NIA Progress Report

NIA_ENWL008
Architecture of Tools for Load Scenarios (ATLAS)

22 July 2016

VERSION HISTORY

Version	Date	Author	Status	Comments
v.1.0	20/07/2016	R Shaw	Final	Final version following internal review and comment

REVIEW

Name	Role	Date
A Howard	Programme Manager	21/07/2016
D Randles	Network Performance and Innovation Manager	21/07/2016
P Turner	Future Networks Delivery Manager	21/07/2016

APPROVAL

Name	Role	Date
Steve Cox	Head of Network Engineering	22/07/2016

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1 PROJECT BASICS

Project Title	Architecture of Tools for Load Scenarios (ATLAS)
Project Reference	NIA_ENWL008
Funding Licensee(s)	Electricity North West Limited
Project Start Date	November 2015
Project Duration	2 years, 1 month
Nominated Project Contact(s)	Steve Cox, Head of Engineering (Project Champion) - (steve.cox@enwl.co.uk)

2 SCOPE

The scope of the future analysis needs to expand from the existing focus on peak loading in MVA, based on winter peak MW loading. The expanded analysis will cover winter and summer conditions, peak loading and minimum or reverse power flow, including the effects of generation. The outputs will include indicative comparisons to thermal capacity. Future loading will be expressed with uncertainty eg scenarios and volatility measures.

This will be delivered in a consistent way across all distribution network assets – GSP, BSP, primary and secondary networks – although the implementation will differ. In particular the grid and primary analysis will be per substation, corrected for weather and generation effects, and cover the range of active power flows, reactive power flows, apparent power, power factor and load factor over a year (P, Q, MVA, pf, LF). For the secondary networks, given the lack of historic data on loading and uncertainty in local geographical spread of new technology, there will be a simpler analysis, and future scenarios will be interpreted on a volume basis ie suggesting a number of assets exceeding capacity in future. The project will deliver the methodology, prototypes and specifications for an enduring automated business solution to analysing current load, generating future scenarios and providing indicative capacity assessments.

The project will build on the analysis and tools developed in elements of the following Electricity North West innovation projects:

- Low Voltage Network Solutions (2011-2014) eg Future Capacity Headroom model of the secondary networks
- Demand Forecasts and Real Options (IFI) - 2013-2015
- Demand Scenarios with Electric Heat and Commercial Capacity Options (NIA) – 2015-2016 – developing peak demand scenarios at grid and primary
- Reactive Power Exchange Application Capability Transfer - REACT (2013-2015) with National Grid and all DNOs.

3 OBJECTIVES

The ATLAS project will develop the method to deliver historic estimates and future annual scenarios of asset loading to 2031, and make indicative comparisons of these to thermal capacity. This will provide inputs to network/business planning, information for stakeholders and help fulfil mandatory reporting requirements.

This project supports four primary objectives:

- To support efficient decisions about load-related investment in the RIIO-ED1 regulatory period (2015-2023)
- To justify the plan for efficient load-related investment in the RIIO-ED2 regulatory period (2023-2031)
- To more efficiently and accurately meet our 'Week 24' reporting obligations to National Grid, and support compliance with future restrictions on the operational envelope of GSPs
- To provide better information to stakeholders and customers, enhancing customer service.

By better understanding current and future loading, this will support the business to only provide necessary network capacity and investments, thus minimising the economic and environmental impact of the networks.

4 SUCCESS CRITERIA

- Automate correction and analysis of peak and minimum load behaviour across all grid and primary substations
- Deliver a prototype tool for annual P and Q load estimates and indicative capacity assessments across all grid and primary substations, including automated delivery of a wider scope of estimates and scenarios of GSP Connection Group loadings to National Grid in the 'Week 24' submission, and for future regulatory reporting required by Ofgem
- Amend internal policies accordingly, and specify the business-as-usual approach for grid and primary substations
- Deliver partial prototypes of load estimates and indicative capacity assessments across the secondary network, and specify the future business-as-usual system to be based on the improved load estimates expected to be available from 2018 onwards.

