Date of Submission

July 2016

Network Innovation Allowance Closedown Report

Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form.

Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

Project Closedown

Project Title	Project Reference
Avoiding voltage regulation action conflicts. (In conjunction with LCNF project CLASS)	NIA_NGET0121

Project Licensee(s)	Project Start Date	Project Duration
National Grid Electricity Transmission	Apr 2013	3 Years

Nominated Project Contact(s)

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Scope

ENW have secured LCNF funding a project that will trial the use of tap changing at a number of primary substations. The purpose of the trial is to establish the degree to which voltage can be either increased or decreased to provide demand increase/decrease to manage DNO network constraints. In addition staggered tap changes will be trailed to establish what scale of reactive power absorption or injection can be provided. The main focus of the trial is to evaluate degree to which primary substations can be used in this novel way without causing a noticeable impact on electricity consumers.

From a NGET perspective, the effect that these actions have on existing Transmission assets and controls must be understood in order to:

- Ensure that no adverse impact occurs on the Transmission protection and control systems
- Conversely to ensure that existing controls do not immediately counter act the intention of the trial,
- To understand the implications of the trial on Transmission asset life on Transmission asset capacity requirements, e.g. transformer capacity and shunt reactors and MSC's for reactive power control.

Objective(s)

The objectives of the project include:

- The avoidance of any negative effects on Transmission protection and control systems,
- The prevention of counter action of the Transmission controls during the project's trials,
- Generate key learning relating to the asset capability of the Transmission systems and potential implications from the trials,
- To evaluate the technical and commercial viability of the potential ancilliary services being trialled under ENW's CLASS project

Success Criteria

The success criteria for the project will be based on the completion of the proposed trials under the CLASS that will investigate the viability of the tap staggering technique for the provision of ancilliary services to National Grid.

Performance Compared to the Original Project Aims, Objectives and Success Criteria

NGET ("NG") has endeavoured to prepare the published report ("Report") in respect of Avoiding voltage regulation action conflicts. (In conjunction with LCNF project CLASS) - NIA_NGET0121 ("Project") in a manner which is, as far as possible, objective, using information collected and compiled by NG and its Project partners ("Publishers"). Any intellectual property rights developed in the course of the Project and used in the Report shall be owned by the Publishers (as agreed between NG and the Project partners).

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Project Overview
National Grid worked with ENW on their Low Carbon Networks Fund project 'CLASS' that trailed the use of tap changing at a number their primary substations. The purpose of the trial was to establish the degree to which voltage can be either increased or decreased to provide an apparent demand increase/decrease to manage DNO network constraints. In addition staggered tap changes was be trailed to establish what scale of reactive power absorption or injection can be provided. The main focus of the trial was to evaluate degree to which primary substations can be used in this novel way without causing a noticeable impact on electricity consumers.

However, from a NGET perspective, it was unclear what effect that this proposal will have on existing Transmission assets and controls which must also be understood in order to:

- ensure that no adverse impact occurs on the Transmission protection and control systems
- conversely to ensure that existing controls do not immediately counter act the intention of the trial,
- To understand the implications of the trial on Transmission asset life and on Transmission asset capacity requirements, e.g. transformer capacity and shunt reactors and MSC's for reactive power control.

Project Plan
This project worked in parallel with the activities set out by ENW's CLASS project, and therefore utilised the project plan from ENW's project schedule (http://www.smarternetworks.org/Project.aspx?ProjectID=413). Data from the practical trails was collated by the academic group led by Manchester University, who produced the final report.

As part of this project National Grid managed the transmission control and protection systems during the CLASS project and facilitated a trial to investigate the viability of the tap change and staggering techniques for the provision of demand management and reactive power services to the GBSO.

