Energy Networks Innovation Process

Project Close Down Form

The voice of the networks

Notes on Completion: Please refer to the NIA Governance Document to assist in the completion of this form.
Do not use tables

Step 1 - Initial Project Details

Project Title

Running Cool

Project Reference

WPD_NIA_70

Project Contact(s)

Liza Troshka

Project Start Date

06/22

Project End Date

03/24

Scope (15000 Characters max)

Running Cool sought to challenge current Active Network Management (ANM) curtailment arrangements by creating a new post fault capability for overhead lines and a new ANM architecture which could help to avoid curtailment. An improved system of short term dynamic OHL ratings (informed by real-time conductor temperatures) and a new corresponding ANM control system architecture were the key outputs of this work.

Objective (15000 Characters max)

This project aimed to integrate a Short-Term Post-Fault Rating (STPFR), derived from real-time conductor temperature measurements, into ANM systems in order to create a new post fault capability for OHLs. The key objectives of the projects were:

- To demonstrate what benefits can be realised by the application of OHL short-term post-fault ratings in ANM
- To develop all required documentation to ensure safe integration of new capability into ANM.

Success Criteria (15000 Characters max)

- The benefits that can be realised by the application of OHL short-term post-fault ratings in ANM are quantified and documented.
- A specification document for the ANM system incorporating new functionality.
- Specification documents for relevant monitoring devices are finalised and fit for purpose.
- Relevant policies reviewed and recommendations for amendments are documented and approved.

Step 2 - Performance Outcomes

Performance Compared to Original Project Aims

Details of how the Project is investigating/solving the issue described in the NIA Project Registration Pro-forma. Details of how the Project is performing/performed relative to its aims, objectives and success criteria. (15000 Characters max)

Running Cool has met its objectives as given below.

- **Demonstrate what benefits can be realised by the application of OHL STPFR in ANM**
  - Network use case and Cost Benefit Analysis (CBA) work packages demonstrate potential capacity release and financial benefits that OHL STPFR can provide when integrated within the ANM system. Results indicated that 132kV OHL circuits rates at 50°C using a 175 mm2 Lynx conductor can provide a potential yearly uplift of approximately 6,842 MWh on average when compared to the static post-fault rating. Similarly, circuits rated at 75°C using a 175 mm2 Lynx conductor can offer 2,961 MWh of capacity uplift on average. The greatest uplift is produced during the cooler months of the year. For circuits with limited available capacity, operating at the static seasonal rating, and consequently higher temperatures, the implementation of STPFRs will not produce a significant potential uplift. For circuits where this is the case, the implementation of a STPFR must be assessed further.
- **Develop all required documentation to ensure safe integration of new capabilities into ANM.**

  The following documentation was developed as part of the project:
  - Functional specification for STPFR of an OHL that exploits thermal capacity of the conductor material.
  - Functional specification for the implementation of STPFR to the existing ANM control system architecture. The proposed functional specification and solution architecture is based on ANM system implementation that is capable of receiving and utilising real time STPFR
  - Failure Modes and Effects Analysis to evaluate each process and component in the system (when using STPFR) to identify how it may fail and what mitigations can be implemented to manage failure modes
  - Functional specification for OHL temperature monitoring equipment in order to monitor conductor temperature to subsequently derive STPFR
  - Recommendations for Policy amendments, specifically SD8A/2 “Relating to Revision of OHL Ratings” and Draft Standard Technique “Relating to the Installation and Maintenance of OHL Monitoring Devices”

Running Cool has met its success criteria as given below.

- **The benefits that can be realised by the application of the OHL short-term post-fault ratings in ANM are quantified and documented**
  - Results of the network use cases analysis and CBA demonstrated a clear potential for capacity release and financial benefits associated with implementation of STPFR capability on OHL network, i.e. “little but often” benefit with significant aggregate energy volume.
- **A specification document for the ANM system incorporates new functionality**
  - Functional specification for the implementation of STPFR to the existing ANM control system architecture was prepared as part of the project and is available upon request. Engagement with current NGED ANM providers confirmed that existing ANM systems are capable of integrating dynamic rating within their systems.
- **Specification documents for relevant monitoring devices is finalised and fit for purpose**
  - Vendor agnostic functional specification for OHL temperature monitoring equipment was prepared and available upon request
- **Relevant policies reviewed and recommendations for amendments are documented and approved**
  - Recommendations for two relevant NGED policy documents (SD8A/2 and Draft ST “Relating to the Installation and Maintenance of OHL Monitoring Devices”) are documented and available upon request.

