Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Apr 2014

Project Reference Number

NIA_NGET0150

Project Registration

Project Title

EPRI Research Collaboration on Underground Transmission

Project Reference Number

NIA_NGET0150

Project Licensee(s)

National Grid Electricity Transmission

Project Start

January 2014

Project Duration

1 year and 7 months

Nominated Project Contact(s)

Iliana Portugues

Project Budget

£230,000.00

Summary

Underground ratings and Increased Power Flow

This programme focuses on developing methods and tools for increasing and optimizing the power throughput of existing assets. It does so through three parallel tasks:

1. Increased Power Flow Guidebook: The development of the *Increased Power Flow Guidebook* (Platinum Book) will be updated and additional material developed on the state-of-the-science and best practices for increasing and optimizing power flow through existing (and new) underground cables and their associated circuits. The output of this work will be an entire guidebook, which in addition to underground cables includes the topics of overhead lines, substation equipment, entire circuit ratings, and economics.

2. Transmission Ratings Workstation (TRW) Version 1.0: The development of a software tool, Transmission Ratings Workstation (TRW), incorporating the capabilities of EPRI's Dynamic Thermal Circuit Rating (DTCR) software and other ratings-related software modules into one comprehensive computer program. The product will be designed for performing rating studies, evaluating and optimizing static ratings, real-time ratings, and forecasted ratings for underground cables and entire transmission circuits. Comprehensive documentation will be included, and the workstation's ultimate goal is to provide all the tools related to circuit ratings at the users fingertips.

3. Soil and Special Backfill Thermal Resistivity Considerations for Underground Cables: A Technical Update will be developed and delivered which covers the following topics related to soil thermal resistivity and backfills: performing accurate measurements, implications for ratings, use of the thermal property analyser, obtaining and transporting soil and backfill samples, testing techniques, interpreting results, and evaluation of thermal backfill requirements and applications.

Technology Transfer for Underground Transmission

This programme will focus on providing transferred technologies, captured knowledge, and educational materials that will support the execution of a reliable and cost-effective transmission cable systems. It will do so through three parallel tasks:

1. Underground Transmission Education Workshop: Topics will include design, construction, installation, operation, and maintenance of both extruded and laminar dielectric cable systems utilizing research and development as well as industry resources.

2. Diagnostic Techniques for Underground Transmission Cable Systems: As an educational introduction, this task is intended to evaluate existing and developmental diagnostic techniques as applied to both extruded and laminar dielectric cable systems. The task will include a technical assessment of the effectiveness and applicability of these techniques based on world-wide utility experience. To the extent practical, the task will include techniques outside the power cable industry and an assessment of their potentials to be developed for transmission cable systems.

3. EPRI Underground Transmission Systems Reference Book (Green Book)

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

The electricity industry faces challenges that National Grid recognises are more cost-effectively and efficiently dealt with through international collaboration initiatives. In particular, challenges whose solutions require statistically diverse data sets and/or significant trialling and testing in different environments, under various conditions and/or diverse ways.

The Electric Power Research Institute (EPRI), with its wide international membership, is one of the routes through which these initiatives can be delivered and stakeholder value maximised. This approach of managing collaborative projects is beneficial to National Grid and our customers, providing valuable information, learning and knowledge, which would be more expensive to formulate on an individual basis.

This portfolio of work is focused on the challenges of installing transmission infrastructure underground, which address key aspects of National Grid's Innovation Strategy. This program helps enhance safety, reliability, asset life and performance, as well as prioritize asset investments and allocation of limited resources, all of which are aimed at reducing the cost of putting transmission equiment underground.

Method(s)

Of the five Underground Transmission projects, National Grid has identified two of particular value to the GB Transmission system:

1) **Underground ratings and Increased Power Flow**

This project aims to develop software tools and methodologies related to design, engineering, system planning, and operation of underground cables. This project performs the research and development to investigate, assess, and document information on state-of-the-science and best-practices of increasing and optimizing power flow through existing assets. It focuses on underground transmission and is executed in coordination with corresponding projects for overhead lines and substation equipment.

2) Technology Transfer for Underground Transmission

This project provides educational sessions and reference materials on various topics related to design, installation, operation, and maintenance of underground transmission systems. Through active engagement, this project assists in transferring EPRI research and development results and industry resources to meet our technical and educational requirements.

Scope

Underground ratings and Increased Power Flow

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3. EPRI Underground Transmission Systems Reference Book (Green Book): This task will develop novel, up-to-date material on underground transmission, perform benchmarking exercises worldwide as well as utility questionnaires. It will collate all the information into one, single source.

Objective(s)

Underground ratings and Increased Power Flow

The main objective of this project is to deliver the tools, information, training, and guidance to assess and implement increased and optimized power flow strategies for specific needs, with continued reliability, safety, and public acceptance.

Technology Transfer for Underground Transmission

The main objective of this project is to provide educational sessions and reference materials on various topics related to the design, installation, operation, and maintenance of underground transmission systems

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria for Underground ratings and Increased Power Flow will be:

- Reference guide to act as guidance as well as reference and training
- Development of the Transmission Ratings Workstation and successful testing.

The success criteria for Technology Transfer for Underground Transmission will be:

- Improved knowledge of underground transmission system design options
- Improved cable project execution
- Retention and/or transfer of institutional knowledge

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

All of the selected Underground Transmission projects are predominantly laboratory or desk based projects and as such there is no scope to reduce the scale of the projects any further.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The research undertaken in the EPRI Underground Transmission programme is predominantly carried out in the USA with some undertaken in the UK, although the programme also reviews the latest relevant research from across the world.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

The total NGET NIA Project Expenditure is £72,500

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:

n/a

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

n/a

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)

Each project will have different financial savings based on the outcomes and potential benefits gained. Each EPRI programme that National Grid joins has been through two stages of review that consider the potential to deliver financial benefits. In the first instance, within EPRI's governance, the Research Advisory Committee provides guidance on policies and issues that impact the power industry to inform the content of the research programmes. Within National Grid, the Technical Leader for each aspect of the GB Transmission Network undertakes a review of the proposed EPRI programme relevant to their technical expertise and responsibilities and evaluates which provide potential value from a GB perspective as part of an annual review of which programmes to participate in.

All Underground Transmission Projects will create new learning opportunities into assessing the reliability and performance of the Network's operation systems.

Please provide a calculation of the expected benefits the Solution

Not required for a research project.

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

Each project can be applied to the maintenance and reliability of underground transmission measures and strategies throughout the transmission and distribution network.

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

The direct cost of making a policy or procedure change could range from as little as ten thousand to hundreds of thousands of pounds depending on the complexity of the change implications. The wider cost implications arising from such changes will be dependent on the specific outcomes generated from the project and typically will be subject to further stages of demonstration prior to roll out. Further information regarding roll out costs can be provided prior to demonstration stage.

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

All GB electricity licensees own and manage underground cables at various voltages.

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

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

n/a

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

n/a

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes