SIF Discovery Round 2 Project Registration

Date of Submission

Aug 2023

Project Reference Number

10053640

Project Registration

Project Title

SIF Black Start Demonstrator from offshore wind (SIF BLADE)

Project Reference Number

10053640

Project Licensee(s)

SP Energy Networks Transmission

Project Start

Apr 2023

Project Duration

3 Months

Nominated Project Contact(s)

Mark Morrison

Project Budget

£271,303.00

Funding Mechanism

SIF Discovery - Round 2

SIF Funding

£149,226.00

Strategy Theme

Net zero and the energy system transition

Challenge Area

Improving energy system resilience and robustness

Lead Sector

Electricity Transmission

Other Related Sectors

Electricity Distribution

Funding Licensees

SSEN-T - Scottish and Southern Electricity Networks Transmission

Lead Funding Licensee

SPEN - SP Transmission Plc

Collaborating Networks

Scottish and Southern Electricity Networks Transmission

Technology Areas

Control Systems, Electricity Transmission Networks, Low Carbon Generation, Offshore Transmission, System Security

Equality, Diversity And InclusionSurvey

Yes

Project Summary

SIF BLADE meets the aim of SIF Round 2 Challenge 3 – improving system resilience and robustness. SIF BLADE will increase the UK's energy system robustness supporting efficient roll out of new infrastructure, by investigating and demonstrating how novel low-cost, low-carbon technologies can allow offshore wind farms (OWFs) to restore the onshore grid following a black out. Proving this concept will enable accelerated roll out of OWFs to replace existing fossil fuel generators, whilst reducing any resilience issues that this may cause.

Doing so requires significant network innovation. Innovation is required to:

· investigate and develop the ability of technology suppliers to provide the necessary novel equipment, by defining intelligent requirements for the equipment from the network perspective;

· develop a black start methodology of restoring the onshore network from offshore wind, including how the OWF can be energised; how in turn the energised OWF can be used to energise the onshore network; and how the restoration can be spread throughout the onshore network, all whilst maintaining robustness of the newly energised system;

· understand the business case and market needs for black start services from OWFs;

· understand the roles and responsibilities of a wide, cross-industry range of stakeholders, from transmission system operators (TSOs) to transmission owners (TOs) to OWF operators to technology suppliers.

Due to this cross-industry nature of the network innovation, SIF BLADE needs cooperation between network companies, generators (OWF operators) and technical experts. The partnership brings together all these necessary stakeholders through SPEN, SSEN, NHVDCC, Strathclyde and Carbon Trust (representing the nine OWA developers, EnBW, Equinor, Ørsted, RWE, ScottishPower Renewables, Shell, SSE Renewables, TotalEnergies and Vattenfall), with Nation Grid ESO (NGESO), Siemens Gamesa Renewable Energy (SGRE), Siemens Energy (SE) and EDF Renewables (EDFR) as project advisers. These leading organisations will provide an unparalleled consortium for the development of black start services from offshore wind.

Regarding users of the solutions developed in SIF BLADE:

· TOs will use the solutions to ensure their networks remain resilient whilst decarbonising, by being able to restore their networks from offshore wind;

· TSOs will use the solutions developed in SIF BLADE to create markets and procure restoration services in the future;

· OWF operators will use the solutions to provide restoration services to the offshore and onshore network, and hence enable more wind capacity onto the network;

· ultimately, consumers will benefit from the solutions by having a more resilient, low-cost, low-carbon grid serving their needs.

Project Description

Enabling a low-cost net zero GB electricity network that is robust and secure, by investigating and demonstrating how novel technology can allow offshore wind farms to restore the onshore grid following a black out.

Preceding Projects

NIA2_NGESO047 - Distributed ReStart – Redhouse Live Trial

Third Party Collaborators

The Carbon Trust

University of Strathclyde

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Project Description And Benefits

Applicants Location (not scored)

SP Transmission PLC, 320 St. Vincent Street, Glasgow, Scotland, G2 5AD

Project Short Description (not scored)

Enabling a low-cost net zero GB electricity network that is robust and secure, by investigating and demonstrating how novel technology can allow offshore wind farms to restore the onshore grid following a black out.

Video description

https://www.youtube.com/watch?v=l8yyaZugd2w

Innovation justification

The problem SIF BLADE is seeking to solve is how a future net zero GB electricity system can be restored following a black out.

One counterfactual to SIF BLADE is that the GB grid will continue to rely on fossil fuel generators to provide restoration, which is not compatible with sustainability or energy security targets. An alternative counterfactual is that fossil fuel generators are decommissioned in line with sustainability targets, but this will lead to slow restoration times (which would have huge negative socioeconomic impacts).

