# Electricity Network Innovation Competition Screening Submission Pro-forma

| **Funding Licensee** |
|---|
| National Grid Electricity Transmission plc |
| **Network Licence Project Partners** |
| Not Applicable |
| **Funding Licensee area** *(or where the licensee does not operate in a specific area the geographic location(s) of the Project)* |
| England & Wales |
| **Project title** |
| **O**ffline **S**ubstation **E**nvironment for the **A**cceleration of **I**nnovative **T**echnologies (OSEAIT) |
| **Project Summary** |
| *The Licensee must provide an approximate Project start and end date.* |
| National Grid Electricity Transmission (NGET) is proposing to develop a substation environment for testing innovative substation technologies at voltages of up to 400 kV. This will allow the electricity sector to maximise the benefits to consumers arising from emerging technologies and novel operating practices by accelerating their implementation and deployment. The facility will be referred to as OSEAIT. OSEAIT will be located on a decommissioned substation in a central location and will be available to all GB network owners and operators.<br><br>The last decade has seen increasing requirements to deliver more affordable, clean and secure electricity leading to changes in the way networks and assets are designed, managed and operated. In order to be successful, this transformation requires new technologies and practises to be implemented. The faster the technologies are deployed throughout the network, the faster the transformation and the quicker their benefits will be realised. OSEAIT will contribute to achieve these aims by reducing the deployment risks and development time of these technologies.<br><br>It is envisaged that this project will commence January 2016 and will complete by October 2020. |
| **Estimated Project funding** |
| *The Licensee must provide an approximate figure of the total cost of the project and the NIC funding it is applying for.* |

| | | | |
|---|---|---|---|
| **Total cost of Project** | £32.5m | **NIC funding requested** | £17.2m |
| **Cross Sector Projects only: requested funding from Gas NIC or NIA?** | *If yes, please specify*<br>Not Applicable | | |

**Problem(s)**

*The Licensee must provide a narrative which explains the Problem(s) which the Project is seeking to address.*

The majority of the electricity network of today was built around predictable generation from large power stations that would flow through the transmission network and then be distributed through the lower voltage networks to the end consumer. The assets that make up the network were designed with this in mind, with a specified number of service years and deterministic time-based maintenance periods. These principles have provided safe, reliable and efficient electricity for decades. However, the energy sector is changing causing utilities to experience new opportunities and challenges in the form of:

1. New Technologies and Practices
2. Managing Existing Assets
3. Changing Generation Mix

**New Technologies and Practices**

New technologies and practices have the potential to reduce the cost of network reinforcement without compromising security of supply. Their adoption is nevertheless slow. This can be attributed to the high risks associated with their failure under normal operating conditions. The large discrepancies between laboratory conditions and the harsh environments of live high voltage networks, combined with the consequences of disruption, has meant that in the past, new technologies have taken decades to be adopted by the industry. For example, in the case of $SF_6$, it took over 15 years for the industry to fully embrace it as an insulating gas.

Currently these new technologies and practices rely upon system outages and unplanned system events to be fully tested and trialled. For example, in the case of condition monitoring technologies, an outage is required for installation purposes and a number of unplanned system events are required to prove the solution can reliably function in a live environment. Equally, testing a range of unplanned system events prolongs a rollout as these cannot be expedited on a live system. This significantly extends the time it takes for technologies to reach their full potential and deployment.

**Managing Existing Assets**

There are five possible actions associated with managing existing assets:

- Replacement is expensive due to lead times as well as system outages and civil costs;
- Partial replacement is complicated due to components being difficult to source or obsolete and often requires a level of redesigning;
- Refurbishment requires new practices and technologies;
- Modification of operating conditions requires a better understanding of the assets and system; and
- Doing nothing potentially impacts the reliability of the network.

**Problem(s) (Continued)**

Addressing the challenges associated with the above actions is difficult and slow without the capability to test new technologies, novel materials, component designs, new practices and monitoring systems to obtain a better understanding of the assets in a real substation environment.

**Changing Generation Mix**

The energy mix is changing and the electricity industry can no longer just rely on past experience and statistical analysis to predict the life expectancy of its assets. Increase in renewable generation at the periphery of the existing network and within the distribution system is creating a shift in power flows impacting the accuracy of the forecasting of asset load profiles. Furthermore, non-synchronous generation, such as wind farms, has increased the level of power quality challenges which could potentially impact asset lives more than would have been predicted historically.

