to allow improved market access to a broader range of potential technologies and participants, including interconnectors, wind, distributed energy resources and storage.
- Explore and evolve alternative methods for procuring Black Start services, to enable a more flexible approach to meeting service requirements.

Forward Plan 2020-21 was published in March 2020, where we have stated that ESO is going to deliver Product roadmap for Restoration implementation by working closely with our stakeholders to give them visibility of the opportunities which are available:

- The delivery of competitively tendered Black Start contracts will lead to increased competition, which will place downwards pressure on prices. It will also encourage non-traditional providers to offer Black Start

services, which will enable us to operate a carbon free network securely, contributing to reduced environmental damage.

- Diversifying the portfolio of generation which can provide Black Start services contributes to improved system security, which benefits society as a whole.
- Provide performance metric which measures the direction of travel away from bilateral arrangements towards open and accessible market opportunities

We are working towards our ESO 2025 vision, where we will be able to operate the system carbon free (for periods of time). We will be looking at all elements of the restoration process, The Black Start Capability (which technologies are able to form Power Islands), Black Start approach (how we energise the system), Network design enabling more efficient energisation, Secondary Generation (readiness of this generation and capability to join a restoration – wind, batteries, solar, EV's/ V2G, smart demand, efficient control system and expanding the resilience of the industry.

The Black Start Strategy and Procurement Methodology publications are the vehicles through which ESO articulates how this commitment will be achieved. These documents are presented in a combined format with three distinct parts:

- 2) Black Start Strategy
- 3) Procurement Methodology
- 4) Summary of delivery to date

The ESO will demonstrate how Part 2 the Black Start Strategy and Part 3 the Procurement Methodology meets the Licence Obligations held in Special Condition 4G.3 and 4G.4 conditions.





# 2

## Black Start Strategy

# Black Start Strategy

## Introduction

Black Start is the procedure to recover from a Total or Partial Shutdown of the NETS, which has caused an extensive loss of supplies. ESO has a Grid Code obligation (CC6.3.5) to ensure that Black Start Capability is available to enable the National Electricity Transmission System (NETS) to be re-energised in the event of a Total or Partial Shutdown. A Total Shutdown leading to a Black Start is a High Impact, Low Probability (HILP) event. Whilst an unlikely event, the consequences would have significant societal and economic impacts. Therefore, ESO must demonstrate that the Black Start Capability procured maintains an acceptable level of provision, but at a cost which is economic and efficient.

This Black Start Strategy (Strategy) identifies how the Restoration Time expectation is used to identify an appropriate level of Black Start Capability to meet the system restoration. Once the capability requirement is known this can then be procured, using the methodologies and principles described in the Procurement Methodology.

This Strategy is made up of four sections which detail:

1. Restoration Standard and Restoration Time.
2. Restoration Approach.
3. Assessment of Black Start Service Provision.
4. Short, Medium- and Long-term strategy.

## Black Start Service

A 'full' Black Start service is defined as a provider, or a combination of providers who can meet the three basic requirements for Black Start;

1. To start-up (following a Total Shutdown or Partial Shutdown) independently of external supplies;
2. To be able to energise part of the network, and;
3. To be able to provide block loading of local demand.

This Strategy will be effective from 1st April 2020. Prior to the acceptance of this V4.0 "Black Start Strategy and Procurement Methodology" by Ofgem, all decisions made were made in line with the previous agreed Black Start Strategy and Procurement Methodology approved on 31<sup>st</sup> July 2019.

With the changing generation profile, there are an increased number, and type of providers who can assist with restoration during a Black Start event. This Strategy aims to enable the identification of new technologies that can contribute to restoration and potentially become new Black Start providers. However, not all generators will be able to meet the technical requirements<sup>2</sup> for Black Start and therefore they may play a part in later stages of the Restoration Approach rather than delivering a Black Start service.

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<sup>2</sup> <https://www.nationalgrideso.com/balancing-services/system-security-services/black-start?technical-requirements>



To continually achieve restoration in an economic, secure and efficient manner the Black Start Restoration Approach, as outlined in this Strategy, will be developed, considering the network infrastructure, Black Start providers' capabilities, new technologies and ways of working. Confidence and competition are required in the Black Start market to make this vital service an attractive prospect for providers.

## 1. RESTORATION STANDARD AND TIME

The Black Start restoration process is complex, and achieving restoration is reliant on the whole electricity sector's ability to assist. Factors that have a significant impact on the speed of restoration include, but are not limited to:

- the number of available Black Start providers (and their MW capacity),
- the time for Black Start providers to reconnect and export following a shutdown,
- the time for non-Black Start providers to reconnect and export following a shutdown,
- network design, network condition and demand availability
- all network operators' ability to manage several power islands, and
- the resilience and reliability of communications and other critical tools/facilities across all key stakeholders (Providers, DNOs, TOs, BEIS, Ofgem)

Whilst the Grid Code states there is an essential requirement for the NETS to incorporate Black Start Capability, there is no current defined standard from which to enable ESO to prescribe further detail of this capability requirement. A GB Restoration Standard, and associated implementation methods are under development through the Black Start Task Group (BSTG), led by the Department for Business, Energy and Industrial Strategy (BEIS). The outcome of this work will require alignment between this Strategy and a GB Restoration Standard to fulfil obligations on ESO and the wider sector. The COVID-19 outbreak as delayed the decision to approve the Restoration Standard but once approved the Strategy will be amended.

In the absence of a Restoration Standard, identifying an appropriate Restoration Time for GB (with consideration for regional differences and an associated commercial view), is required to set a baseline for restoration against which sufficient Black Start Capability can be sourced and procured.

ESO has maintained the planning assumption for Restoration Time, in line with historic expectations; this means planning to achieve restoration of 60% of national demand within 24 hours, provided the procurement of this capability can be demonstrated to be economic. Calculation of the Restoration Time requires a probabilistic assessment of shutdown scenarios, reflecting the range of severity of events, to determine likely timescales for differing stages of restoration.

Whilst there will inevitably be regional variations to this Restoration Time the aim is to create a broadly consistent rate of restoration, reflecting the regional nature of civil contingency planning. During restoration, demand would be

gradually restored by establishing a skeleton transmission network. The selected Restoration Time strikes a balance between a realistically achievable level of network energisation against an economic level of service provision. This timescale is informed by current industry expectations and enables the civil contingency community to plan accordingly.

Whilst the Restoration Time is a fixed value throughout the year, seasonal variations in demand mean that the required capacity of Black Start service providers available at any one time is not a static value. Restoration Time can therefore be assessed in operational timescales so that service availability can be maintained in an economic manner, and additional availability is not instructed over the requirement.

Once capability has been procured to meet the Restoration Time, it may be necessary to take operational actions (e.g. issuing of warming instructions to maintain Black Start Capability) due to provider outages or individual provider running patterns. These actions will ensure that the Minimum Service Level is maintained always.

The Minimum Service Level sets out a minimum Restoration Time that is deemed acceptable for restoration should the planning assumption (60% demand restored in 24 hours) prove uneconomic to procure, or to maintain in real time operations as detailed in the Procurement Methodology.

