

## NIA Project Close Down Report Document

### Date of Submission

Jul 2023

### Project Reference Number

NIA\_WPD\_071

## Project Progress

### Project Title

ANM - Balancing Coordination Demonstration (ABCD)

### Project Reference Number

NIA\_WPD\_071

### Funding Licensee(s)

NG ESO - National Grid ESO

### Project Start Date

June 2022

### Project Duration

1 year and 0 months

### Nominated Project Contact(s)

Jenny Woodruff

## Scope

The project will amend one ANM system but the algorithms developed and the specification of the additional communications will be shared so that they can be adopted by other ANM systems. The modified ANM system is trialled using a test system, rather than a real ANM system to minimise the costs and risks of the project, but a wide range of operational scenarios are used to ensure that the modified system operates effectively.

If balancing services and ANM systems are not coordinated then there is a financial impact in terms of NG ESO needing to despatch further services. There is also an impact on the liquidity of the balancing services market if players are wary of signing up to provide services when the operation of ANM schemes may affect their ability to deliver services putting them at risk of contractual penalties. NIA\_NGSO0035 analysed the potential benefits of different coordination options. The modification of ANM systems to hold headroom being deployed in this project was estimated to have an annual benefit of £44m across the UK.

Developing and testing this upgrade is expected to speed up the adoption of this solution by approximately 18 months and therefore the UK wide benefits from the project are in the order of £70m.

## Objectives

The project objectives are to;

- Develop the detailed coordination process required to avoid counteraction of Balancing Services by maintaining the headroom on ANM systems and document this in sufficient detail so that it can be used by any ANM system provider to enhance their system.
- Understand and capture the data exchanges required to support the coordination process.
- Modify an ANM system and test it using realistic scenarios to show how it would operate in a real-world implementation.
- Capture and share the project learning.

## Success Criteria

Success criteria for the project are that;

- The detail behind the coordination methodology has been explored and expanded into a specification and a design solution which has been captured in the System Specification and Design document.
- The requirements of communications to support coordination have been evaluated and the data items, frequencies and underlying technologies have been specified.
- A demonstration system has been built that can mimic the coordination process that would take place with live systems and this has been used to test the process under a variety of realistic test scenarios.
- The learning from the project has been captured and disseminated.

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

The ABCD project has completed all its objectives as detailed below.

- Develop the detailed coordination process required to avoid counteraction of Balancing Services by maintaining the headroom on ANM systems and document this in sufficient detail so that it can be used by any ANM system provider to enhance their system.

- **Complete** – A coordination process was developed and findings documented in the project closedown report with signposts to the key documents developed during the course of the project.

- Understand and capture the data exchanges required to support the coordination process

- **Complete** - Simulation systems were used to validate the data exchanges.

- Modify an ANM system and test it using realistic scenarios to show how it would operate in a real-world implementation.

- **Complete** – A demonstration system was built in AWS based on SGS products (WP3 - System Development complete).

- Consolidate and share the learning from the project

- **Complete** - The learning from the project has been captured in this closedown report. A dissemination webinar was held in May 2023.

The project has also met all its success criteria as detailed below.

- The detail behind the coordination methodology has been explored and expanded into a specification and a design solution which has been captured in the System Specification and Design document.

- **Achieved** - This was captured as part of WP1 D1 - System Specification & Design document.

- The requirements of communications to support coordination have been evaluated and the data items, frequencies and underlying technologies have been specified.

- **Achieved** - This was captured as part of WP1 D1 - System Specification & Design document.

- A demonstration system has been built that can mimic the coordination process that would take place with live systems, and this has been used to test the process under a variety of realistic test scenarios

- **Achieved** - A Demonstration system was built in AWS (WP3 - System Development complete)

- The learning from the project has been captured and disseminated.

- **Achieved** - The learning from the project has been captured in this closedown report, which will be published. A dissemination webinar was held in May 2023.

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

There were several minor modifications to approach that took place during the project.