The value of SIF BLADE is to avoid these counterfactuals in a low-cost manner. Without reliable, well understood net-zero-compatible restoration procedures, the future grid will not be sufficiently robust.

To achieve this, SIF BLADE is exploring how OWFs can restore onshore networks. Previous studies have identified compelling opportunities for OWFs to provide net-zero-compatible restoration services, due to their large power capacity and high availability (compared to other renewable generators).

However, these previous studies have also shown that there are significant technical risks to be overcome before OWFs can provide restoration. Firstly, black start capable OWFs do not yet exist. Secondly, even if they did exist, TOs and TSOs do not know how to restore the onshore grids using OWFs. Thirdly, the OWF operators and technology suppliers do not understand the stresses conducting a black start will have on their offshore assets.

There are also commercial risks. The cost of OWFs providing black start services is unknown, which inhibits market creation. Because of this, from a technology supplier and OWF owner perspective, the potential revenues from providing restoration services are not known. This in turn inhibits the necessary investment in innovation, which is why SIF is the perfect mechanism for SIF BLADE.

Whilst NGESO has recently launched a tender for restoration services from wind, SIF BLADE partners strongly believe that the technical and commercial risks mentioned above are too great for the market to solve through business as usual (BAU) tendering alone. Rather, solving these complex problems requires collaborative high risk innovation. SIF BLADE brings together the necessary stakeholders: from technology suppliers to OWF generators to TOs to TSOs. This would not happen in a BAU setting. All of these stakeholders must understand each other's capabilities and requirements in order to make black start from OWFs a reality.

SIF BLADE is an ambitious project that will add significant value to the GB consumer.

Benefits Part 1

Environmental - carbon reduction – direct CO2 savings per annum against a business-as-usual counterfactual
Financial - cost savings per annum for users of network services
Financial - future reductions in the cost of operating the network
New to market – products, processes, and services
Revenues - creation of new revenue streams
Revenues - improved access to revenues for users of network services

Benefits Part 2

SIF BLADE will lead to direct CO2 savings. In BAU counterfactual, restoration capability is mainly provided by fossil fuel generators. Continuing in this manner is not an option for the electricity system to achieve net zero by 2035 (the current GB target). SIF BLADE will investigate and demonstrate how OWFs can provide restoration services, which will allow for the energy system to cease its reliance on fossil fuel generators. To quantify this, SIF BLADE will assess the CO2 savings providing restoration from OWFs will provide.

SIF BLADE will also lead to financial benefits. In the future, the fossil fuel generators relied upon for restoration may be purely dedicated to providing restoration (i.e. they will have no other purpose or value). These fossil fuel generators are costly to maintain in a state of readiness. Further, the cost of fossil fuel is volatile, with large increases recently. Conversely, offshore wind is now the cheapest form of electricity in GB, and prices are expected to keep falling. SIF BLADE will show that using low cost OWFs to provide restoration instead of the costly fossil fuel generators will reduce the cost of operating the network. This will lead to a reduction in energy bills for GB consumers. To quantify this, SIF BLADE will assess the financial benefits of providing restoration from OWFs.

SIF BLADE will bring new products, process and services to market. Currently, black start from OWFs is not possible.

Regarding products, currently there are no wind turbines (WTGs) with black start capability, and no supporting products to enable existing WTGs to provide black start. SIF BLADE will work with necessary suppliers to create such products.

Regarding processes, the procedures required to restore the onshore network, and return it to normal operation, from OWF black start is unknown. Doing so will place stresses on components in the offshore and onshore networks, and hence will be studied in SIF BLADE.

Regarding services, black start from OWFs is not currently available to TSOs. The main outcome of SIF BLADE will be to create a service ready for TSOs to procure. This in turn will provide additional revenue streams for OWFs.

Discovery will identify detailed counterfactuals, and the metrics for measuring the benefits, and will use these to assess the benefits. In later Phases, the analysis will be further refined with improved data produced in the project.

Project Plans And Milestones

Project Plan and Milestones

Discovery has been designed as a flexible scoping exercise for the later Phases, with five work packages (WPs). Details are in the attached Project Plan.

WP1 – project coordination:

· A large consortium is to be brought together to deliver work in a short timeframe. WP1 will ensure the effective running of Discovery.

· Lead: SPEN and Carbon Trust.

· Milestone 5 (week 13): completion of other WPs; End of Phase Report (Deliverable 1.1 (D1.1)).

· SIF funding: £11,159

WP2 – literature review:

· Project parties have separately conducted significant relevant prior work. Cross-pollination is key to avoid duplication and to understand future priorities.