The Minimum Service Level for the period 1 April 2020 to 31 March 2021 has been determined as a Restoration Time which will allow for variations of number of available providers across GB. Should there be a situation where the Minimum Service Level cannot be maintained, either through lack of Black Start Capability or a significant increase in costs to maintain the Minimum Service Level, ESO will inform both BEIS and Ofgem of this and demonstrate the actions that have been taken to reduce the impact to system restoration and detail the changes being proposed to the level of provision. This situation may arise due to extreme unforeseen circumstances, for example a type fault on an asset class.

## 2. RESTORATION APPROACH

The changing nature of the generation mix within GB has led to rising operational costs for current conventional Black Start providers. Alternative approaches to restoration techniques, and Black Start provider technologies are being actively considered and developed through the Network Innovation Allowance (NIA) and the Network Innovation Competition (NIC) funded projects, which we expect will lead to an evolution in system Restoration Approach and technical requirements.

Currently, our Restoration Approach uses a number of self-starting generators to restore local demand, to energise a pre-agreed Local Joint Restoration Plan (LJRP) and create a small power island.

Power Islands are developed in line with LJRP's which are agreed alongside a Black Start contract and set out the activities and steps that the Black Start provider, relevant DNO and ESO will carry out during a Black Start event. It is a contractual obligation for the Black Start provider to have an agreed LJRP in place when the Black Start service goes live.

The number of LJRP's that each TO and DNO area can carry out at any one time is continually reviewed for changes in Black Start providers and LJRP's. The duration of switching actions and available Control Room resources are likely to limit restoration progress far more than provider availability. During a Black Start event, not all contracted providers may be able to Black Start and a spread of LJRP's across TO and DNO areas is therefore a consideration for resource management during an event.

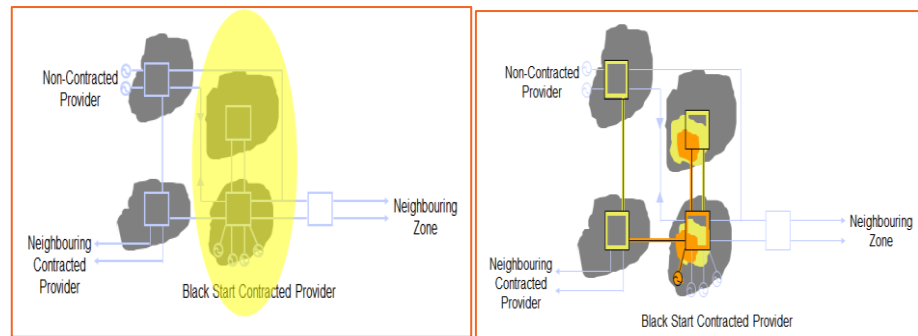


Figure 1: Initial Restoration



The current GB Restoration Approach aims to create a skeletal version of the NETS – called the skeleton network. This has the benefit of extending auxiliary supplies to non-Black Start providers sooner. This enhances the restoration as the sooner these providers can start up, the sooner they can contribute to restoring the national demand and the remaining Transmission network.

The skeleton network Restoration Approach adds flexibility to provider diversity and locational considerations. Here the focus shifts from the number of parties within a geographical zone, to the impact that a provider (or combination of providers) has on Restoration Time within a region and on GB.

This Restoration Approach also identifies the importance of providing start up supplies to non-Black Start providers in a timely fashion to reduce delay to the overall restoration. In some areas, the Black Start Capability is supplemented with additional restoration services to enable non-Black Start providers with significant restoration capabilities to be contracted and committed to the system restoration under certain scenarios.

In 2017, as part of the BSTG the Restoration Approach was explored, and it was concluded that the current skeleton network Restoration Approach is most suitable for the current number and placement of the providers as well as the current network infrastructure. The Restoration Approach will be continually reviewed to align with any significant network infrastructure change or significant change in providers' characteristics. Distributed Restart project (NIC funded) will also be scoped to explore the restoration approach. More information will be available when the project design will be published in July 2020.

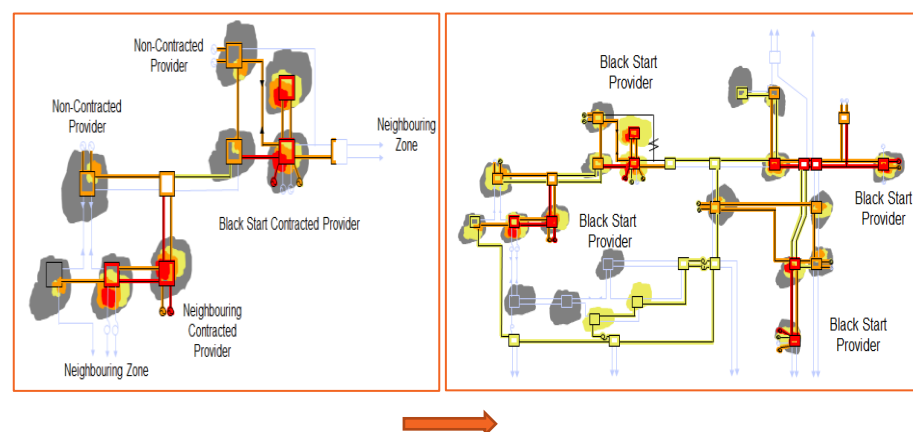


Figure 2: Skeleton Network

To deliver this Restoration Approach procurement of Black Start service provision is carried out across six zones within the GB network.

The use of GB zones for contracting:

- Ensures the split of Black Start providers is reasonably spread over DNO licence areas to share the resourcing of enacting LJRP and demand loading.
- Ensures that most non-Black Start stations are all relatively close to a Black Start provider and therefore auxiliary supplies are provided as the skeleton network is established.
- Creates a relatively uniform restoration of the NETS along the skeleton network.

Additional flexibility and resilience for providers is allowed by the nature of a skeleton network approach as there are no fixed boundaries for contracting zones. These can evolve and change as the transmission system and Black Start provider locations change and develop over time. Multizone capability should also promote competition as greater participation would be expected and therefore more commercial benefits are realised. A provider would be more inclined to consider participating if there are more opportunities.

Although service availability is a requirement for a Black Start provider there may be instances when an operational decision is taken by ESO to make a provider available, when it is not currently – i.e. to take actions to warm (if appropriate) and run a provider to reinstate as Black Start available to maintain the Minimum Service Level. Moreover, the number of providers available at any time can be monitored and revised with the changing demand throughout the year as long as the Restoration Time is met.

### 3. ASSESSMENT OF BLACK START SERVICE PROVISION

A mathematical probabilistic model has been developed using @Risk software. This model takes the jointly agreed and electrically validated LJRP restoration routes, with many input parameters to create a distribution of Restoration Times for the national and zonal picture. Network parameters (for example reactive power) are therefore not explicitly modelled, however the impact of resource, network failure and the time of day are considered.

The model outputs are therefore used as a baseline indicator of the impact of a combination of Black Start providers to deliver the Black Start Capability within the range of Restoration Time and Minimum Service Level. Input variables to the model have been validated within the BSTG.

It should be noted that the model may undergo further developments and therefore associated results may vary as the model is improved. Decisions that are taken for Black Start provision and procurement will be made in reference to this baseline, to demonstrate improvements and to show that value is being delivered.