The project budget was £339,950

Project Activities
The activities of the project were undertaken to

- The avoidance of any negative effects on Transmission protection and control systems,
- The prevention of counter action of the Transmission controls during the CLASS project's trials,
- Generate key learning relating to the asset capability of the Transmission systems and potential implications from the trials,
- To evaluate the technical and commercial viability of the potential ancillary services being trialled under ENW's CLASS project

During the first year the required technology was put in facilitate the CLASS trials; National Grid worked closely with ENW through Monthly Teleconferences, regular technical meetings, direct ad-hoc discussions between both Information Services and wider teams and by participation in quarterly steering board meetings. At the end of the first year the required technology and trial plan was put in place, allowing the trials to commence on schedule the second year. As part of these activities National Grid implemented an Inter-control centre communications protocol (ICCP) link with ENW's control centre (ENWCC) to facilitate the transfer of data between the separate control centres regarding control actions under the CLASS project (e.g. transformer tap positions, demand levels, real and reactive power). This also allowed National Grid's Electricity National control centre (ENCC) to implement Transformer Tap actions on Electricity North West's network as part of the trials.

The second year saw the practical trails commence in accordance with ENW's schedule. To ensure that the trials and technology is planned and carried out in the most effective and efficient way for both organization we continued to work closely with ENW utilising

the same methods.

Previous Progress Reports
The previous project reports can be found at: http://www.smarternetworks.org/Project.aspx?ProjectID=1462#project-details

2014/15 - The first year of the project has been about getting the technology and trial plan in place, for practical trials to take place in the second year. This has been through monthly project teleconference, regular technical meetings, direct ad-hoc discussions between the two IS and wider teams and participation in quarterly steering board meetings.
The work has all progressed to plan to allow the trials to start as scheduled in April 2014, with National Grid's involvement commencing in June 2014.

2015/16- Following the first year of the project where the technology and trial plan was put in place, the second year has seen the practical trails commence in accordance with ENW's schedule. To ensure that the trials and technology is planned and carried out in the most effective and efficient way for both organization we have worked closely with ENW. This has been through regular monthly project teleconferences, regular technical meetings, direct ad hoc discussions between the two IS and wider teams and participation in Quarterly Steering Board meetings. Data from the practical trails is being collated by an academic group led by Manchester University to produce a final report. Work has commenced on examining impacts on the SQSS and Grid Code within the project with respect to Emergency procedures and protection.

The work has all progressed to plan with National Grid's involvement in the trials starting as scheduled within ENW's project plan.

Required Modifications to the Planned Approach During the Course of the Project

None.

It is worth noting that ENW has extended their CLASS project timeline by one year to investigate the impacts of commercialisation of the CLASS concept. This has not impacted the timelines of National Grid's involvement in the project.

Lessons Learnt for Future Projects

Any future project that looks to measure impact of Distribution network actions at Transmission level should be scaled to be visible to the transmission level. The majority of the CLASS actions were around ~60MW and this was invisible amongst the 'noise' of constant demand changes at the Transmission level. An assessment should be done on the substation's demand to assess the correct level to be a noticeable impact. This could, for example, be 10% of the substations' average transmission demand. This would make it visible at the transmission level and not lost amongst the normal second by second transmission demand changes.

The ICCP link that was implemented between the ENWCC and the ENCC was crucial to real time monitoring of the trials by National Grid. Any future project between National Grid and Distribution Network Operators that involves real time actions that may impact the transmission network should be facilitated and monitored in real time by an ICCP link.

Any future distribution network operator project which seeks to impact the transmission system should involve the ENCC so as to ensure no counter actions are taken which may impact the project trials.

The CLASS project dissemination is located at : http://www.smarternetworks.org/Files/CLASS_151127094432.pdf

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The outcomes from this project are closely tied with and form part of the conclusions from the CLASS project

(http://www.enwl.co.uk/class/knowledge-learning/closedown-report).

The avoidance of any negative effects on Transmission protection and control systems

- The scale of ENW's project was not sufficient to measure any impact on the transmission system during any of the trials. During the CLASS trials 60 primary transformers, equating to a total peak demand change of 170 MW were utilised.