The work within the commercial evaluation work package was originally expected to have a wider scope, however it was found that key items of data that were required for a full financial analysis were unavailable. Therefore, the commercial evaluation report included more qualitative analysis and less quantitative analysis than had been originally anticipated.

The original intent was to have separate stages for Factory Acceptance Test (FAT) and scenario testing but as the project progressed it was determined to be more beneficial to carry these out simultaneously.

The original modifications to the system were found to operate incorrectly, causing additional unwanted curtailment. This required a

revision to the system.

A change in staff roles within NGED resulted in bringing in additional project management resource from Smart Grid Consultancy.

There were small scale delays that resulted in an extension to the project timescales to complete in May rather than at the end of March.

All modifications to the project approach were assessed for materiality and impact using the normal project governance process.

## Lessons Learnt for Future Projects

### Data Quality and Availability

The project had hoped to use data that was not normally used within the business for the commercial evaluation report. The lack of certain data items and the difficulty in determining the context for any customer constraint periods became apparent as the work progressed. The project learned that the following data items were not available:

- Historic levels of headroom created by the ESO's balancing service decrement requests
- Historic export prices
- Historic levels of curtailment
- Flexibility procurement prices
- Exceeded Capacity Price

Similarly the curtailable load and position in the Last-in-First-Out (LIFO) stack for each relevant generator was more difficult to obtain than was anticipated as this is not data that has been shared before. It is expected that some of this data will be collected in the future to meet the Access SCR changes.

### Specification & Design

**Data Mapping:** During the implementation a potential complexity around data mapping was identified where the unique identifiers for generation and load assets used by the ESO would likely differ from those used by the DNO. As such a mapping layer would need to be implemented somewhere on the system, initial designs discussed an independent "Data Platform" which could be a suitable place for this mapping to occur.

**Signal Exchange:** There was difficulty around the mechanism of communicating Bid Offer Acceptance Instruction (BOAi) / Physical Notification (PN) between ESO & DSO – operational protocols such as ICCP make this type of data transfer difficult. The use of web services to exchange data was explored, however, early in the design stage it was clear that the required information wasn't available through web services in neither the ESO nor the DNO operational environments. For purpose of demonstration, ICCP conformance block 4 (InformationMessages) was used to transmit messages in text format but this block is not widely supported / utilised in control systems and as such may not be practical in an operational context.

### Deployment & Test

Due to time constraints the Factory Acceptance Tests were not witnessed by the wider project team. It would have benefited the project to have had representation from all partners witness Factory Acceptance Testing. The project had many nuances, and the documented test script alone was not a substitute for the project team to having the opportunity to see SGS's product "in action" and ask questions to the SMEs.

### Trial

**Service Degradation Due to Ramping:** Some degradation of ESO service due to Balancing Mechanism Unit (BMU) ramp down occurring before the hold mode ends. The system implementing the hold mode ideally should initiate hold mode when the BMU starts ramp down, not at the BOA start time, but this requires knowledge of BMU ramp rate / start time. Two solutions are possible for this:

- Exchange a larger volume of information such as generator ramp rate and expected start time. The ESO holds operational data for each registered BMU including ramp up and ramp down within the Balancing Mechanism (BM) system. When the BM instructs a BMU to be at a set power level at a specified time the BOA instruction issued by the ESO has accounted for the BMUs power ramp rates.
- If the only information exchanged is a binary on/off hold mode signal then it must be applied at start of generator ramp down. This may have further implications on other methods of solving this conflict of services.

**Reduction of Curtailment Events:** Hold mode can help reduce control actions on ANM controlled Distributed Generation (DG) when an embedded BMU ramps up after providing a BM service.