In this probabilistic model, cases are developed based on a range of scenarios that may be in place during a Black Start.

Restoration Time stated in this Strategy is based on the Central case; which is deemed as a credible balanced scenario, representing a more typical, and perhaps more likely, set of circumstances. It is a balanced view based on restoration requirements across the year with some support from renewable sources. It reflects a general belief that restoration is unlikely to go precisely to plan - as suggested by the various options and in-built flexibility within LJRP, as there will be mild difficulties and obstacles throughout the restoration process. The model results provide statistical measures of restoration performance and can be based on several factors.

An outline view of the way in which this work process can be implemented can be seen in Appendix 1. However, until such time the Restoration Standard has been sanctioned, details are subject to review.

#### Technical Requirements:

The technical requirements are fundamentally describing three significant activities undertaken during restoration:

- the ability to start up independent of external supplies
- the ability to energise part of the network with MVar export only (i.e. at OMV)
- the ability to block load local demand

Detail technical requirements are available on the following ESO Black Start website:

<https://www.nationalgrideso.com/balancing-services/system-security-services/black-start?technical-requirements>

In 2019/20, ESO launched two Competitive Procurement Events for new services in:

- i) South West and Midlands
- ii) North West, North East and Scotland

With the changing generation landscape, the technical requirements have evolved including the and also emphasizes on contribution to stability e.g. inertia and short circuit level. We have developed a Technical Requirements and Assessment Criteria <sup>3</sup>to be used to objectively assess each service offering.

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<https://www.nationalgrideso.com/sites/eso/files/documents/Appendix%201%20-%20Tech%20Requirements%20and%20Assessment%20Criteria.pdf>



## Combined Services

Historically one large provider has delivered all aspects detailed in the technical requirements; however, in certain situations these requirements can be met using a combination of providers to deliver the equivalent Black Start service (and as one contract), therefore providing opportunity to other provider types that have previously been incompatible with technical requirements.

One example of this arrangement could be an interconnector which can provide active and reactive power and energise part of the transmission network. If it can then provide start up auxiliary supplies to a mainland provider, and if the mainland provider is proven capable to block load demand, then the requirements of a Black Start service would be met. However, ESO will need to understand the contractual basis between the lead and secondary parties. This may also include interconnectors, where an agreement for provision of active power with the respective System Operator will need to be in place.

This arrangement must be considered on a case by case basis as not all provider combinations may be capable or may not wish to enter such an arrangement. The negotiated commercial terms for this agreement will be in line with the procurement approach detailed in the Procurement Methodology.

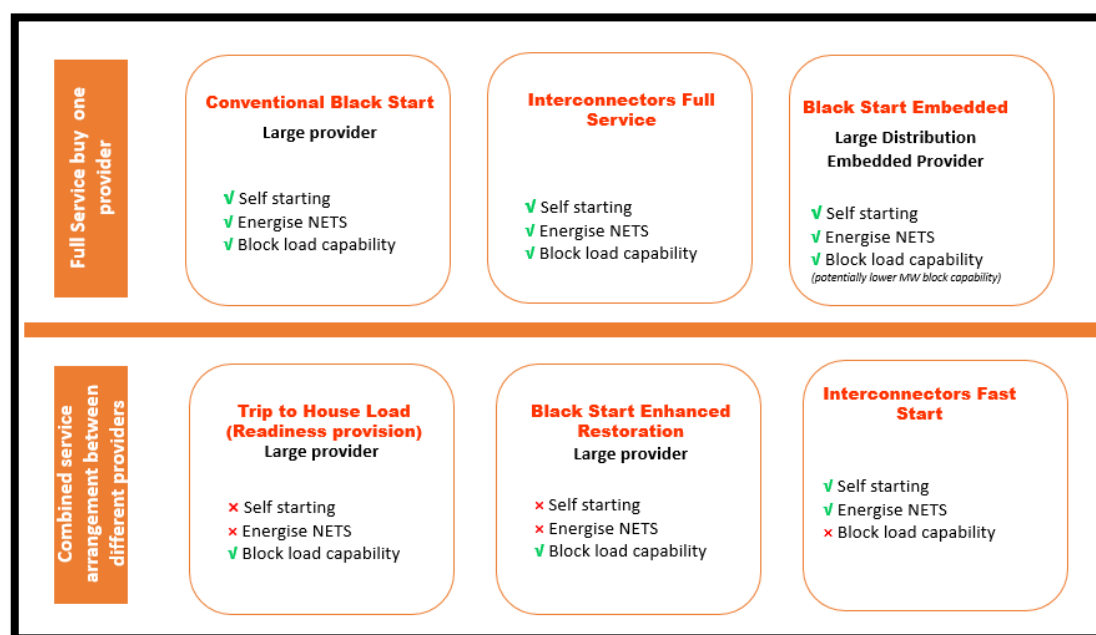


Figure 3: Examples of Black Start Services

Whilst there is additional resilience in one provider delivering all activities i.e. there is no reliance on specific transmission routes for all activities to be carried out (e.g. needing to energise part of the transmission network before block loading can commence), the benefits of diversification of provider type will bolster resilience against events which may render one type of technology unable to start up (e.g. a gas shortage for CCGT plant).

The Competitive Procurement events launched in 2019/20 provided an opportunity for various technologies to participate as combined services. Greater participation is encouraged by evolving the contractual framework, technical requirements and removing barriers to entry. During the tender submissions, there were various good examples of combined services e.g. conventional (thermal) + storage; wind + storage. These examples demonstrate the appetite and viability of the combined services for Black Start. With the Distributed Restart project, we anticipate more of the combined services examples.

ESO believes it is important to procure new Black Start providers that can fulfil these requirements and demonstrate a positive impact to the restoration process. Furthermore, providers that do not have Black Start Capability still have a critical role to play within restoration and ESO will continue to engage with these non-Black Start providers to ensure that their requirements are understood for further modelling and that the providers are clear in terms of their understanding of Black Start technical requirements and expected actions.

#### 4. SHORT, MEDIUM AND LONG TERM STRATEGY

The ability to maintain Black Start Capability is an ongoing requirement and as such the competition and transparency of Black Start provision needs to evolve. Below are the proposed activities over short (1 year), medium (1-3years) and long term (3-5years) timeframes to build confidence in the Black Start market and to evolve and develop Restoration Approaches and new provider technology options.

The evolution of the system Restoration Approach and the development of new technology options to provide Black Start Capability are interlinked and a development in one may trigger both a need and an opportunity in the other.

##### Short Term Strategy 1 year ahead

The Restoration Approach as detailed in this document has been adopted to allow for flexibility of provider technologies to be further explored. This approach will enable the Restoration Time expectation of restoring 60% of GB demand within 24 hours to be met with wider types of providers and with more consideration for the entire network, rather than particular regions.

In the short term the aim is to maintain and improve the Restoration Time expectations, whilst broadening participation for Black Start services. More specifically, we aim to provide transparency around technical requirements and guidance for service opportunities for providers of all technology types in a clear and consistent manner. This will increase both the market awareness of the

service and open the service to a wider range of providers, enabling competition.

