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## NIA Project Registration and PEA Document

### Date of Submission

Sep 2023

### Project Reference Number

NIA2\_NGET0047

## Project Registration

### Project Title

Cable Oil DEcontamination by BaCteria (CODEC)

### Project Reference Number

NIA2\_NGET0047

### Project Licensee(s)

National Grid Electricity Transmission

### Project Start

September 2023

### Project Duration

1 year and 7 months

### Nominated Project Contact(s)

Siyu Gao

### Project Budget

£2,146,310.00

## Summary

The decommissioning of fluid-filled cables for the transmission system is often an intense, complex and lengthy process. The conventional nitrogen purging method could only remove about 40% of the oil in cables during the initial purge and would commonly need another 5 years of subsequent purging to remove the remaining oil. The large amount of excavation required could cause significant disruption to local communities while the remaining oil could pose risk to the surrounding environment. This project would look to trial a novel, bacteria based decommissioning method that could remove more than 95% of the all the cable oil in 14 to 16 weeks and thus could substantially reduce the disruption to local communities while mitigating the risk to the surrounding environment.

## Third Party Collaborators

BioNRec GmbH

## Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

## Problem Being Solved

High voltage fluid-filled cables are an important asset class that have been in operation for more than 50 years in the transmission system. Many of them are now at the end of their design life and need to be decommissioned. Conventional nitrogen purging would require oil monitoring pits to be dug and installed at every high and low point along the cable route to blow gas or to collect oil or both. The first nitrogen purge would typically remove about 40% of the oil and usually 5 years of subsequent purging would be required to remove the remaining oil that is held by the paper matrix. The process is complex, lengthy and intensive. Due to the large amount of excavation and civil work involved, it could cause severe disruption to the local communities and local traffic. The large quantity of remaining oil in the cables also pose a potential risk to the surrounding environment during the decommissioning period, especially when there exist adjacent water bodies. There is a need for a solution that can shorten the delivery timeframe, be more effective at oil removal and reduce the amount of excavation and civil work required.

## Method(s)

A new method to decommission fluid-filled cables via bacteria-based bioremediation is proposed. The solution would produce a bespoke bacteria combination that is highly effective and efficient at degrading and mobilising hydrocarbons to remove the oil from the cables. This solution can remove more than 95% of all the cable oil in a timeframe between 14 to 16 weeks. The remaining oil is bound to the paper matrix and does not leak. Once the purging is complete, the cables can be safely left in-situ with no risk to the surrounding environment. The bacteria used are all naturally occurring with no genetic engineering and are of risk group 1 bacteria (the same as yoghurt). The solution also conforms to all relevant EU laws and regulations. This solution would significantly reduce the need for excavation and thus reduce the disruption to local communities as it does not require oil monitoring pits to be installed, nor does it require any subsequent purging. The much shortened timeframe also reduces the risk of oil contamination to the surrounding environment. Reduced excavation is also a safety benefit.

## Scope

This project comprises of 4 phases.

- Phase 1: Oil profiling
  - Oil sampling at site
  - Oil analysis to determine the best combination of bacteria
- Phase 2: Mobilisation
  - Acquire permits from relevant landowners for hardware installation
  - Production of hardware and bacteria including shipment to site
- Phase 3: Cable treatment
  - Connection of hardware to cables and start the treatment process
  - Periodic sampling and analysis to ensure good progress
  - Waste oil disposal
  - Disconnection and uninstallation of hardware post treatment completion
- Phase 4: Reporting and finalisation
  - Sample the treated cable to confirm the oil removal percentage and generate lab reports

## Objective(s)

The objective of this project is to validate the new method to decommission fluid-filled cables by using the novel bacteria purging solution. The key aspects are:

- Validate the efficacy of the bacteria in removing oil in cables
- Validate the time needed to remove 95% of the oil in cables
- Validate the much reduced environmental and community impacts from this novel solution

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register.

This project has been assessed as having an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to reduce the amount of disruptions to them in the home. Other considerations including the projects impact on supply, immediate health and safety in the home have been made in carrying out this assessment.

## Success Criteria

This project is deemed as successful if the objectives are achieved. In particular, the following outputs will be important when assessing the success of the project:

- Successful demonstration of the efficacy of the bacteria-based solution in removing oil in cables
- Successful decommission of the selected cables in a much-reduced timeframe without the need for subsequent purging

## Project Partners and External Funding

N/A

## Potential for New Learning

The potential new learnings from this project are:

- The efficacy of the novel bacteria-based method for decommissioning fluid-filled cables used in the UK transmission system
- Any adaptation required for the UK transmission system specifics
- Best practice to incorporate this novel solution to the wider decommissioning activities and designs

The learning will be disseminated through the publication of project progress and closedown reports on the ENA portal. Various workshops and dissemination events would also be planned.

## Scale of Project

The scale of the project includes the followings.