5 PERFORMANCE COMPARED TO THE ORIGINAL PROJECT AIMS, OBJECTIVES AND SUCCESS CRITERIA

The project is on plan against the original aims, objectives and criteria.

In its first phase, the ATLAS project has focused on the methodology to deliver future annual scenarios of asset loading. Within this context the high-level methodologies for active and reactive power (P and Q) demand forecasting have been developed.

The proposed method for P demand forecasting extends the existing approach in Electricity North West to:

- Forecast peak and minimum P demand, across the year and reflecting half-hourly variations in loading

- Forecast true demand and latent demand met by distributed generation (DG), including generation with export metering and generators offsetting customer demand

- Adopt enhanced approaches to the true demand forecasting, using the learning from the 'Demand Scenarios with Electric Heat and Commercial Capacity Options' (NIA) project.

The definition of Q demand forecasting enhances the methodology developed in the REACT (NIA) project to consider:

- The effects of different types of DG and LCTs

- Be aligned with the more sophisticated P demand forecasts

- Estimate effects not previously investigated (eg long HV cables connecting renewable generation DG, power factor assumptions for DG and LCTs).

The P and Q forecast methodologies require historic half-hourly P and Q load behaviour as an input. The automatic correction and analysis of historic P and Q load behaviour across all grid and primary substations. Delivering this addresses success criterion 1 of the ATLAS project. So far a methodology and prototype MATLAB tool for processing time-series demand data has been developed and tested using half-hourly active and reactive power data of Electricity North West's 71 bulk supply points (BSPs) and 384 primary substations. The developed tool uses half-hourly resolution in analyses and outputs; it has already been used to identify seasonal peak and minimum demand values and associated historical trends.

In the next phase of the ATLAS project, the prototype tools to deliver the P and Q forecasts will be built for all grid and primary substations, addressing the first aspects of success criteria 2.

6 REQUIRED MODIFICATIONS TO THE PLANNED APPROACH DURING THE COURSE OF THE PROJECT

No change to the planned approach has been made, but the timeframe of the grid and primary scenarios has been extended beyond 2030 on an indicative basis to 2050.

7 LESSONS LEARNT FOR FUTURE PROJECTS

The following lessons for future projects have been learnt so far in ATLAS:

- Successful development of a prototype data processing tool requires a methodology tailored to the potential data issues (ie missing data, spikes, step changes due to switching operations or network reconfigurations). Therefore, it was necessary for the proposed data processing methodology to use a combination of techniques (eg half-hourly and daily analyses) to deal with all potential monitoring data issues.

- The more detailed use of half-hourly loading data has revealed necessary updates in Electricity North West's demand data system for the collation and pre-processing of the monitoring data for grid supply points (GSPs), BSPs and primary substations.

- A major challenge for the high-level definition of P and Q demand forecasting is to ensure the methodology and assumptions will cover existing and forthcoming

challenges; scenarios can use a bottom-up approach capturing the significant changes in distribution networks taking place at lower voltage levels (eg LCTs, DG, storage) and the variation in behaviour across a distribution network. At the same time the increasing significance of transmission-distribution (T-D) interactions seen by National Grid (NG) at GSPs requires a mutual understanding and actions between DNOs and National Grid (eg, demand scenarios more aligned with NG's future energy scenarios) to tackle these issues. ATLAS will continue to work with a bottom-up methodology, but maintain a dialogue with National Grid on how to develop distribution network scenarios consistent with the core assumptions in National Grid's future energy scenarios.

- The high-level definition of the Q demand forecasting approach has shown that there are various different effects of distribution network assets on Q demand. Therefore, the use of empirical formulas versus the use of detailed network modelling for Q demand forecasting, as well as the associated mismatches, will be further investigated in the next stage of the ATLAS project. This analysis will show whether the use of empirical rules instead of detailed network modelling is sufficient to assess effects on Q demand from distribution network assets.

8 THE OUTCOMES OF THE PROJECT

Not applicable.

9 PLANNED IMPLEMENTATION

Not applicable.

10 OTHER COMMENTS

Not applicable.