We will continue to monitor Restoration Time in real time and take necessary actions e.g. warming of additional units to ensure Restoration Time is achieved as we have done so in previous years. Further information in Part 3.

Over the past year, ESO contracting process has been adapted to integrate several alternate solutions, including combined services, islanding or Trip to House Load, and interconnectors (more details are provided in Part 3). ESO will continue to drive benefit for the end consumer by deploying these options where possible and appropriate to meet our requirement.

Periodic reviews of Black Start requirements, that may arise due to contracts expiring or new requirements being established will continue to be carried out to ensure that actions within this strategy year are building market competition and enabling new technologies to participate within the Black Start market. This will be achieved through a robust forward procurement approach outlined in the Procurement Methodology which will identify potential opportunities as they become available, and proactively procuring to meet this need.

Further opportunities to create competitive procurement will continually be identified, where/if there is enough liquidity and it can be demonstrated that a competitive procurement approach for Black Start provision provides value for the end consumer.

To maintain a flexible, fit for purpose restoration plan ESO has sought to enable varied technology restoration solutions. This will reduce the reliance on any individual solution for restoration and will increase competition in this area. New provider technologies identified to be Black Start capable will be progressed, as required.

We are engaging with the wind industry to understand their capability in more detail and capturing the information received into operational advice for control engineers. This will build our knowledge and skill base to be able to use more wind generation earlier within a restoration

The NIC funded project, now known as “Distributed Restart is underway. Design scope of the project will be published in July 2020. Further details of the project are available at its website<sup>4</sup>.

Due to variation in demand and generation in different zones in the country, for efficiency and relevance, a zonal strategy may be considered. This will become even more vital once the Restoration Standard is implemented. This may require revision of current policy as well as TO network reinforcement.

Ongoing industry collaboration with the BSTG continues to design and inform a Restoration Standard, alongside new obligations in the Network Code on Emergency & Restoration (NCER). ESO will continue to work on the implementation of the NCER in 2020, with further changes being made to SO-TO Code Procedures (STCP), potential expansion of SGUs (Significant Grid

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<sup>4</sup> <https://www.nationalgrideso.com/innovation/projects/distributed-restart>



User) to ensure a more resilient restoration and updates to the electrical standards for Control and System telephony.

Over this timescale, the Black Start service providers will also undergo a programme of tests and exercises to assure their competence and provide assurance against their contracted position. Article 43 states the general principles for compliance testing of capabilities for SO, TOs, DNOs and SGUs. Articles 44 to 49 describe the testing requirements and are summarised in the System Restoration Plan<sup>5</sup> and System Defence Plan.<sup>6</sup>

#### Medium Term Strategy 1-3 years

ESO will continue to explore new provider technologies and innovative Restoration Approaches to improve the efficiency of the service. ESO will continue its active engagement with both the Black Start Task Group and wider industry.

This will include, but is not limited to:

- Whole System Approach: Any future Restoration Approach needs to consider future trends in generation and network design, and the ability to adapt to new technologies whilst maintaining reliance of restoration. In some areas, further network investment may be required to enable alternative restoration methods.
- Spinal Restoration Approach – Depending on the network infrastructure and Black Start Service provider capabilities, this Restoration Approach of energising a single energy corridor during restoration may be explored.
- Distributed Restart: In the medium term the project scope will be further refined. Phase II of the project will be progressed to produce its findings by January 2022. The project will prove feasibility through physical testing of case studies across various DNOs. A successful project outcome provides solutions that must be applicable/ relevant across the GB networks, not only to limited regions/ zones.
- Results from Competitive Procurement event: Potential providers who met the tender and technical requirements will be selected to progress with contracts and service delivery from April 2022 in South West and Midlands; and from October 2021 in North West, North East and Scotland.

If a Restoration Standard has been imposed, then this will be implemented and a suitable Restoration Approach derived. If no Restoration Standard is in place

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<sup>5</sup> <https://www.nationalgrideso.com/document/135211/download>

<sup>6</sup> <https://www.nationalgrideso.com/document/135226/download>

during the medium term, then the short-term expectation will be reviewed and amended if required.

#### Long Term Strategy - 3-5 years

There will be continued exploration into Restoration Approaches with the intention of moving towards a more suitable Restoration Approach for GB. New emerging technology types, such as storage will also be continually explored to understand how these can contribute to restoration and whether a commercial service is appropriate.

The Restoration Approach will be reviewed at least once every two years, to ensure that Black Start Capability procured keeps pace with all relevant technologies. Any significant network infrastructure change or providers' geographical dispersion will also trigger a review of Restoration Approach.

Any technology type that is considered to be feasible to provide Black Start Capability, as part of the NIA project's finding will be further explored and implemented.

By this term, Distributed Restart project, if proven feasible and viable, should provide an enduring solution to be implemented into business as usual restoration activities.

Furthermore, it is equally imperative to have sufficient secondary level of generation<sup>7</sup> available for an efficient and sustainable restoration., following the initial stages. This means better engagement in order to ascertain better information about the secondary level of generation

If a Restoration Standard has been imposed, then this will be implemented and a suitable Restoration Approach derived. If no Restoration Standard is in place during the long term, then the medium-term expectation will be reviewed and amended if required.

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<sup>7</sup> Secondary level of generation are non-Black Start providers who get supplies from the Black Start service provider and forms second layer in the restoration.



# 3

## Procurement Methodology

# Introduction

This Procurement Methodology documents the approach for determining value to current and future consumers and how each Black Start service contracted will provide that value and how this is assessed cumulatively. It will also outline our approach to assessing the trade-off between an economic and efficient level of service provision for consumers and the restoration timeframe that such provision will deliver, whilst ensuring that such provision is conducted in an economic, efficient and competitive manner where appropriate.

As part of our procurement of Black Start, we will continue to follow our overarching Procurement Guidelines as prescribed in condition C16 of ESO transmission licence<sup>8</sup>. This Procurement Methodology has been produced in accordance with Special Condition 4G Part B and should be read in conjunction with the Procurement Guidelines and the Black Start Strategy produced in accordance with Special Condition 4G, Part A.

This Procurement Methodology will be effective from 1st April 2020. Prior to the acceptance of this V4.0 “Black Start Strategy and Procurement Methodology” by Ofgem, all decisions were made in line with the previous agreed Black Start Strategy and Procurement Methodology approved by Ofgem on the 31st July 2019.

As noted in the Black Start Strategy, in lieu of a Restoration Standard we will be making procurement decisions on the expectation of complying to a Minimum Service Level that we currently work towards, however if the Restoration Standard is approved, and it sets out additional obligations, we may have to procure more capability more than what we deem would be required to meet this obligation, particularly in the case of procurements events with published timelines. If this is the case, then we would amend the Black Start Strategy and Procurement Methodology appropriately as soon as practicable.

This Procurement Methodology is made up of the following parts:

5. Cost Components for Black Start.
6. Procurement Principles.
7. Value Assessment.
8. Short, Medium- and Long-Term Strategy.

