Kent Active System Management Low Carbon Networks Fund

Project Progress Report December 2016

UK Power Networks
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Contents

Executive Summary

The Kent Active System Management (KASM) project aims to carry out a range of technical innovation trials to demonstrate more advanced operations and planning techniques for the 132kV and 33kV network in South Eastern Power Networks' (SPN) East Kent area. It is envisaged that the project will deliver benefits that will span various areas, including the enablement of low carbon generation, the deferral of capital-intensive reinforcement associated with new generation connections and improved network reliability.

The project is running for three years, from January 2015 to December 2017, and was awarded funding of £3.4m by Ofgem under the Low Carbon Networks Fund (LCNF) scheme. Total funding for the project is £3.9m, with the remaining funding provided by UK Power Networks (£450k) and project partners (£50k).

This six-month reporting period (July-December 2016) is the fourth for the project. The main focus of this reporting period has been on the development and testing of the Contingency Analysis System (CAS) and Forecasting Module.

Following the submission of the previous six-month report, in June 2016, the project has completed two further Successful Delivery Reward Criteria (SDRC) deliverables:

1. SDRC 9.2 – Completion of the system integration of Contingency Analysis (CA) software into UK Power Networks' systems, excluding real-time link to National Grid
2. SDRC 9.3 – Completion of installation of forecasting modules that will link the DNO control with other data sources

In order to achieve the delivery of SDRC 9.2 and SDRC 9.3, the focus has been on completing development and testing for Release Zero, which is considered to be the core product. Key testing completed includes Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT). In addition to delivering the SDRCs, the project team has continued with the testing of the Inter-control Centre Communications Protocol (ICCP) link, which is expected to go live in January 2017. The project team has also continued working with Bigwood Systems Inc. (BSI) to ensure that Release One development remains on track for trials to start as scheduled in May 2017.

In addition to design, development and testing, the team has continued to ensure that value can be delivered by the KASM solution. A key success in this area is the approval of a change to the Grid Code, which came into effect on 28 July 2016. This change allows the same National Grid network models to be used for operational and planning purposes by DNOs (previously the use of these models was restricted to operational purposes only). This change will be important in improving visibility of National Grid's network to DNOs.

Following detailed planning, the delivery of SDRC 9.4 has been impacted by the delays to SDRC 9.2 and SDRC 9.3. On 14 September, following discussions with Ofgem, UK Power Networks submitted a notification to reschedule the delivery of SDRC 9.4 from 31 December 2016 to 16 June 2017. SDRC 9.4 will demonstrate the use of near real-time contingency analysis in the control room.

Overall, this reporting period has demonstrated that the installation and core functionality of the CAS and Forecasting Module have been successful. The project team continues to work with suppliers and stakeholders to develop the proposed improvements for Release One, which will be delivered prior to trials commencing in May 2017. The project still expects to deliver the full benefits and learning within the overall project timescales.

Finally, the achievements of the project have been recognised at the 2016 UK IT Industry Awards, where the project was shortlisted for the Innovation Infrastructure of the Year.

There remain some key risks which are currently being closely monitored and mitigated:

Key Risks

Risk Ref	RISK Description	IMPACT Description	MITIGATION - Action Plan & Progress
R0035	Suspect analogues are not rectified in time for KASM trials.	Some data inputs into CAS are likely to be incorrect. Converged power flow solutions may be achieved but the reliability of the results may not be fully reflective of network conditions.	Suspect analogues will be fixed as part of the ongoing business-as-usual replacement of measurement transducers. In the meantime, recommendations from the data survey report will highlight sites with accurate and inaccurate analogues.
R0038	The reduced trial period is not sufficient to deliver the full benefits.	The benefits cannot be delivered by December 2017 (close of the project).	The project team is working with trial participants to carefully plan the trials to ensure that full benefits can be captured during the reduced period. A strategy has been developed to retrospectively analyse available data and we believe this will deliver the benefits during the period.

Learning and dissemination

During this reporting period the project team engaged with stakeholders at various learning and dissemination events. A key event for the team was the Low Carbon Networks Innovation Conference 2016, held in Manchester. The key messages disseminated were:

- The operating challenges in East Kent
- The KASM solution
- The business impact of using the KASM solution
- Initial lessons learned

Project Manager's report

1.1 Workstream 1

Workstream 1 is responsible for designing, developing, testing and delivering the Inter-control Centre Communications Protocol (ICCP) link between UK Power Networks and National Grid. Both UK Power Networks and National Grid will exchange relevant real-time data for the purpose of contingency analysis.

The project team has completed the ICCP infrastructure implementation and is currently in the final testing phase. During testing it was discovered that the agreed design did not fully support resilience and business continuity. This resulted in revisiting the communications network design, which concluded that the design would require an extra communication circuit in the architecture. This impacted the testing timelines. The implemented solution now has three fully configured environments to support live and test connections. The learning associated with the change will be disseminated as an addendum to SDRC 9.1, which captures the design of the ICCP link. This updated document will be published in the next reporting period.

In parallel, both UK Power Networks and National Grid have replicated and integrated the electrical networks in their respective electricity control systems to enable the mapping of corresponding electrical components and send and receive real-time data via the ICCP link. A change process has been put in place to ensure that any physical electrical infrastructure changes are reflected in the drawings of the respective electricity control systems.