Required Modifications to the Planned Project Approach

The Network Licensee should state any changes to its planned methodology and describe why the planned approach proved to be inappropriate. Please confirm if no changes were required. (15000 Characters max)

Three changes were required during the course of the project reflecting the need for additional time for equipment delivery and installation, ensuring data capture period is enough to draw reasonable conclusions and restructure of the delivery plan to align with installation schedule.

All change requests were managed according to the NGED governance process with no impact on budget or quality.

Lessons Learnt For Future Projects

Describe how the project (methodology, stakeholder engagement etc.) changed, or provided opportunities, from your expectation at the start of the project and therefore could be useful for a future project. In addition, please discuss the effectiveness of the research development or demonstration undertaken. (15000 Characters max)

Methodology for short-term post-fault rating (STPFR) calculation

- The calculation of STPFR, based on CIGRE Technical Brochure 601, is not dependent on convective cooling, solar heating and radiative heating/cooling. The conductor temperature measurement is the only parameter required to be monitored in real-time to provide a rating to cover STPF generation curtailment events.
- A functional specification for STPFRs builds upon the learnings of the previous NGED NIA project “Overhead Line Power Pointer”.

Active Network Management and system architecture

- NGED has different ANM arrangements depending on a licence area. Implementation of the STPFR capability will require all vendors to be able to accommodate acceptance of dynamic ratings within their power system analysis and decision making.
- The ANM system would require the rating values to be sent to the ANM system every 5 seconds or greater. The ANM system requires the rating to be in either Amps or MVA.
- There are multiple ways of passing STPFR values from the system that would derive the values to the ANM. The preferred implementation method is for the STPFR system to send values directly to the NGED Control System (PowerOn). This arrangement will eliminate a need for multiple interfaces with the ANM system. It will reduce undesirable IT maintenance burden and future proof the system if/when ANM functionality is taken in house (i.e. implemented within PowerOn).
- It is expected that the STPFR will be delivered to ANM in the same ICCP transfer as the network measurements. Additionally, the ANM system will have access to a set of static ratings that are used by default if the STPFR is unavailable via the ICCP transfer set.

OHL temperature monitoring equipment

- Equipment used for the temperature monitoring (Smart Navigators 2.0 or SN2.0) uses sim cards for information transfer. During the course of the project there had been a few issues with sim cards to stop communicating with iHost and therefore loss of data for a period (up to 3 months). If STPFR capability is implemented within ANM such comms failure will be critical; therefore, further consideration should be given into failover arrangements by ANM providers and alternative comms solutions.
- The existing NGED Standard Technique for installation of SN2.0 on OHL was not detailed enough for 132kV OHLs. This has caused minor confusion across operational staff. As a result, feedback from operation personnel was sought and standard techniques updated (in draft).
- SN2.0 devices used during this study for live temperature measurements have been proven efficient. Along with temperature monitoring, SN2.0 provides visibility of real-time voltage, current and directional power flow which is not required for STPFR capability. There is an opportunity to explore alternative technologies with a sole purpose of temperature monitoring if they are proven to be a cheaper option. (Functional specification for that equipment was prepared as part of the project). It is worth mentioning, however, that at the time of writing SN2.0s are relatively cheap devices and when combined with additional visibility can provide for control operation there is an opportunity to optimise the installation of the devices for both ANM and control use hence derive additional financial benefit.

Qualitative benefits of STPFRs: capacity uplift and potential for avoided curtailment

- The increase in available capacity when using STPFR has been assessed and compared against the static post-fault rating.
- For the 175 mm2 Lynx conductor rated at 50°C results demonstrated that the potential yearly uplift in capacity of OHL circuit using STPFR is 6,842 MWh on average when compared to the static post-fault rating. For 175 mm2 Lynx conductor rated at 75°C the results indicate potential yearly uplift in capacity of 2,961 MWh on average. The greatest uplift is produced during cooler months.
- A common hourly uplift profile was identified by this study amongst all sites which produced the minimum uplift during peak sunlight hours and the bulk of the uplift during the evenings and mornings. This uplift profile would benefit generators that have a constant energy output irrespective of meteorological conditions. This is a result of the adiabatic methodology used to obtain the STPFR which is dominated by ambient temperature, which has a bell curve profile, and conductor load. Generators such as PV connections that have an output profile similar to the ambient temperature profile will not be capable of reaping the full benefits of STPFRs.
- The benefits of the STPFR capability can only be realised under a condition when uplift is present at the time of a circuit being thermally constrained.
- The results of this study demonstrate that the implementation of STPFR offers a “little but often” benefit with significant aggregate energy volume that will further unlock latent capacity within the distribution network.
- Financial benefit derived from STPFR capability is mainly associated with avoided curtailment for ANM curtailable connections subject to a cap. This study provides an indication of financial benefits associated with reduction in flexibility procurement where the indicative figure for MWh is available (£300/MWh):
    - Annual reduction in flexibility procurement of 341MWh or ~£102,300 for a highly loaded circuit (ALVE 305) with limited headroom, six sets of SN2.0 installed.
    - Modelled annual reduction is flexibility procurement of £96,483 with one set installed (for future pipeline ANM sites)
- There is no additional impact on OHL conductor design life associated with the implementation of the STPFR. Static post-fault ratings use a 9% exceedance value, which signifies higher thermal stresses could be sustained by the conductor in the event of a prolonged fault. The deterministic nature of STPFRs and the 10-minute interval for ANM response does not increase any currently accepted risk of exceedance. However, the preserved level of risk exceedance relies on the ANM system’s ability to react within