· Lead: all parties.

· Milestone 1 (week 3): list of inputs from prior projects.

· SIF funding: £18,198

WP3 – black start methodology assessment:

· Examine the “art of the possible” and the technical research questions to be examined in later Phases.

· Lead: Strathclyde and NHVDCC

· Milestone 2 (week 9): black start methodology assessment summary ; risks, opportunities and options for black start of SPEN network, SSEN network and coordinated offshore networks.

· SIF funding: £52,703

WP4 – business case assessment:

· Detail counterfactuals, qualitatively assess the benefits of black start from offshore wind, and identify further work required in Alpha and Beta.

· Lead: Carbon Trust.

· Milestone 3 (week 9): business case assessment summary.

· SIF funding: £40,007

WP5 – Alpha Phase scoping:

· This is the overarching aim of Discovery – to intelligently scope Alpha by building on previous WPs.

· Lead: Carbon Trust.

· Milestone 4 (week 13): Alpha Phase scope.

· SIF funding: £25,563

Risk assessment is shown in the attached document. SIF BLADE is taking a proactive approach to risk management, including regular risk reviews.

The main risk / constraint is that technology suppliers may not yet see the commercial potential of providing black start technologies, and hence their technologies are not sufficiently mature. To mitigate this, SGRE and SE (two leading technology suppliers) have already been approached and will advise the project.

Another key risk is the need for a demonstration site or facility. To mitigate this, demonstration site requirements will be considered when the demonstration methodology is developed. OWF operators are already being approached and Ørsted has already shown interest.

There are also commercial risks. The benefits may not be demonstrable, and hence suitable markets may not be created by TSOs. To mitigate this, strong TSO engagement will be included in the project. NGESO is to be a project adviser and other international TSOs are already being approached.

Regulatory Barriers (not scored)

We are not aware of any show-stopper regulatory barriers to implementing black start from offshore wind. However, it is likely that new requirements for black start services will need to be set by TSOs.

TSOs have understandably onerous requirements for black start providers. This includes long term contracts for the service provision, with high availability of service (90%). From previous work, it has been shown that such existing requirements may not be achievable for renewable sources of black start. Shorter term contracts may be required, potentially with lower availability expectations, to account for the inherent variability of wind power depending on meteorological conditions. SIF BLADE will seek to build an evidence base for what offshore wind can provide to TSOs in terms of black start provision, and hence help TSOs set more realistic requirements in future.

Another possible regulatory issue is that different countries / TSOs may have different requirements for black startable OWFs. If this is the case, then technology suppliers may need to provide different technologies for different countries. This will increase the suppliers' costs and hence increase the costs to TSOs for procuring black start. SIF BLADE will engage with international TSOs to ensure that requirements on technology are kept as streamlined as possible across borders. This will help to reduce the cost for GB consumers.

Finally, by investigating the resource (human, technical, capital) required for offshore wind to provide black start, SIF BLADE will also show to TSOs the investment required for OWFs to provide black start. This can be used by TSOs to create suitably structured markets with sufficient incentives for OWF operators to provide black start.

Commercials

Route To Market

To ensure BAU adoption, TSOs need to define practical, realistic and well-functioning markets for black start services from offshore wind. SIF BLADE is designed to provide evidence for such market creation. These markets will incentivise private investment from OWF operators into procuring and operating the innovative black start technology and methodology developed SIF BLADE.

To provide the necessary evidence for market creation, the innovative technologies required to provide black start (and the methodology for using them) must be developed and de-risked. Further, the commercial case for black start from offshore wind must be understood. SIF BLADE will do so by bringing together all necessary stakeholders: technology suppliers (SGRE, SE), technology owners (OWA partners, SPEN, SSEN) and TSOs (NGESO).

TOs and OWF operators will be responsible for the implementation of black start from offshore wind by procuring and operating black start technologies. The consortium includes two TOs (SPEN and SSEN) and nine leading OWF operators (the OWA Partners). SIF BLADE will allow these key stakeholders to innovate together to understand how to perform black start from offshore wind using the assets they own and operate, and hence to ensure adoption of the technology.

TSOs will be the key customer for the innovation, since they procure black start services. The value proposition is that these customers can achieve their sustainability targets whilst maintaining a robust electrical system at low cost to consumers. Achieving this value proposition will unlock the financial and sustainability benefits listed in question 5.

SIF BLADE aims to ensure that black start services have a route to market internationally as well as in GB. This will be achieved through the presence in the consortium of internationally interested OWF operators (the nine OWA Partners), as well as engaging with international TSOs and technology suppliers. Working with international TSOs is important in this regard, to ensure technology requirements specified by various TSOs are consistent, which will ease the burden on technology suppliers, and hence reduce costs for all stakeholders.