## 5. COST COMPONENTS FOR BLACK START SERVICE

ESO shall demonstrate how consumer value is assessed across all Black Start services contracted cumulatively. ESO will continue to procure economically, whilst developing new and alternative providers to assist with the medium- and long-term strategy in accordance with the Strategy. When assessing value to the end consumer and overall combined cost ESO shall consider the following.

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<sup>8</sup> <https://www.nationalgrideso.com/balancing-services/c16-statements-and-consultations>



Black Start Availability – to cover costs for providers to maintain the availability of capability on site for the duration of the contract term – typically resource and maintenance, and to provide a return for delivering the service. Where capital is paid off, we would expect a payment to reflect the reduction in cost.

Black Start Capital Investment – to cover costs for either installing capability or works required to maintain the capability – typically an auxiliary generator.

Black Start Testing – to prove the capability of service providers. Traditionally, the cost reimbursement arrangement is agreed between the provider and ESO at the time of the test based on the provisions in their Black Start service contract. In the competitive procurement event for Black Start in the SW & Midlands and for the Northern Tender we are trialling including the testing costs in the Black Start availability fee to equally compare the total cost of the service and provide more transparency. Where we have negotiated bilaterally for the test, we will work together with the provider to test the unit at the most economic and efficient time. In 2019 we introduced a cost reimbursement methodology (an example of this in Appendix 3) for existing providers which is linked to market indices and is cost reflective, making the cost more transparent and fairer to the provider and the end consumer. This methodology will be used for providers when appropriate to do so, in particular for those who would be influenced more by the gas/coal spread.

Black Start Feasibility Studies – to cover the costs for a provider to understand what is required to deliver a Black Start service, including identifying if any capital investment is required. We will ensure any costs incurred through feasibility studies incurred by service providers will have been secured through an economic and competitive process. As an example, service providers will be expected to tender for their OEM. If this isn't feasible, National Grid will expect the service provider to demonstrate why they have chosen to use only one provider and we would expect the costs to be itemised, so National Grid can challenge the cost and content of the feasibility studies to drive value.

In 2019 for both competitive events we have capped the cost of the feasibility study to £150,000 per service offering. This is an average of recent studies that we have agreed and believe is a fair reflection of the internal and external costs associated with the study and is paid on an open book basis.

Black Start Warming – to cover costs associated with bringing existing Black Start capable providers' units who are not self-dispatching to a warm state so they can be Black Start available. When assessing whether to warm Black Start units, ESO will also assess other system services that will be inherently delivered. For example, where a Black Start provider also has Reactive Power capability and is in an area where action is needed to manage voltage levels this will be considered as part of the value assessment. In such circumstances ESO use a local work instruction that outlines the method used to determine what costs are allocated to Black Start and what portion will be allocated to Balancing Service costs. This is further explained in Appendix 2.

These cost components relate to different stages in the contracting process, the timing of which can impact ESO cost recovery. All Black Start costs are included in the Black Start Allowed Revenue Report submitted to the Authority at the end of the relevant year in accordance with special condition 4G. Part E, noting the following:

**Incurred Costs** - It is also important to note that the ESO will incur costs in the relevant year but may not make payment until the next year. For example, if a provider invoices ESO for works carried out in conjunction with a feasibility study on the 30th March, ESO will validate the invoice before submitting to the settlements team for processing, in this case payment would not be made until after the 1st April. We will document any such cases in the Black Start Allowed Revenue Report. It is also worth noting that ESO will also make spend decisions in a year, but the costs are not incurred for later years, such as forward contracting and where capital investment is paid over a period of time. For example, in July 2020 and October 2020 the ESO will make spend decisions for Black Start services in the SW & Midlands and Northern Tenders starting from April 2022 and October 2021 respectively and cost recovery will be from 2022 onwards.

## 6) PROCUREMENT PRINCIPLES

Our principles for procuring Black Start services are:

- A clear and transparent requirement.
- Enabling competition, where appropriate.
- Reducing and removing barriers to entry to enable broader participation.

### Principle 1 – clear and transparent requirement

ESO commits to sharing, where it is appropriate and possible to do so, when and where there is a requirement, and sufficient information about that requirement to enable potential providers to assess whether they could contribute. This may not be possible for all requirements, but as and when it is in the interests of the end consumer, this is the approach ESO will aim to use.

### Principle 2 – competition

ESO will use the following criteria to assess the level of competition in relation to meeting a requirement and to determine whether a Market Mechanism, Bilateral Negotiation or a combination of the two is most appropriate to deliver the best outcome for the end consumer.

- 1) Is there a clear requirement to improve/increase/replace Black start provision?
- 2) Who are the parties who could contribute to meeting this requirement? How many are there? Are they suitably independent or do they share a parent company?
- 3) When does, the requirement start? How long would it take for the identified parties to complete the feasibility assessment process and be able to prepare a commercial offer? Could other parties also complete this process in this timeframe?
- 4) What is our best view of the life expectancy of current providers (using Future Energy Scenarios (FES)? Is introducing competition in the best interests of the end consumer, considering whether additional capital investment would be required?

Where ESO determines that a bilateral contract is the most economic and efficient approach, we shall ensure that any Black Start costs will be assessed using approach(es) detailed in the Value Assessment outlined below.

#### Principle 3 – reducing and removing barriers

ESO has adapted the standard contracting process and revised the technical requirements so that interconnectors and combined services can participate alongside conventional generation which the ESO observed in the competitive procurement events in 2019. We will continue to adapt our processes as and when we are confident that an appropriate technology readiness level for restoration contribution has been met, and that the risk to end consumers is sufficiently reduced.

ESO has introduced updated standard Black Start terms that enable all technology types to offer Black Start services and these have been used as part of the tender for the SW & Midlands and Northern and will be used for the future procurement of new services.

Although ESO remains technology neutral in our approach to the technical requirements, we will draw on the outcomes of the Distributed Re-start project as and when they are available to support diversification of technology types.

## 7) VALUE ASSESSMENT

### a) **Black Start Services**

Once an offer has been received, either through a market mechanism (tender) or a bilateral negotiation, ESO shall then assess the cost of that service against the value it contributes to the regional and GB restoration timescale. This section will identify the methodologies used to determine the value to current and future electricity consumers in GB of Black Start provisions. In 2019 we developed the Technical Requirements and Assessment Criteria that will be used for both competitive events in an objective way that is fair and transparent for all parties to determine the most valued service offering. This assessment is also used in the process for renewal of existing contracts if required.

The existing methods outlined in the current Procurement Methodology are still relevant for decisions in 2020/21 and outlined below.

#### i) **Market Pricing**

Where ESO has determined there is sufficient liquidity to competitively procure, the costs of the service will be determined by the market through a pay as bid mechanism and assessed in accordance with the published Technical Requirements and Assessment Criteria. Future prices accepted through these events will be published on our website.

ESO reserves the right to employ a third-party consultant to support in the assessment of capital contributions, where this is required, to ensure value for the end consumer

ESO will allow potential providers to make clarifications and refinements to these costs through the clarification period after commercial submissions have been submitted, further outlined in the tender process.

#### ii) **Cost Plus**

This approach is used for new services that require significant capital investment; to cover the costs of the investment plus variable costs for the service. During the contractual discussions information, such as the rate of return on the investment, installation and design costs shall be requested and assessed from providers to provide justification for the offers.

