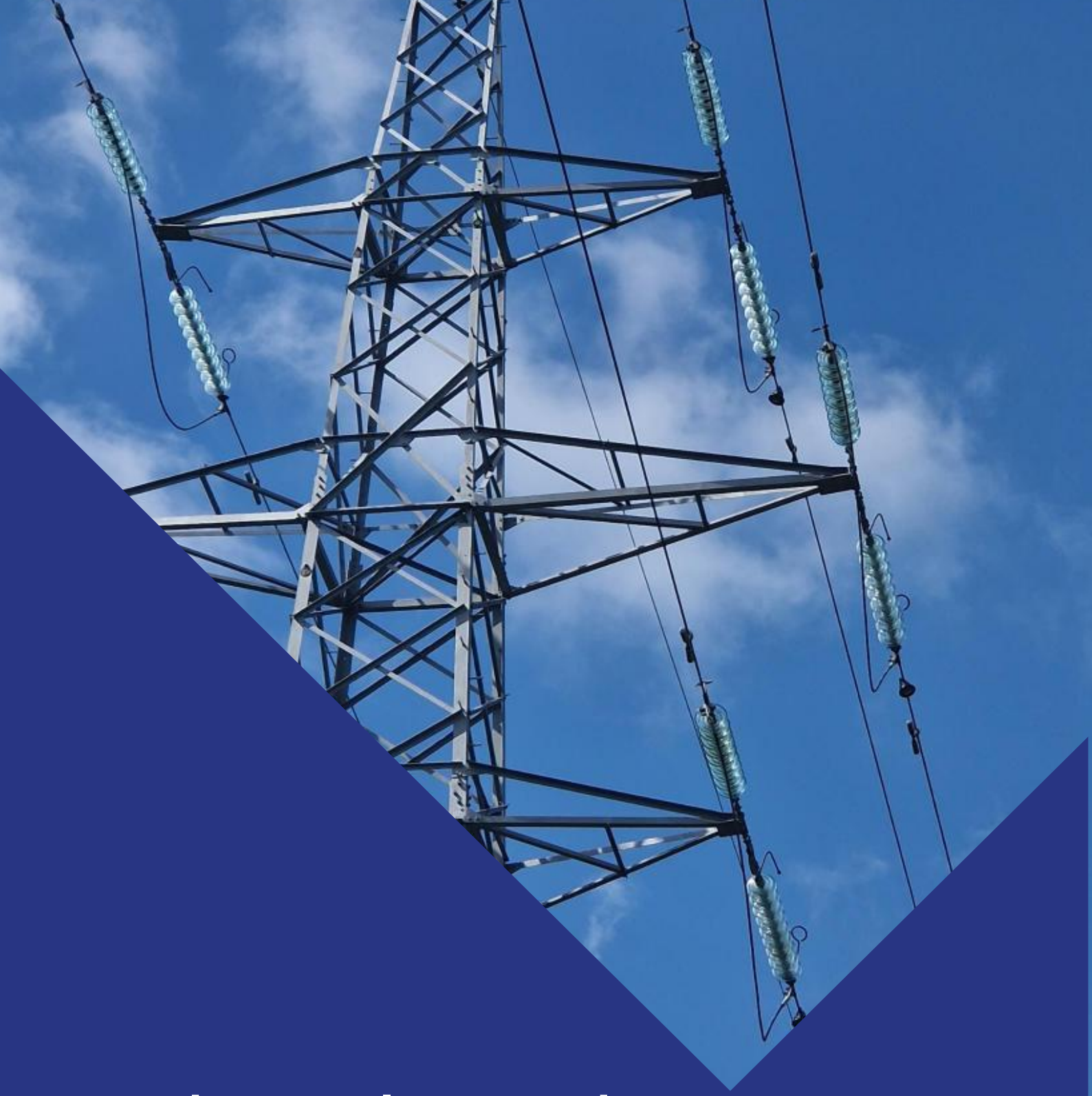

Running Cool NIA Project

Work Package 4.1 – ANM System Architecture Technical Specification

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Electricity Distribution

nationalgrid

Contents

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1.0	29/06/2023	S Casallas S Jupe	L Troshka	First draft for comment
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Glossary

ANM	Active Network Management
DER	Distributed Energy Resource
DLR	Dynamic Line Rating
DNP3	Distributed Network Protocol (version 3.0)
FEP	Front End Processor
ICCP	Inter-Control Centre Protocol
NGED	National Grid Electricity Distribution
OfGEM	Office of Gas and Electricity Markets
OHL	Overhead Line
RTU	Remote Telemetry Unit
SCR	Significant Code Review
STPFR	Short-Term Post-Fault Rating

1. Introduction

This document provides a functional specification for the implementation of short-term post-fault ratings (STPFR) to integrate with existing (and potential future) Active Network Management (ANM) control systems.