**Method(s)**

*The Licensee must describe the Method(s) which are being demonstrated or developed. It must also outline how the Method(s) could solve the Problem. The type of Method should be identified where possible eg technical, commercial etc.*

The OSEAIT project will give network licensees the opportunity to make a step change in the ability to challenge the conventional approach to asset life and maintenance without reducing system reliability and service to customers. This will be achieved through the delivery of an offline substation energised up to 400kV. This would be available to all GB network licensees. The substation will allow short and long term testing, development and demonstration of new technologies and techniques.

The users will have control of the environment in which they are working. This will allow assets to be tested to their full potential in a safe environment, without any risk to the network and its customers. Evaluating asset performance could entail overstressing or accelerating their ageing by means of electrical, thermal and mechanical tests. An offline testing facility is not only safer for the users but will increase user understanding of asset failure mechanisms and predictive failure detection methods. This will provide greater knowledge about "true" asset life, deterioration speeds and the ability of existing and novel monitoring techniques to detect asset deterioration.

The project will be designed and implemented to allow the opportunities and challenges to be addressed in the following ways:

**New Technologies and Practices**

Development of an offline facility to allow various technologies to be trialled and evaluated without impacting the main transmission system. This facility will allow evaluation without being constrained by timescales, outage requirements or network availability. By having a facility that is offline, not only can multiple systems be tested in a controlled environment, but novel techniques can be adopted earlier, for instance cost-effective refurbishment techniques.

**Method(s) (Continued)**

*The Licensee must describe the Method(s) which are being demonstrated or developed. It must also outline how the Method(s) could solve the Problem. The type of Method should be identified where possible eg technical, commercial etc.*

**Managing Existing Assets**

OSEAIT will be developed to allow controlled accelerated ageing of assets in order for the industry to develop a greater understanding of their degradation. Monitoring the ageing process of an asset in a substation environment enables the condition of an asset to be more accurately deduced. This will inform the optimal intervention and its timing. This will ultimately reduce the cost to the consumer whilst maintaining the same level of reliability. A reduction in cost will be seen due to the improved outage requirements on the system for maintenance and asset operational lives will be maximised.

**Changing Generation Mix**

OSEAIT will be developed with the required functionality to allow quantification of the effects of non-synchronous generation on asset degradation. Maintenance practices will be updated to take into account the impact on asset degradation.

Once the effects of changing power flow and power quality is understood at an asset level, modelling can be undertaken and applied to assess network reliability and security of supply.

**Delivery**

It is envisaged that OSEAIT will be delivered in five phases, which are likely to be:

1. Optioneering
2. Detailed Design Phase
3. Build Phase
4. Operational Phase
5. Enduring

At the end of each of these phases there will be a stage gate where responses to a set series of questions within a framework are clearly defined. This will ensure that in the event of the project no longer meeting its scope or timescales the project can be suspended whilst discussions take place with Ofgem.

## Funding commentary

*The Licensee must provide a commentary on the accuracy of its funding estimate. If the Project has phases, the Licensee must identify the approximate cost of each phase. OFTOs should indicate potential bid costs expenses.*

**Accuracy of the Funding Estimate**

The total cost of the project is £32.5m with the total NIC funding requested being £17.2m. This will provide the project an approximate leverage of 47%.

The funding estimate has an accuracy of +/- 30%. The project has been developed with a location in mind. However, the exact substation location cannot be secured until this project is fully approved. This provides a significant level of uncertainty in terms of identifying the effort required to develop the site for the creation of OSEAIT.

In order to manage this uncertainty level, the project will be delivered in several phases. This will ensure that in the event of the project no longer meeting its scope or timescales the project can be suspended whilst discussions take place with Ofgem and any stakeholders. The 5 phases, and the breakdown of costs between phases, are detailed below:

1. Optioneering (£195k)
2. Detail Design Phase (£520k)
3. Build Phase (£27.6m)
4. Operational Phase (£1.2m)
5. Enduring (Business as Usual funded)

In addition, Project Management throughout the first three phases is estimated to be £3m.

The funding sought in this proposal is for stages 1-4.

