

## NIA Project Registration and PEA Document

### Date of Submission

Mar 2013

### Project Reference Number

## Project Registration

### Project Title

Flexible Rating Options for DC Operation (FRODO)

### Project Reference Number

### Project Licensee(s)

National Grid Electricity Transmission

### Project Start

March 2008

### Project Duration

3 years and 1 month

### Nominated Project Contact(s)

National Grid TO Innovation Team

### Project Budget

£108,000.00

## Summary

National Grid is currently evaluating DC cable schemes to increase the transmission capacity of the UK network, particularly for increasing the import of electrical energy from renewable sources in Scotland.

The calculation of current ratings for DC cable is significantly more complex than that for AC cable. The rating is often determined by electric stress constraints rather than considerations of thermal ageing. Ratings are also strongly influenced by thermally induced pressure transients within the cable. In some cases the rating of the cable can be restricted by the cable being too cold.

As the normal operating voltage of the cable increases the cable can experience high levels of electric stress while the cable is hot. As the cable cools it is susceptible to electrical failure. Some manufacturers require the converter station to reduce its operating voltage if the current on the link is reduced. The implementation of these current dependent voltage control systems may help protect the cable, but this approach does not align well with the concise cable rating sheet used as part of the CUP package. This introduces an additional level of complexity for Network Operations.

Modelling the complex interactions of thermal and electrical parameters is essential if National Grid is to make a thorough assessment of tenders for HVDC cable schemes. The modelling of transient thermal conditions and the behaviour of the cable insulation under reversals of power flow will provide guidance for the development of dynamic rating algorithms and operational regimes suitable for high power HVDC cable circuits. The thermal and electrical models will be constructed in such a way that the outcomes of planned R&D work on pressure transients and partial discharge ageing can readily be incorporated at a later date.

The models will also be suitable for assessing the effect of fast polarity reversals on the cable system. This will provide guidance on more flexible operation of existing and future HVDC links. In some circumstances the opposite scenario will apply (a cable link where the direction of power flow is rarely if ever reversed). In this case the outcomes of this project could allow restrictions on cable voltage or overload capability to be lifted; again increasing the flexibility of the link.

### Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

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## Problem Being Solved

## Method(s)

## Scope

## Objective(s)

This project aims to:

- Develop tools for the rating and technical assessment of high power HVDC cable options. The work will initially concentrate on cables with mass impregnated insulation
- To provide National Grid with techniques to evaluate continuous, transient and dynamic (real time) ratings for DC cable circuits and to evaluate the options and limits for features such as current dependent voltage control.

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

n/a

## Success Criteria

n/a

## Project Partners and External Funding

n/a

## Potential for New Learning

n/a

## Scale of Project

n/a

## Geographical Area

## Revenue Allowed for the RIIO Settlement

## Indicative Total NIA Project Expenditure

## 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)

n/a

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

n/a

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

n/a

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

n/a

### 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**

n/a

**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

**Please demonstrate how the learning from the project can be successfully disseminated to Network Licensees and other interested parties.**

**Please describe how many potential constraints or costs caused, or resulting from the imposed IPR arrangements.<**

**Please justify why the proposed IPR arrangements provide value for money for customers.**

## 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