This document builds on the high-level technical implementation of STPFR delivered under the Overhead Line (OHL) Power Pointer project to determine the post-fault rating of OHL conductors based on real-time reported conductor temperature measurements. This was trialled in a non-live operational environment as part of OHL Power Pointer.

Background

Full ANM systems are being implemented in areas where multiple complex constraints are affecting a number of customers over an extended time period. A significant number of National Grid Electricity Distribution's (NGED) ANM systems will curtail customers on a precautionary basis under intact network conditions in anticipation of the next worst circuit fault to keep assets within defined ratings. This is partly because NGED's OHL ratings are defined either as pre-fault or post-fault which do not permit an ANM system to wait for an event to happen and instruct generators to curtail. This ultimately means that curtailment is enacted even if an event does not occur.

Pre-event curtailment strategies significantly increase the level of curtailment imposed on generation customers which can make a business case for some generation developers unviable. Under previous regulatory arrangements, NGED were not required to reinforce when an ANM area was categorised as being "full". However, the result of OfGEM's Access Significant Code Review (SCR) determination means that NGED (and, consequently, its customers) now needs to cover the cost of deep reinforcement. It is NGED's responsibility to ensure that there is sufficient generation capacity for all generation connection applications and it's in NGED's best interests to minimise generation curtailment wherever possible.

Scope

This technical specification builds on the following:

- A review of the existing ANM system architectures, delivered by ZIV and Smarter Grid Solutions (SGS) to understand the requirements for the implementation of STPFR.
- Implementation of necessary changes to the ANM system architecture to support the use of STPFRs.
- An assessment of failover arrangements of the ANM system in the event that conductor temperature (and hence STPFR) information becomes unavailable.

The proposed functional specification and solution architecture is based on an ANM system implementation that is capable of receiving and utilising real time STPFR.

Based on feedback from ZIV and their consideration of the incorporation of Dynamic Line Ratings (DLRs) within their ANM solution, this has been used to inform the overall solution architecture (encompassing iHost and PowerOn) and updated for consistency.

Moreover, the handling of STPFRs has been considered and future-proofed by architecting the solution such that STPFRs are transferred from iHost to PowerOn (rather than from iHost directly to other ANM systems). This modular architecture means that NGED can make STPFRs available to existing ANM systems (ZIV and SGS) as well as to any future ANM systems (whether developed within the PowerOn environment itself or as a satellite system to PowerOn).

2. Technical Specification

This section outlines the technical requirements of the ANM system to incorporate the use of STPFRs. It focuses on the connection between the NGED PowerOn and the ANM system.

System Requirements

Requirement No.	Requirement/ Procedure	Description
1	The ANM system requires the rating value(s) to be sent to the ANM system every 5 seconds or greater.	Values sent at a higher frequency would be accepted but the operating period of the ZIV ANM system would only take most recent value is used in the ANM calculations. The STPFR will change at a slower rate even though the response can be quicker. The higher response rate could be used by other ANM system providers.
2	The ANM system requires the rating to be in either amps or MVA.	This is predefined during the configuration of the ANM system. The STPFR will be calculated in Amps and can be presented by PowerOn to the ANM system in Amps or MVA (using operational voltage as the conversion factor)
3	The ANM would apply the rating value to the specified circuit/transformer at the next calculation cycle.	The STPFR provided will be valid for 10 minutes[1] on a continuously rolling window (i.e. The STPFR is continuously recalculated every minute to provide a rating for the next 10 minutes). ZIV This would then be used in curtailment calculations and may affect Distributed Energy Resource (DER) set-points. There would be a delay between receiving the rating value and issuing a new DER set-point, this period may be up to twice the ANM operating period. SGS This would then be used to generate a scaling/ sensitivity factor that will in turn be used to update/ populate the lookup table. If the setpoint delta is such that it would cause instability in the network, the new setpoint will be implemented gradually within the specified time frame to avoid a sudden change in network operating conditions. The time frame in which the setpoint is implemented will be set by the ANM provider.