Based on the available information, analysis is undertaken to evaluate the cost to provide the service. ESO will use our own models to provide estimates of costs and fair returns on investment to provide an indicative service cost. This will guide our contractual discussions as to a fair price for the service. Alternative costs (see below) will also be considered for new build or retrofits.

### **iii) Alternative Costs**

This approach is the primary assessment approach for existing Black Start providers, although can be used for new providers or retrofits, and is based on using real and forecast alternative costs to calculate Black Start service costs. The technical capability of the provider as well as the contribution to the restoration will be assessed in accordance with the published technical requirements and assessment criteria and we shall also consider existing service providers' prevailing costs and future operating costs in the determination of value.

There are a number of geographical zones where thermal assets are closing or scheduled to close and we will review market conditions and forecast future costs to determine the economic value of services. For example, ESO may procure Black Start Capability from providers at a higher overall contract service cost, if analysis indicated an alternative provider was forecast not to be economic to self-dispatch for a significant part of the year and so require extensive warming costs to deliver its capability.

In zones where multiple units of the same technology type are forecast to require extensive warming, we shall factor this into our wider strategy consideration. For example, we will procure an alternative technology subject to meeting the procurement principles and Black Start Strategy (with lower forecast costs) to ensure that we reduce the requirement for multiple units that require warming and improve diversification. This in-turn can drive competitive tension between the remaining units that do require warming.

### **iv) Portfolio**

This approach is used where we have multiple stations from the same provider to drive a discounted rate and reduce overall costs. In contrast, where a portfolio of assets means that a parent company has a dominant market position, ESO may instead opt to use a combination or subset of the principles and approaches to deliver the best result for the end consumer.

It is expected that the evolution of market mechanisms will be used predominantly to determine value of Black Start services, therefore Cost Plus, Alternative Costs and Portfolio methods would generally be used if ESO bilaterally contracts with providers. The methods outlined above will ensure that ESO will procure economically and efficiently.

### **b) Feasibility Studies**

ESO will assess whether it is economic and efficient to incur feasibility studies costs to allow new providers to participate. The feasibility assessment process is a mandatory prerequisite to service participation, and therefore a potential barrier to entry to potential new providers. As such, when assessing the cost of the feasibility study, ESO must also assess the impact on future service costs, liquidity and competition. This process is a defined part of the tender process and will be incorporated as a cost for future tenders, currently capped at £150,000 per service offering.



Before entering a new Black Start contract a potential service provider must demonstrate that they can become Black Start capable. This is done through a two-stage feasibility study approach.

The Stage One study identifies the potential provider's Black Start Capability at a very high level, to consider whether a more detailed study should be carried out.

If Stage One<sup>9</sup> is successful in identifying potential Black Start Capability, and subject to the Black Start Strategy, a Stage Two study will be commissioned. This study will determine whether the provider has or will be able to develop Black Start Capability, and will identify any requirement for capital investment.

Before committing to studies and especially funding Stage Two, ESO will consider the following criteria:

1. Current and future anticipated Black Start Capability in GB, in line with the Black Start Strategy.
2. The impact of the potential new provider on zonal liquidity and competition, and national service provision.
3. The impact of the potential new provider on diversification of technology/fuel type.
4. The impact of the potential new provider on current and future service costs.
5. The impact of the potential new provider on the Restoration Time.
6. Costs of the feasibility study and evidence from the provider that this has been procured economically, including assessing costs against previous feasibility studies and demonstrable evidence of negotiations with OEM's.

With the introduction of the competitive events, to promote competition and to remove barriers to entry, feasibility study costs will increase in aggregate, however the cost is only sanctioned if the ESO believe the proposed service could offer a valuable Black Start service and the cost removes barriers to entry. This is validated by the two-stage process above and careful consideration is taken to determine which service providers are taken through to the next stage of the tender.

The cost of an F2<sup>10</sup> study without any guarantee of a contract would otherwise be a critical barrier to entry and limiter of competition. We believe the short-term cost provides a greater long-term benefit overall and is in the interests of current and future end consumers. Therefore, meaning we will not always contract with every provider who have completed an F2, however this approved study would be valid for any future tenders (assuming no material changes have been made to the asset providing the service).

### **c) Other Considerations and Differentiating Factors**

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<sup>9</sup> <https://www.nationalgrideso.com/balancing-services/system-security-services/black-start?overview>

<sup>10</sup> <https://www.nationalgrideso.com/sites/esofiles/documents/Appendix%20%20-%20Feasibility%20Assessment%20Process.pdf>

If necessary, and including for the purposes of a competitive procurement (for example if two providers are scored the same using the Technical Requirements and Assessment criteria), ESO reserves the right to apply differentiating factors which may include but are not limited to: -

**Evaluation of provider longevity.** With forecast market conditions, uncertain and a number of traditional sources closing, the life of the station is an integral part of the decision to award Black Start contracts, in particular when capital investment is required.

**Evaluation of secondary system benefits.** This procurement approach aims to ensure that the entire system operation is secure and economic. To that end cost savings are considered where secondary benefits have been identified.

When assessing secondary benefit, we perform analysis to determine what the system requirements are likely to be, both locally and nationally, and to what extent the Black Start provider contributes to the competitive procurement of those requirements. This can include the displacement of the need to procure balancing services from other providers, e.g. voltage support but can also increase the level of competition between potential providers of a service and thus lower prices.

**Requirement to warm stations.** Where Black Start contracted units are likely to require warming, we consider the provider economics, including a view on ancillary service revenue, wholesale market revenue, Capacity Market contracts as well as the fixed costs associated with the station. This is used to assess what is a reasonable level of top up payment that should be made to the provider to ensure the station is warm and thus Black Start capable.

- Forward spreads are used to determine potential wholesale market running and profit.
- Historic analysis of running patterns and spreads are used to inform the likelihood of the unit dispatching for the warming period.
- The future outlook (for the warming period) is also evaluated (including spread analysis) as well as the top-up that may be required to incentivise the unit to run.

This analysis informs the negotiation strategy, which seeks to minimise any top-up paid to the counter-party and determines appropriate contractual mechanisms to minimise distortion in the energy market.

**Flexible Restoration Approach:** The Black Start Strategy Restoration Approach adds flexibility to provider diversity and locational considerations. If the incremental costs of contracting an additional provider in an under-contracted zone could be reduced by using a provider from a neighbouring zone, then this would be considered during the assessment process. This would also work in zones where providers are contracted but with warming requirements. We would evaluate the use of a provider from a neighbouring zone to provide Black Start Capability rather than agreeing a potentially high

cost warming contract. We may also use the ability to support more than one zone as a differentiating factor.

ESO will use the above approaches and criteria to determine whether procuring Black Start services will provide consumer value. For example, If the incremental cost of an additional service is excessive and provides marginal benefit, ESO may decide not to contract providing the impact on the resulting Restoration Time does not have an unacceptable impact on the Minimum Service Level.

## 8. SHORT, MEDIUM AND LONG TERM STRATEGY

### SHORT TERM – year ahead

In the short term ESO will continue to employ our contracting principles including, introducing competition where possible, renewing where appropriate, and assessing value to ensure economic and efficient spend decisions that benefit end consumers.

We will continue to provide transparency around the Black Start market, including publishing a clear requirement where appropriate to do so, and along with technical requirements to help potential providers self-assess whether they could contribute to a restoration. Further information on the ESO Restoration plans is documented in the ESO forward plan for 2019-21.

Learning from both the competitive events for the SW & Midlands and the Northern Tender will be used to determine the approach for the next competitive tender which we expect to launch in Q2 2021 for the South-East zone. We have attached an indicative timeline below:

Dates	Activity
May 2021	Expression of interest opens for SE Mini Tender
July 2021	Expression of Interest closes for SE Mini Tender
Sept 2021	Invite providers to present FS1 and Scope FS2
Dec 2021	FS1 and FS2 Scope closes
Feb 2022	<b>Review FS1 and FS2 Scope and move providers to next stage</b>
Aug 2022	F2 and Commercial Submissions
Oct 2022	Contract Award
Dec 2022	Service commences
Dec 2025	Service expires

In this timeframe, we will have also agreed contracts with service providers for the SW & Midlands and the Northern tender for services commencing from April 2022 and Oct 2021 respectively. If the ESO foresee a reason why long-term ambitions of competitive markets and using alternative approaches cannot be met in the short to medium term we would continue to ensure capability is maintained which may require contracting with existing providers through bilateral contracts if appropriate to do so.

If a Restoration Standard has been agreed, then this will be implemented, and a suitable Restoration Approach derived. Consequently, this could have an impact on this Procurement Methodology and therefore this will be reviewed and updated as appropriate.

### **MEDIUM TERM 1-3 years**

The SW & Midlands competitive event will have completed, and services will start delivering in April 2022, additionally we will have services delivering from the Northern tender from October 2021. Learning from these processes will enable the ESO to shape and determine the procurement approach for future competitive events.

As technology readiness levels increase, we will adapt our processes to enable wider participation, which will increase competition and drive down the overall cost of this service to the consumer.

We will have an outcome from the Distributed Re-start project and would expect to use this to support a whole system tender if appropriate.

### **LONG TERM 3-5 years**

The long term will build upon the work of the previous years in evolving a Black Start market where possible and identifying and valuing technologies that can provide a positive contribution to restoration. The Black Start Capability will be continued to be procured to meet the strategic requirement. Outcomes of the Distributed Re-start project will become available, and as these are implemented into our processes, we will update our documented Procurement Methodology to reflect this.

In the Functional Requirements for Procurement & Compliance for the Distributed Re-start published in Nov 2019 we provided an indicative timeline of when the outcomes of this project could participate in future tender rounds for the provision of Black Start Services. A view of this attached below, but further information can be found in the document<sup>11</sup>

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<sup>11</sup> <https://www.nationalgrideso.com/document/156221/download>

	19/20				20/21				21/22				22/23				23/24				24/25				25/26				26/27				27/28				Ongoing			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
NIC	Phase 1				Phase 2				Phase 3				Implementation and procurement process				Future services commence																							
SC, NE, NW – BAU	Current services endure, tender open								Tendered service duration																															
SC, NE, NW – Future									Implementation and procurement process								Future services commence																							
Mids, SW – BAU	Current services endure, tender open								Tendered service duration, procurement process for post contract opens																															
Mids, SW – Future									Implementation and procurement process								Future services commence																							
SE – BAU	Current services endure																																							
SE – Future									Implementation and procurement process								Future services commence																							

Certainty of timing: ■ ■ ■ High ■ Medium ■ Low





# 4

## Summary

# Summary

We need to respond to stakeholder feedback and the changing energy landscape to ensure that Black Start service provision is fit for the future. To do this, we need to be more transparent, introduce competition, and reduce and remove barriers to entry to enable wider participation. The Black Start Strategy and Procurement Methodology, in conjunction with the Restoration Roadmap May 2018 and Forward plan 2020-21 documents are our approach to achieving this.

ESO will consider the most appropriate method to ensure that we are following the Procurement principles. The Previous Procurement Methodology introduced the concept of a Market Mechanism where it is clear there is or likely to be sufficient competition in the provision of Black Start services. In 2019/20 we used this approach to deliver: -

- A Competitive Procurement Event for Black Start Services in the South West and Midlands was launched in February 2019. The increased market competition allowed more parties to participate, which should drive down the overall cost of the Black Start service to the consumer. The event also enabled potential providers to come forward and offer a combined service solution. Currently, ESO has requested participants, who progressed to next stage of the event, to submit feasibility study two reports by 30 April 2020. Details of the results and timeline are provided in the ESO Black Start website<sup>12</sup>
- A Competitive Procurement Event for Black Start Services in the North East, North West and Scotland was launched in August 2019 through an Expression of Interest (EOI). The increased market competition allowed more parties to participate, which should drive down the overall cost of this service to the consumer. ESO invited providers to submit an Invitation to Tender (ITT) in November 2019 to those who successfully demonstrated their capability in the EOI. These providers have now submitted their feasibility one and feasibility two scope reports on the 31 January 2020. ESO is now assessing the reports for next stage. Details of the results and timeline are provided in the ESO Black Start website.

ESO has also made progression on the delivery of Alternative Black Start services, such as:

- **Combined Services:** ESO explored and identified combined service opportunity with various providers. It is now progressing these through various stages of feasibility process. The competitive event also saw some good examples of combined services, which ESO is reviewing for next stage.
- **Trip to House Load (Islanding):** In 2019, another new provider with TTHL capability was contracted and has provided service delivery since January 2020.

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<sup>12</sup> <https://www.nationalgrideso.com/industry-information/balancing-services/black-start>

- **Interconnectors:** Interconnectors with suitable technology (voltage source convertor) have proven to be Black Start capable. There is enough interest from various interconnectors for the Black Start service. In 2019/20 /19, different interconnectors have been progressed to various stages of the feasibility process as part of the competitive procurement events. There is also enough competition to procure interconnectors competitively in some areas whilst more advanced level of engagement was made with interconnectors for service provision for some areas.
- **Results from NIA project:** Completed in May 2019. Various technologies were explored and scored for its contribution and viability to restoration. Wind, Solar and Storage were scored favourably and will be explored further for the service.
- **Distributed Re-start:** The project was commissioned to explore the Distributed Embedded Resources (DER) capability for the Black Start. The bid was approved by Ofgem in November 2018. The project team is now formed in partnership with ESO, Scottish Power Energy Networks (SPEN) and TNEI. Webinar sessions were held in March 2019, August 2019 and January 2020. The project also reached out to the industry via various workshops, teleconference and conferences etc. The first annual conference was held on 30 Jan 2020.

ESO engaged with the industry in further making the service efficient and relevant, such as:

- **NCER:** ESO has been implementing the Network Code on Electricity Emergency and Restoration in 2019. This has been completed by progressing the code changes
  - GC0108, EU Code: Emergency & Restoration: Black Start testing requirement (concluded)
  - GC0125, EU Code Emergency & Restoration: Black Start testing requirements for Interconnectors (Current)
  - GC0127/GC0128 EU Code Emergency & Restoration: Requirements resulting from System Restoration Plan (current)

These changes have been completed in collaborating with industry working groups and are seeking Ofgem's approval.