SIF BLADE will not undermine competitive markets; rather, it will promote new competitive markets for black start services. SIF BLADE includes a large consortium of nine OWF operators. Upskilling this broad consortium of OWF operators will enable more participants in future black start markets, which will increase competitiveness of those markets.

Intellectual property rights (not scored)

For Discovery, the majority of the IPR arrangements will follow the default recommendations of Chapter 9 SIF Governance Document. There may be some Background IPR and some Foreground IPR that fall within the exemptions of Clause 9.2 and 9.14 of the SIF Governance Document.

At the time of drafting this application we are unable to provide specific pieces of Background IPR and Foreground IPR that we would request to be exempt from the default treatment as we are still in talks with third parties. However, an explanation of the situation is provided below.

SIF BLADE will greatly benefit from input from technology suppliers and OWF operators. This input could involve provision of models, data or other information. Due to the innovative nature of the technologies in question, and commercial sensitivities in relation to their operation, it is likely that at least some of the inputs and outputs will be necessarily confidential, meaning that these inputs and outputs cannot be fully shared with all project partners or anyone outside the SIF BLADE project.

We will continue to work with technology suppliers and OWF operators prior to Discovery kick-off and during Discovery to set up these arrangements in good time to enable receipt of their inputs when required.

SIF BLADE will use an IP register to track the Background IPR, the Foreground IPR, and the use and access rights to all this IP. The main contract governing the project (the Consortium Agreement) will include detailed, mutually agreed terms governing IP that are in line with the SIF Governance Document.

It is proposed that, for expediency, Carbon Trust will sign the project's Consortium Agreement as the representative of the OWA programme (i.e. the nine OWA Partners would not sign the Consortium Agreement, but be bound to BLADE as members of the OWA programme). With this contracting arrangement, we would expect OWA Partners to have access to Background and Foreground IPR like any other project partner.

SIF BLADE will also include an Advisory Panel of key stakeholders (NGESO, SE, SGRE, EDFR) who may wish to become Project Partners in future. We intend to make all FIP available to the Advisory Panel.

SIF BLADE may benefit from information exchange with the HVDC BLADE project (see Project Plan for details). We may seek a collaboration agreement to share FIP between the two projects under NDA.

Costs and value for money

The total project cost for Alpha phase is £269,707.

The project is requesting £147,630 of funding (55% of the total cost), with the remaining £122,077 (45% of the total cost) being provided by project partners.

This level of funding will lead to outcomes that provide value to the consumer. Discovery will investigate the benefits of BLADE to the consumer in more detail. However, from previous work conducted prior to BLADE, low-cost renewable offshore wind shows great promise to be able to replace costly and unsustainable fossil fuel generators providing black start services. However, that previous work has also shown that further R&D is required to bridge the innovation "valley of death" for black start from offshore wind. The SIF programme and funding is the ideal mechanism to bring together the necessary stakeholders (networks, OWF operators and technology suppliers) to collaboratively innovate in this space.

The £122,077 (45%) of the total cost that is being contributed to the project is more than the minimum 10% compulsory contribution giving excellent leverage of SIF funds.

SPEN is contributing £9,722 in time.

The OWA Programme which is an industry-led RD&D initiative 100% privately funded by nine OWF developers (the OWA Partners), is providing £20,000 in cash to the Discovery Phase. This cash is going to fund work by Carbon Trust (the representative of the OWA programme) and SGRE.

Ørsted as Project Champion is contributing £5,000 in time. The OWA Partners are contributing £70,055 in time. This allocation of technical expertise reflects the OWA Partners commitment to SIF BLADE and highlights the importance of the research subject.

The Advisory Panel is contributing £17,250 of human resource (technical expertise within each company). The allocation reflects the Advisory Panel's commitment to SIF BLADE and highlights the importance of the research subject.

It should be noted that the OWA Partners, EDFR, SE and SGRE are multinational organisations, whose experts that will work on SIF BLADE will sit in many different locations globally and may be employed by non-UK entities. However, all such partners have strong interest in developing black start services in the UK.

Document Upload

Documents Uploaded Where Applicable

Yes

Documents:

SIF BLADE SHOW AND TELL.pdf

SIF Discovery Round 2 Project Registration 2023-08-10 3_46

SIF Discovery Round 2 Project Registration 2023-08-10 3_51

SIF Discovery Round 2 Project Registration 2023-08-11 9_14

SIF Discovery Round 2 Project Registration 2023-11-06 10_21

This project has been approved by a senior member of staff

☑ Yes