**Specific Requirements** (please tick which of the specific requirements this project fulfils)

| | |
|---|---|
| A specific piece of new (ie unproven in GB) equipment (including control and/or communications systems and/or software) | |
| A specific novel arrangement or application of existing electricity transmission and/or distribution equipment (including control and communications systems software) | ✓ |
| A specific novel operational practice directly related to the operation of the electricity transmission and/or distribution system | ✓ |
| A specific novel commercial arrangement | |

**Accelerates the development of a low carbon energy sector & has the potential to deliver net financial benefits to existing and/or future Customers**

*The Licensee must demonstrate that the Solution has the potential to accelerate the development of the low carbon energy sector in GB and/or deliver wider environmental benefits to GB Customers. The Licensee must demonstrate the potential to deliver net financial benefits to existing and/or future Customers.*

*As stated in the Electricity NIC Governance Document, the Network Licensee must provide the following to demonstrate compliance with this criterion:*

*i. How the proposed Project will make a contribution to the Carbon Plan. In particular the Network Licensee should outline:*
- *What aspects of the Carbon Plan the Solution facilitates*
- *The contribution of the rollout of the Method across GB can have in facilitating these aspects of the Carbon Plan*
- *How the rollout of the proposed Method across GB will deliver the Solution more quickly than the current most efficient method in GB; and/or*

*ii. How the proposed Project could deliver environmental benefits to Customers; and*

*iii. The expected financial benefits the Project could deliver to Customers.*

## I. Contribution to the Carbon Plan

OSEAIT contributes to the Carbon Plan in three different areas:

1. Supporting new entrants and technologies into the market,
2. Creating an environment to accelerate the way towards a 'smarter' grid,
3. Supporting the UK ambition to internationally drive the climate change agenda.

The project provides a platform that allows the development and trialling of low carbon technologies such as $SF_6$ replacement gases and mineral oil replacements as well as the optimisation of network interventions.

This project does not deliver a method which can be rolled out. Instead it delivers a platform to allow an accelerated rollout and deployment of a range of technologies and methods to support to delivery of the Carbon Plan.

## II. Environmental Benefits to Customers

OSEAIT will allow low carbon technologies, for instance new materials such as $SF_6$ replacement gases, to be subject to accelerated evaluation and will result in an earlier adoption of these technologies. This will ensure customers can benefit from any financial advantages that these technologies bring, as well as the environmental benefits that will assist in delivering the targets within the Carbon Plan.

The facility will also allow utilities to investigate and learn about network assets in more detail. Understanding asset life expectancy and their degradation will ensure that the appropriate interventions are in place to fully utilise assets, avoiding unnecessarily early replacement. Optimised interventions will reduce the environmental impact of disposing assets that may not yet have reached the end of their usable life.

## III. Expected Financial Benefits to Customers

Optimising the management of the existing transmission asset fleet is one of the main ways that NGET can achieve savings to consumers. The financial benefits to the customer following these findings are as follows:

- Reduced system access from a better understanding of the assets will result in reduced operational costs including constraints,
- Reduced early asset replacement costs,
- Improved maintenance practices, which enables full utilisation of the assets,
- Earlier adoption of low cost, low carbon technologies

**Delivers value for money for electricity Customers**

*The Licensee must demonstrate that the Method(s) being trialled can derive benefits and resulting learning that can be attributed to or are applicable to the electricity transmission system/ to the electricity Distribution System.*
*As stated in the Electricity NIC Governance Document, the Network Licensee must provide the following to demonstrate compliance with this criterion:*

*i. What is the potential Direct Impact of the Project on a Network Licensee's electricity network or on the operations of the GB System Operator;*
*ii. Justification that the scale/ cost of the Project is appropriate in relation to the learning that is expected to be captured;*
*iii. The processes that will be employed to ensure that the Project is delivered at a competitive cost; and*
*iv. The expected proportion of the benefits which will accrue to the electricity Transmission System/to the electricity Distribution System as opposed to other parts of the energy supply chain.*

*Sub-criterion v (the internal systems, procedures and processes used by the Network Licensee to identify Project Participants and Project ideas) should be covered in the 'Project Partners and external resourcing/funding' section below.*

## I. Direct Impact

The project will deliver a platform to allow the network licensees' to:

1. Trial, evaluate and approve novel technologies and practices to be rolled out and deployed across all electricity networks
2. Better understand the ageing of electricity assets in a substation environment
3. Better understand the power characteristics of new generation types on the assets that make up the electricity network.