- Oil sampling at sites
- Production of hardware and bacteria powder
- Installation of hardware at sites
- Cable treatments at site and waste oil disposal
- Uninstallation at site post treatment
- Confirmation of oil removal percentage by laboratory certification
- Various reporting, presentations and dissemination

## Technology Readiness at Start

TRL7 Inactive Commissioning

## Technology Readiness at End

TRL8 Active Commissioning

## Geographical Area

The project will mainly be carried out on the premises of the NGET in London, UK. Primarily on and near the sites of Hurst substation and Crayford termination tower.

## Revenue Allowed for the RIIO Settlement

N/A

## Indicative Total NIA Project Expenditure

NGET will contribute £300,000 from its own operational budget, therefore the total NIA expenditure is: £1,661,679

## Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

### Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

#### How the Project has the potential to facilitate the energy system transition:

This project has the potential to facilitate the energy system transition by accelerating the decommissioning process for aged assets to allow more advanced and more environmentally friendly assets to be commissioned faster. It can also help to reduce the carbon emissions caused by decommissioning activities since excavation and other related civil work could be significantly reduced. Also, due to the accelerated timeframe, the risk of oil contamination to the surrounding environment is also much reduced.

#### How the Project has potential to benefit consumer in vulnerable situations:

The new solution could significantly reduce the need for excavation and other civil work, which would in turn reduce disruptions to local communities and local traffic including access to public and private roads.

### Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

#### Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

#### Please provide a calculation of the expected benefits the Solution

With conventional decommissioning, execution of a large excavation is commonly required to facilitate monitoring pit installations and hardware removal. Such excavation could cause severe disruption to local communities and local traffic, while increasing risks to safety. With this new solution, the need for excavation can be largely mitigated and thus could provide significant benefits. The much shortened decommissioning timeframe also means that the surrounding environment's exposure to the risk of oil contamination is significantly reduced.

#### Please provide an estimate of how replicable the Method is across GB

This technology has been successfully used for distribution level voltage cables in Europe and therefore distribution network licensees could readily use this technology, should they decide so. Once this technology is validated at transmission voltages, transmission network licensees could also choose to use this solution.

#### Please provide an outline of the costs of rolling out the Method across GB.

The cost of deploying this new method will very much depend on the individual cable specifications, the sizes and length of the cables and the difficulty of access to the cables. The size and length of the cables would very much impact on how much bacteria would be needed to treat the cables.

### Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

- A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).
- A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)
- A specific novel operational practice directly related to the operation of the Network Licensees system
- A specific novel commercial arrangement

#### RIIO-2 Projects

- A specific piece of new equipment (including monitoring, control and communications systems and software)
- A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- A specific novel commercial arrangement

### Specific Requirements 4 / 2a

#### Please explain how the learning that will be generated could be used by the relevant Network Licensees

levant licensees can use the learning generated from this project to assess whether the proposed solution can provide better results for decommissioning their own fluid-filled cables. The relevant licensees can choose to adopt this solution if they decide so.

#### Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/A

#### Is the default IPR position being applied?

- Yes

### Project Eligibility Assessment Part 2

#### Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

#### Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

This technology has been successfully used in Europe but has never been used in the UK. A search on the internet and the ENA portal did not return any project in the UK that had used this technology.

Any risk of duplication will be addressed through dissemination of progress with other licensees and being open to co-operate with licensees working in similar areas.

#### If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

### Additional Governance And Document Upload

#### Please identify why the project is innovative and has not been tried before

Though this technology has been used at distribution level voltage cables, it has never been used for transmission level voltage cables. Cables at transmission level voltages are different from distributions'. One of the most distinctive differences is the corrugated cable

sheath that creates small pockets of oil between the sheath and the paper matrix. This phenomenon has presented difficulty for the conventional nitrogen purging. Since the bacteria used for this technology would spread homogeneously along the cables, the proposed solution should be able to overcome the said difficulty, which in itself would be a major innovation achievement.

## **Relevant Foreground IPR**

The foreground IPR will mainly be the learning and validation of the new bacteria-based decommissioning solution, including the various oil samplings, analysis, reports, presentations, etc. The supplier will contribute the background IP for the bacteria-based solution for decommissioning the fluid-filled cables while NGET will contribute the background IP regarding the cable specifications and relevant sites.

## **Data Access Details**

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at <https://smarter.energynetworks.org>, to contact select a project and click 'Contact Lead Network'. National Grid already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at <https://www.nationalgrid.com/uk/electricity-transmission/innovation>
- Via our managed mailbox [box.NG.ETInnovation@nationalgrid.com](mailto:box.NG.ETInnovation@nationalgrid.com)

## **Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities**

The proposed solution is yet to be proven for transmission cables and guarantees no success. These are significant business risks and thus this project is not suitable for BaU.

## **Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project**

The project can only be funded through NIA since there are still uncertainties around the proposed solution that require further investigations since this solution has yet to be used for transmission cables. The efficacy and adoptability of the proposed solution are still unclear for transmission cables at the moment. Without the NIA funding, these risks would never be mitigated and the potential benefits would never be realised.

## **This project has been approved by a senior member of staff**

Yes