Outcomes of the Project

When available, comprehensive details of the Project's outcomes are to be reported. Where quantitative data is available to describe these outcomes it should be included in the report. Wherever possible, the performance improvement attributable to the Project should be described. If the TRL of the Method has changed as a result of the Project this should be reported. The Network Licensee should highlight any opportunities for future Projects to develop learning further. (15000 Characters max)

Running Cool project has produced a number of documents in alignment with the objectives of the study:

- Technical Specification and Implementation for ANM System Architecture Changes required to embed STPFR capability within existing ANM systems. The document specified different implementation strategies for transferring STPFR values from the source of STFPR system to ANM.
- Technical Specification of how to derive STPFR using a live temperature of the conductor and accompanying risk assessment that specifies each process and component of the STPFR solution, identify how it may fail and propose mitigation solutions to manage the failure modes.
- Report detailing network use cases and detailed information of where the temperature monitoring equipment was installed, methodology for capacity uplift, methodology for curtailment analysis (new ANM connections), results of the uplift analysis and curtailment analysis (observed and modelled).
- Engineering Specification for retrofit OHL temperature monitoring equipment that enables STPFR calculation.
- Documented Cost Benefit Analysis of the STPFR capability and qualitative discussion of the impact of STPFR on OHL conductor design life.
- Recommendations for amendment to the relevant NGED policies relating to OHL ratings and installation and maintenance of the monitoring equipment.

The documentation specified above is available upon request.

Step 3 - Outputs And Implementation

Data Access Level

A description of how any network or consumption data (anonymised where necessary) gathered in the course of the Project can be requested by interested parties. Please include a link to the publicly available data policy. (15000 Characters max)

Information for Running Cool has been published on our innovation website:

National Grid - Running Cool

Specific reports and functional specifications can be requested by submitting a form on the website.

Foreground IPR

A description of any foreground IPR that have been developed by the project and how this will be owned. (15000 Characters max)

The following IPR has been generated as part of this project. Ownership is 100% NGED.

- ANM System Technical Specification document
- Retrofit OHL Temperature Monitoring Equipment Engineering Specification

Planned Implementation

Please describe the next steps to implement this innovation project. What policies and standards need to be updated or created as part of this implementation. (15000 Characters max)

Running Cool demonstrated clear benefits of the STPFR method when integrated within an ANM system. The results presented throughout this report have been generated in a non-live operational environment and therefore, there is further need to upgrade both the ANM system and the NGED control system to ensure they are capable of receiving, sharing and actioning upon dynamic STPFR generated in the iHost system.

The following steps have been considered for full method implementation:

- Liaise with ANM providers and implement necessary changes within existing ANM architecture
- Test secure delivery of STPFR from iHost to PowerOn and confirm consistency of power system parameters shared between all systems involved
- Integrate STPFR values in the ICCP transfer package along with other network parameters to be shared with ANM providers
- Identify a test location within operational ANM connections to conduct live testing
- Following lessons learnt gathered following the trial, implement STPFR capability across all licence areas

Wider business activities will involve:

- Working with a procurement team to identify the most cost efficient OHL temperature sensors that are capable of supporting the STPFR method
- In collaboration with the DSO team to identify constraining circuits resulting in curtailment/flexibility procurement and make recommendations for STPFR method deployment
- In collaboration with control and DSO teams develop guidance around the placement of temperature sensors
- Implement suggested recommendations into NGED policy documents.

Other Comments

N/A

Standards Documents

Identify any industry standards that may require updating due to the outcomes or understanding developed from this innovation project. If no standards will need to be updated, please state - not applicable

Not applicable