## II. Scale/Cost of the Project

The aim of OSEAIT is to evaluate the performance of assets and accelerate the development and demonstration of novel technologies developed by industry, research organisations, small/medium enterprises and original equipment manufacturers, that have an operational life span of multiple decades. Often these new technologies and practices take a very long time to be adopted on the electricity system or don't make it at all; not because they don't work, but due to the practicalities of reproducing live HV substation environments. This is further complicated by the complex interaction and interdependencies between multiple components and proximity of other HV equipment. In order for this aim to be delivered, the project needs to replicate a real substation environment with the additional ability of controlling electrical, mechanical and thermal properties if/when required. These controlled, conditions can be replicated in two ways:

1. Undertake tests and trials at an operational substation.
2. Create a substation that is not part of the critical network infrastructure

If the first method is followed, the simulation of live system events or accelerated ageing would create a risk which is unacceptable on a network connected site. In order to deliver a project capable of significantly accelerating the deployment of new technologies and practices without impacting reliability and security of supply an offline substation environment at voltages up to 400kV is the only realistic approach.

## III. The Processes

As previously mentioned, the project is structured with five stage gates built into the programme. These stage gates will ensure the programme and cost are reviewed at key points throughout the development of the project. A governance body, chaired by a NGET Director, will be created to oversee the plans and to demonstrate on-going value for money for the consumer. Furthermore, NGET will deliver the project in accordance with procurement obligations and will competitively tender the build phase of the project which accounts for approximately 85% of the overall cost of the project.

**Delivers value for money for electricity Customers? (Continued)**

**IV. Proportion of Benefits Accrued**

During the length of the project, OSEAIT will benefit 100% the electricity network licensees. At an enduring level, OSEAIT could be expanded to benefit the associated supply chains.

**Demonstrates the Project generates knowledge that can be shared amongst all Network Licensees**

*The Licensee must explain the learning which it expects the Method(s) it is trialling to deliver. The Licensee must demonstrate that it has a robust methodology in place to capture the learning from the Trial(s).*

*As stated in the Electricity NIC Governance Document, the Network Licensee must provide the following to demonstrate compliance with this criterion:*

*i. What new knowledge is intended to be generated from completing the Project;*
*ii. What methodology will be used to capture results from the Project and how the Project's results will be disseminated to other Network Licensees; and*
*iii. Whether the Network Licensee wishes to conform to the default IPR arrangements as set out in Section B: Chapter 9. If the Network Licensee wishes to deviate from the default IPR arrangements it must outline the proposed arrangements, justify why the arrangements are more suitable than the default arrangements and justify how the new arrangements will deliver value for money for Customers.*

**I. New Knowledge Generated**

OSEAIT will generate new learning in the following areas:

- Build upon the industry's understanding of the condition and degradation of network assets to inform decision making,
- Evaluate novel maintenance and monitoring techniques with the objective to improve or validate them,
- Speeding up the process of adopting new technologies and practices.

**II. Methodology of Results Capture and Dissemination**

The results from the project will be captured and the knowledge will be shared as follows (illustrative as opposed to exhaustive):

- Reports identifying all relevant knowledge gained will be prepared twice a year.
- Project Progress Reports will be reported through various different types of media.
- A website for the project will be created to disseminate capabilities, outcomes and events.
- The ENA learning portal will be utilised to upload presentations.
- By hosting events for other Network Licensees and relevant third party organisations.
- The LCNI conference will be used as a platform to share findings.
- Several events at the location of the facility shall be organised throughout the project including an inaugural launch event.

**III. IPR Arrangements**

The project will conform to the default IPR arrangements.

| **Please tick if the project conforms to the default IPR arrangements set out in the NIC Governance Document?** | ✓ |
|---|---|

*If the Licensee wishes to deviate from the default requirement for IPR then it must demonstrate how the learning will be disseminated to other Licensees and how value for money will be ensured. The Licensee must also outline the proposed alternative arrangements and justify why the arrangements are more suitable than the default arrangements.*

The project will conform to the default IPR arrangements.

**How is the project innovative and with an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness?**

*Demonstrate why the Licensee has not previously used this Solution (including where the Solution involves commercial arrangements) and why NIC funding is required to undertake it. This must include why the Licensee would not run the trial as part of its normal course of business and why the Solution is not Research.*

*As stated in the Electricity NIC Governance Document, the Network Licensee must provide the following to demonstrate compliance with this criterion:*

*i. Why the Project is innovative and has not been tried before;*
*ii. Why the Network Licensee will not fund such a Project as part of their business as usual activities;*
*iii. Why the Project can only be undertaken with the support of the NIC, including reference to the specific risks (e.g. commercial, technical, operational or regulatory) associated with the Project.*

**I. Project Innovation**

Testing centres around the world are focused on assessing for compliance, whilst some are able to support enhanced testing for fault finding and technology development. Although these centres are able to isolate and measure a particular asset under controlled test scenarios, they do not consider, and cannot simulate, a live substation environment.