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 of the project are as follows;

- A coordinated solution to mitigate conflict between balancing and ANM services has been developed and documented.
- A proof of concept solution has been demonstrated during a trial comprising scenario driven tests to validate the ANM operation during the ESO and ANM service conflicts.
- 20 scenarios were tested under the following categories:
  - Service Conflicts: Demonstrating conflict of services where the ANM degrades the ESO request.
  - ESO Decrementing Service Requests: Demonstrating successful resolution of conflict
  - Management of Boundary Export: Demonstrating management of conflict & continued management of conflict during the duration of ESO service requests.
  - Constraint Management: Demonstrating successful resolution of conflict under when different constraints are active.
  - Response to Failures: Demonstration resolution of conflict under different failure scenarios.
  - Principle of Access: Demonstrating resolution of conflict under different ANM principles of access.
- The system was seen to operate correctly with “Hold Mode” preventing ANM generations from increasing their export when other generations are providing ESO Balancing Mechanism instructed generation turndown services.
- The learning from the project has been shared via a dissemination webinar and closedown report.

## Data Access

No new data was captured as part of the project.

Key information about the project is available on NGED’s Innovation website or upon submitting a request on [NGED.Innovation@nationgrid.co.uk](mailto:NGED.Innovation@nationgrid.co.uk).

## Foreground IPR

New IPR was generated in terms of the algorithms applied in the future modified systems and the specification of the communications link. This IPR is owned jointly by all four partners each having a 25% share. The IPR associated with the modified code and software developed by SGS is owned entirely by SGS.

## Planned Implementation

The project successfully developed the proof-of-concept implementation of the solution W1 that facilitates the coordination between Balancing Services activation and ANM services to avoid potential conflict. The mitigation of the conflict was successfully demonstrated within an offline test environment. All care and due diligence have been undertaken to ensure the developed solutions can be implemented in real-world, ensuring the protocols used for communication, cyber-security implications and ensuring generalisation for implementation within networks of all DNOs.

Work remains to be undertaken for the deployment of the proposed solution within the field, the technology readiness level of the solution needs to be further appraised. The consortium is currently in discussion and preparing a potential application to Strategic Innovation Fund to enable the development of the product and consequent implementation within a distribution network for field trial.

The steps towards full Business as Usual roll out could include the following items.

1. Hardware-in-the-loop testing including some of the scenarios tested in the project simulated environment. It is proposed to reduce the areas of simulation and replace with real systems where possible as an intermediary step to a full system test.
2. Full live system testing on a selected area of network with Distributed Energy Resources (DER) providing ESO balancing services within a DNO ANM managed zone. Again, this would include testing some of the scenarios tested in the project simulated environment.
3. Extending the ANM functionality in the project which covered Balancing Services export decrementing to include export and

import incrementing and import decrementing.

4. Extending the ANM functionality tested in the project to include other ESO Services such as Transmission Constraint Management (TCM) or Short-Term Operating Reserve (STOR) which use DER.
5. The project architecture for the coordination of ESO and DNO services introduced the idea of the ANM Data Platform. The ANM Data Platform is a new component which aims to provide a single location for data relevant to service co-ordination. This provides flexibility when considering the extension of the system to exchange a wider set of data allowing both ESO and DNO to plan service dispatch to reduce the chances of conflict. Much of this data is not suitable for the operational communication channels currently used to exchange data between ESO and DNO. Work to prepare for Business as Usual implementation could develop a meaningful function for this platform e.g., allow the DNO to place weekly forecasting of flexibility service dispatching to assist the ESO with dispatching of its own services. Consideration could be given to the ESO to ANM Data Platform interface and a test and trial plan developed taking the ANM Data Platform from a simulated test to some form of hardware-in-the-loop testing.

It is recognised that development of the ANM Data Platform is dependent on areas of ESO/ DNO system development and areas such as the Energy Networks Association (ENA) Primacy Rules project and hence may be some years away from becoming a reality. However, it is thought that the concept of the ANM Data Platform is worth exploring further and agreeing at least one useful function that could be trialled to help the ESO and DNO coordinate services from DER. This could be the provision of embedded BMU ramp rates to improve hold mode performance.

6. "Service Degradation Due to Ramping" could be further investigated, where a number of methods for reducing degradation could be explored, such as:

- Tuning of the control algorithm to act faster,
- Transferring a richer data set to inform the Hold Mode calculation.

The application of these methods could result in less degradation of the ESO Service, and a reduction in curtailment.

## Other Comments

N/A

## Standards Documents

N/A