[1] 10-minutes has been selected based on the thermal time constant of the OHL system and the observed maximum time taken by an ANM system to communicate its set points and receive feedback that generation curtailment is being enacted.

4	A fixed de-rating factor may be applied to the rating value.	This would provide a safety margin to accommodate the various system latencies and would be fixed during the ANM system configuration.
5	As a future enhancement, the STPFR value may also be used by the N-1 Contingency Rating calculation.	In this instance the N-1 rating module would use the STPFR value as the basis for calculating curtailment in accordance with NGED specification SD11. This could then be used by ANM systems in their real time calculations of ratings and/or sensitivity factors. The STPFR ratings are valid for use in N-1 scenarios because STPFRs are deterministic, based on measured conductor temperature, rather than statistical.

3. Implementation Strategy

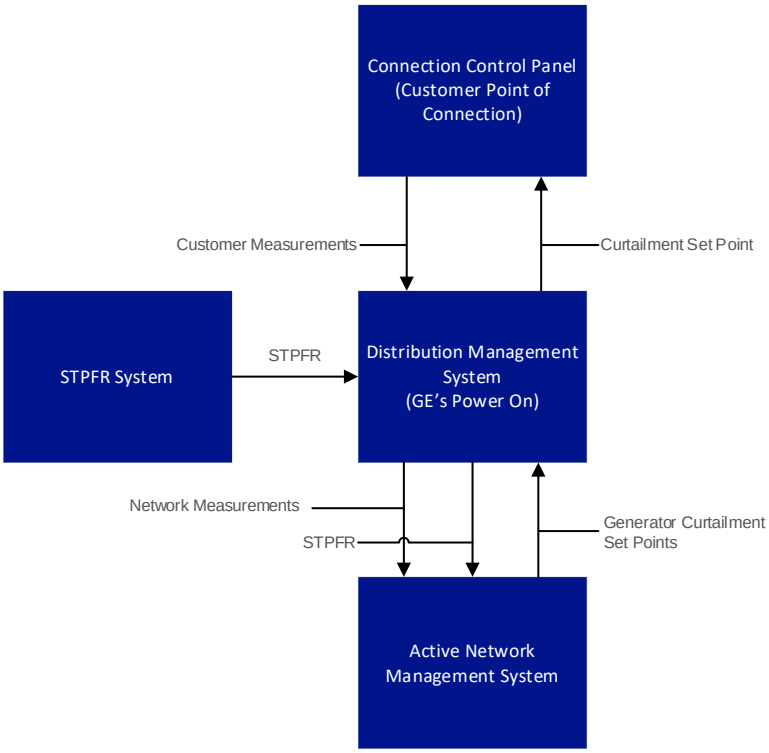
This section provides an overview of the chosen implementation strategy which has been assessed based on the ease of integration with the source STPFR system to the ANM.

The preferred method of implementation is by using the STPFR system to send the value(s) directly to the NGED PowerOn. The STPFR system will transfer data to NGED's PowerOn by collating relevant datapoints into a single virtual Remote Telemetry Unit (RTU) which will be used as an interface to transfer data via Distribution Network Protocol 3 (DNP3). The detailed implementation specification (describing how this is achieved in practice) is available from Digital Grid Support (Regulation & Corporate/ Electricity Systems) on request. This means STPFRs are available within the PowerOn environment to all ANM systems. The iHost-PowerOn implementation avoids the creation of multiple interfaces to the ANM systems (which, in turn, would have an undesirable IT maintenance burden). These values are then included in the PowerOn to ANM ICCP transfer set, in conjunction with the majority of other ANM signals. The STPFR data point will then be available in PowerOn for the ANM providers to use accordingly.

4. Architecture Implementation

This section illustrates the proposed system architecture between NGED PowerOn and the ANM system.

ANM Architecture



It is expected that the STPFR will be delivered in the same ICCP transfer set as the network measurements from PowerOn to the ANM system. In a failover scenario, 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.

5. Conclusion

This document has provided a functional specification of the technical requirements for the ANM implementation of the STPF of OHL conductors based on real-time reported conductor temperature measurements.

This specification has covered the following:

- A review of the existing ANM system architecture.
- The considered approach for implementing necessary changes to the ANM system architecture to support the use of STPFRs (including interoperability with multiple ANM system providers and future-proofing of the solution).
- An assessment of failover arrangements of the ANM system in the event that conductor temperature information becomes unavailable.

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