In accordance with NCER ESO have prepared and consulted on the following documents<sup>13</sup> with industry and Ofgem:

  - System Restoration Plan
  - System Defence Plan
  - Market Suspension
  - Test Plan.

Through a series of consultations there has been strong engagement from the industry. This feedback has been published

<sup>13</sup> <https://www.nationalgrideso.com/codes/european-network-codes>

on our [nationalgrideso.com](http://nationalgrideso.com) website; amendments made to the document and have now submitted these to Ofgem for approval.

- **Seasonal Readiness Strategy;** Since 2018, the seasonal readiness strategy has been used to assess and economically maintain the operational level of Black Start service in order to meet the Restoration Time. This considers the seasonal demand variation to adapt the number of providers in a state of readiness at any time whilst still maintaining the required Restoration Time and Minimum Service Level. The readiness strategy was further evolved and adapted in 2019 and the process is made more clear, measurable and efficient.
- Various Assurance Activities (e.g. Black Start tests, LJRP review, station assurance visits) were undertaken to comply with European code and align with Restoration Standard when it is implemented. Major long route energisation testing was also conducted in 2019.
- Black Start Training in September/ October 2019 was extended to include the external parties, TOs and various DNOs.
- LJRPs new format to represent and clarify roles and responsibilities among different stakeholders post Legal Separation was also completed in 2019.

In addition, the ESO has continued to engage with Stakeholders through various channels, such as: -

- Operational Forum
- Energy UK
- Interconnector Workshops
- BSTG
- Restoration workshops for all TOs and DNOs
- External consultation on System Restoration Plan
- Consultation on the EOI
- NCER Code work
- Consultation on the Draft Black Start Strategy and Procurement Methodology 2020/21

## General Provisions

Generally, ESO publish information on the Balancing Services we intend to procure and subsequently do procure. In doing so, we seek to provide market participants and other interested parties with sufficient information without compromising the commercial position of any contracting party.

### Disclaimer

All information published or otherwise made available to market participants and other interested parties pursuant to this Black Start Strategy and Procurement Methodology is done so in good faith. However, no warranty or representation is given by National Grid Electricity System Operator Limited, its officers, employees or agents as to the accuracy or completeness of any such information, nor is any warranty or representation given that there are no matters material to any such information not contained or referred to therein. Accordingly, no liability can be accepted for any error, misstatement or omissions in respect thereof, save in respect of a misrepresentation made fraudulently.





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Appendices

# Appendix 1

The proposed introduction of a GB-wide industry standard for restoration performance relies on a process to track year-on-year changes coupled with a measurement tool to account for these changes, translating them into a set of statistical results.

A year-on-year review of the following factors will be undertaken to provide annual updates. These factors have the greatest influence on restoration performance: -

- The generation fleet in GB (capacity, availability, fuel type and technical parameters)
- National and regional demand levels
- Design of Network, electrical and geographical
- Black Start Providers capability and Local Joint Restoration Plans
- wider zonal / strategy plans
- Seasonal levels of warmth in generation and quantity of generation connections able to join a restoration.
- Other related systems such as telecoms, network resilience, substation resilience, SCADA etc.
- Operational limitations and staffing.
- Interconnector characteristics
- Other major external influences such as weather, pandemics and potential network damage.

Revisions to these factors will be made with reference to market related data, operational data, feedback from the Assurance Framework activity or other pertinent source. Necessary changes will follow a change control process to manage the activity, otherwise data will remain unaltered to preserve year-to-year consistency.

The modelling tool proposed for the measurement task is based on the same structure and methodology developed by ESO on behalf of the E3C, Black Start Task Group (BSTG). This is a probabilistic model which used Monte-Carlo simulation techniques to map the spectrum of possible outcomes. The results are typically histograms showing likely performance outcomes which allow confidence levels to be derived. Results will be based on National and zonal statistics.

It is anticipated that successive restoration performance results will provide important trend indicators on where pinch-points occur. This will help focus resources to preserve a defined standard to the extent that options exist. This could require additional investment, new service provision, changes to industry processes or other measures to preserve a strategic capability to meet a standard.

The exercise relies on engagement from a wide range of industry parties, ESO modelling expertise and oversight by BEIS/Ofgem and/or independent verification of process.

# Appendix 2

## Secondary System Benefit

When assessing the value of a Black Start contract ESO will also assess other ancillary services that will be inherently delivered. For example, where a Black Start provider also has Reactive Power capability and is in an area where actions are regularly taken to manage voltage levels this will be considered as part of the value assessment.

In such a scenario ESO would assess the expenditure on the Black Start provider, less the amount that would have been spent on securing alternative voltage management units. This can be compared against other Black Start options which may or may not provide some secondary benefit and a holistic cost assessment can be made.

When assessing secondary benefit, we perform analysis to determine what the system requirements are likely to be and to what extent the Black Start provider contributes to those requirements. This will include not only displacement of the need for alternative actions but also to what extent the procurement of this Black Start provider drives further competition.

If ESO is in a position where the contracting of the Black Start provider means, we are less reliant on other providers then this too can have the effect of lowering prices.

In the specific example of voltage management benefit, the analysis will include the following.

- Review historic dispatch patterns of units capable of satisfying the secondary requirement including analysing data on the position of units over recent months and years.
- Review historic costs of managing the system requirements including evaluating costs and trends associated with managing the system requirements.
- Forecast cost of black start options.

Forecast of the benefit of running a black start unit to satisfy both the requirements.

## Appendix 3

$$\text{Lost Generation Costs} = \text{MAX} (0, (\text{Power Price} - \text{Gas cost} - \text{Carbon cost} - \text{Fixed cost})) * (\text{Capacity} - \text{MEL}) * H$$

Where:

Power Price Price (£/MWh)	is the hourly N2EX UK Day Ahead Auction
Gas cost Gross Unit efficiency factor	= (Gas price/Gas conversion factor * 10)/
Carbon cost factor	= (CPS rate + (EUA price/FX)) * Emission
Fixed cost	is [     ]/MWh
Capacity	is [     ] MW
MEL	is the Maximum Export Limit of unit (MW)
H	is the number of hours during which the relevant unit within the Power Station is made unavailable due to Black Start testing.
Gross Efficiency Factor	is [     ]%
Emissions Factor	is [     ]
Gas Conversion Factor	is 29.3071 (therms to kWh)
CPS rate	is UK Carbon Price support rate (£/tonne)
Gas Price	is the hourly UK NBP Natural Gas Forward Day Ahead price (p/therm)
EUA Price commodity (£/MWh)	is ICE ECX Emission December 2020
FX	is the £/€ daily rate from the Bank of England

$$\text{Exercise Payment} = \text{Start cost} + \text{Auxiliary unit cost}$$

Where:

Start Cost is running prior to the test	is Fixed cost of no more than [TBC] if the unit
Auxiliary Unit Cost	is (10000 therms*Gas Price)/100



Faraday House, Warwick Technology Park,  
Gallows Hill, Warwick, CV346DA

[nationalgrideso.com](http://nationalgrideso.com)