The trials being of a scale not readily observable from a transmission perspective generated some key learning points.

- Trials at low voltage levels on the distribution network do not have a noticeable impact on the Transmission system unless done

at a large scale in relation to the demand at the relevant transmission offtake. This level will fluctuate throughout the day and year along with demand.

- Any future trials of this process or any future projects expecting a transmission level impact should be at a scale to have a visible impact at transmission level. For future projects this should be assessed early in the project to ensure that sufficient scale is utilised to be visible at the transmission level. This scale will be individual to each project and distribution network as it will be based upon the impacted offtake's demand.
- Communication between the control centres was key to ensuring that the distribution led trials were not impacted adversely by actions on the transmission system that may counter the intended actions of the trial. The ICCP link that was created between the ENCC and ENWCC was fundamental to this communication.

Prevention of counter action of the transmission control during the trial was facilitated by

- The active cooperation and involvement of the ENCC within the trial. Any future projects by distribution network operators which have the aim of impacting the transmission system should involve the ENCC.
- The ICCP link put in place to transfer data between ENWCC and the ENCC ensured that both parties were informed of network actions by the other party in a timely manner. This, plus close trial cooperation and communication, ensured that no counter action by the System Operator occurred during the trial.
- Where future projects may be observed or impacted by actions on the transmission network, these trials would benefit by closer operational cooperation between a Distribution network operator and the ENCC facilitated by an ICCP link. This is taken forwards as a learning point for future projects.

To evaluate the technical and commercial viability of the potential ancillary services being trialled under ENW's CLASS project

- The technical and commercial viability of the CLASS technology showed potential for ancillary services but this will rely heavily on several key points being validated:
  - Impacts at transmission level are shown to be invisible from these trials and would therefore need the impacts from considerable volume expansion (dependent upon the size of the Distribution Network and its impact on Transmission level demand) to be trialled to assess transmission impact.
  - Investigation that the effects of this technology are consistent when scaled or in different areas of the country with different demand or distributed generation mixes. This would therefore require other Distribution Network Operators to adopt and trial the CLASS methodology. ENW has extended the CLASS project to examine the commercialisation of the CLASS technology. The outcome of this extension is likely to impact the uptake of this method by other DNO's.
  - That the costs for this service are competitive with other similar services and that the consumer is not adversely financially affected.

No significant problems were discovered with the trialled CLASS method.

We have examined the impact on the SQSS and Grid Code within the project with respect to Emergency procedures and protection and found no changes are required within the SQSS but minor changes to emergency procedures should be made to accommodate future use of the CLASS method when taken up by distribution network operators.

As noted in the CLASS project close down report, http://www.smarternetworks.org/Files/CLASS_151127094432.pdf, the trials demonstrated that ENW could provide ancillary services for demand reduction during frequency events and reactive power absorption.

Planned Implementation

ENW has extended the CLASS project timeline by one year to investigate the impacts of commercialisation of the CLASS concept. Therefore at this time there can be no roll out plan of ancillary services based upon this trial. The outcome of this extension will influence the uptake, or not, of the CLASS method by other DNO's. Until DNO's uptake this method in scale there will be no impact on the operation of the transmission system.

The ICCP link utilised during the CLASS trials will be rolled out to all Distribution network operators who are willing to work with the System Operator to take up the technology.

The use of ICCP link in this project will also bring about further benefits in greater collaboration between the System Operator and Distribution Network Operation (DNO) in tackling increasing challenges of managing complex, changing and unpredictable transmission and distribution networks. This will enable visibility of the other party's network for improved study results and forecast. National Grid is currently establishing an ICCP link with UKPN for the Kent Active System Management project (KASM) due for completion in September 2016 with further plans of rolling the ICCP out to other DNOs in phases.

The CLASS approach to managing reactive power through staggered tap positions on primary substation transfomers is being further

developed and trialled as one of the distributed voltage control methods in the 2016 NGET and UKPN NIC project TDI 2.0.

Other Comments

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