This project will develop a unique facility which will allow utilities to evaluate innovative technologies and practices, as well as better understand our assets, to a level of detail never before achieved in a live substation environment.

**II. Business as Usual Funding**

There is presently no mechanism available to incentivise the investment of resources by electricity utilities on a high-cost, high-risk investment project as the one proposed in this submission. As such, and due to the high potential gains a successful outcome can have across the electricity industry to the consumer, utilities and UK PLC, it is appropriate that the risk be shared during the development phase so as to make the investment viable. This partnering ethos is exemplified by the level of investment NGET will be contributing should the bid be successful.

**III. Requirement for NIC support**

Following from the previous point, NIC support is required due to the commercial and technical risks associated with this project due to its unique nature. A facility of this kind has never been attempted before and hence its development has a level of technical risk which is unacceptable to any individual utility. The additional NIC funding will allow the development of a facility which may be utilised by UK network licensees.

With the creation of OSEAIT, NGET is looking at creating an environment to allow a significant step-change in the way and speed technologies are adopted by electricity utilities and develop novel equipment and practices to meet our customer needs.

## Project Partners and external resourcing/funding

*The Funding Licensee should provide a description of the internal systems, procedures and processes used by the Funding Licensee to identify Project Participants and Project ideas.*

*The Licensee should provide details of any Project Partners, External Funders or Non-Network Licensees who will be actively involved in the Project and are prepared to devote time, resources and/or funding to the Project. If the Licensee has not identified any specific Project Partners, it should provide details of the type of Project Partners it wishes to attract to the Project.*

NGET has followed a robust selection process to arrive at the project being put forward for the 2015 Network Innovation Competition. Initial internal workshops were held to identify candidates from our portfolio of Innovation Funding Incentive and Network Innovation Allowance projects as well as considering entirely new proposals. At this stage each potential candidate was considered against the eligibility criteria; particularly the benefit to consumers and contribution to a low carbon energy sector.

A number of projects were shortlisted with leads identified across the business who went on to develop the initial scope of their projects and to achieve the appropriate director support to proceed.

In parallel we canvassed externally, requesting submission of project proposals. To support this we provided information about the Network Innovation Competition and the eligibility criteria to encourage a full spectrum of possible projects to be received.

A number of submissions were received and these were reviewed internally against both the eligibility criteria as well as our current business goals and ambitions. Whilst none of these ideas are being taken forward this year we intend to further investigate the feasibility of the strongest submissions through the Network Innovation Allowance.

The output of the initial scoping exercise revealed a clear leading candidate project on which to concentrate our effort for ISP submission. Engagement with potential partners and suppliers around this specific project then began with the publishing of our developed project proposal to NationalGrid.com.

NGET believes the process undertaken to identify project partners demonstrates a commitment to engaging with as wider base of partners and suppliers as possible; ensuring an open door for all innovative ideas.

A competitive tender will be held to find project partners for the Detailed Design Phase and Build Phase. Project partners during the operational phase will be suppliers and partners with whom we have engaged by issuing an open call for new technologies that they would like us to trial.

| Derogations or exemptions |
|---|
| *The Licensee should outline if it considers that the Project will require any derogations, exemptions or changes to the regulatory arrangements.* |
| The project will not require any derogations, exemptions or changes to the regulatory arrangements. |

| Customer impact |
|---|
| *The Licensee should outline any planned interaction with Customers or Customers' premises as part of the Project, and any other impacts (such as amended contractual or charging arrangements, or supply interruptions).* |
| This project will have no impact on consumers as the intended site will be an existing decommissioned substation.<br><br>However, it is possible that a customer may own bays within the decommissioned substation, and therefore meetings to discuss the potential purchase of the bay may be required. Alternatively their bay(s) may be excluded from the development. If a customer is potentially impacted in this way, a plan will be devised to manage the situation and minimise any impact. |

| Details of cross sector aspects |
|---|
| *The Licensee should complete this box only if this Project forms part of a larger cross sector Project that is seeking funding from multiple competitions (Electricity NIC and Gas NIC). The Licensee must explain about the Project it will be collaborating with, how it all fits together, and must also add a justification for the funding split.* |
| Not applicable. |
| **Any further detail the Licensee feels may support its submission** |
| Not applicable |
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