The ICCP infrastructure so far has been tested for:

- Non-functional Testing
    - Proving infrastructure resilience, service continuity and performance using the revised communications architecture
    - Security and penetration testing to ensure that no external unauthorised connections are possible and neither of the two organisations are at risk from intrusion

- Functional Testing (the following tasks have already been proven in the pre-production test environment)
    - Validating data sent for component/data point data required by National Grid
    - Validating data received from National Grid for KASM purposes

The formal test phases remaining (planned for early in the next period) prior to declaring ICCP live are:

- User Acceptance and Operational Acceptance Testing
    - Custodians of UK Power Networks' PowerOn Distribution Management System (DMS) and National Grid's Energy Management System (EMS) have witnessed and accepted the ICCP solution
    - The technical support teams have reviewed processes and witnessed the Operational Acceptance Testing in order to declare the solution live and in business as usual

Two key challenges were encountered during the design and implementation phase:

- The Vodafone communications network architecture design had not incorporated the necessary full resilience for the solution. This resulted in the reworking of initial designs and the addition of further network circuits and routers to the infrastructure.
- To ensure that testing was delivered successfully, a dedicated project management resource was required to manage the test plans with multiple stakeholders, across a range of geographical locations.

Tasks for next period:

UK Power Networks and National Grid will be actively exchanging network data over the ICCP link, enriching their respective control systems with live data. The main steps for the next period are:

- User Acceptance and Operational Acceptance Testing
- Working closely with the infrastructure support service providers, guiding them through any difficult situations and, in the event that any changes are required, assisting with the management of the change process
- Supporting the drawing office team to ensure that accurate information is received, changes are implemented in a timely manner and data continues to flow accurately for the changed components

In summary, during this period the ICCP link has been fully implemented and the final testing will be completed in readiness for operational acceptance and ready to go live. The workstream remains on schedule and during the next reporting period the real-time National Grid data will be incorporated within the PowerOn XML export which is utilised in the CAS.

1.2 Workstream 2

Workstream 2 is responsible for delivering the CAS to satisfy the business requirements of Real Time Mode, Study Mode and Look Ahead Mode.

The delivery phases for the CAS were described in the previous six-month progress report as:

- Release Zero (delivering the core CAS set out in the criteria under SDRC 9.2)
- Release One (delivering additional user functionality, integration of ICCP data, automated file transfer and a more strategic hosting platform)

Release One will cover all requirements for the solution to transition into trials for SDRC 9.4 (Demonstration of use of real-time contingency analysis in the control room).

During this reporting period the objective was to develop, test and deliver the Release Zero phase of the project and provide evidence for SDRC 9.2. This phase was successfully achieved.

This reporting period has seen the delivery of SDRC 9.2, which details the overall architecture of the CAS and the interface with UK Power Networks' Distribution Management System (DMS) and planning tools. In addition, SDRC 9.2 demonstrates the successful installation and testing of the CAS module.

The main tasks executed during this reporting period are set out below:

- BSI developed the CAS for Release Zero and tested it against their integration testing strategy.
- The project team conducted workshops with the business users (Control, Outage Planning and Infrastructure Planning) to develop the test cases and scenarios for CAS Factory Acceptance Testing (FAT).
- BSI used these FAT cases and scenarios to demonstrate to the project team, who witnessed that CAS Release Zero functionality satisfied the requirements.
- The project team installed the CAS Release Zero software in UK Power Networks' environment and conducted the Site Acceptance Testing (SAT), using the same test cases and scenarios. Both FAT and SAT results were compared and it was deemed that CAS Release Zero had passed SAT.
- Following Release Zero SAT, the project team worked closely with BSI to address when the defects (technical and/or observations) identified during Release Zero testing would be fixed.
- The team conducted a lessons learned workshop to identify lessons that could be shared with other DNOs and also lessons that could improve Release One delivery.

The following table summarises the results from the Release Zero testing:

CAS requirements covered	Number of test scenarios executed	Defects identified	Defects carried into Release One
29	37 (FAT) 27 (SAT)	46 (mainly cosmetic and installation defects)	32 (It was agreed to take these into Release One as they were not show stoppers for Release Zero.)

A number of defects identified during FAT highlighted that certain tests could not be fully completed. As these tests were not considered critical to the functionality, it was decided that the defects would be resolved during Release One and would not be tested during SAT.

Tasks for next period:

- The project team will focus on getting the IT cloud infrastructure procured, configured and ready for Release One testing. This will include:
  - Application and database servers (three environments: Production, Preproduction and Test)
  - Security firewalls and interfaces with external suppliers and systems for support and data
  - Message handler/broker to manage and control data files received by CAS
  - Storage area for holding large volumes of data required for CAS
  - Interface management software to extract input data for CAS from DMS and PowerFactory (Planning Tool)
- BSI will continue to develop CAS Release One software ready for FAT and SAT
- Through a series of workshops, the project team will define the test cases and scenarios for the Release One testing phases. The testing phases will be:
  - Factory Acceptance Testing (FAT)
  - Site Acceptance Testing (SAT)
  - System Integration Testing (SIT)
  - Non Functional Testing (NFT)
  - User Acceptance Testing (UAT)
  - Operational Acceptance Testing (OAT)
- On completion of the Release One software development, the project team will witness FAT in the BSI environment and then install CAS Release One on UK Power Networks' IT infrastructure. CAS will be integrated with all required UK Power Networks systems; the main interface being with the DMS.
- UK Power Networks will test the CAS starting with SAT through to OAT. On successful testing, CAS will be released to the live/production environment for trials to begin.

The key challenge encountered during this reporting period was to agree the data sets required to satisfy the FAT and SAT. Network data was needed to reflect electrical network changes so that CAS could be tested for varying electrical states. Working closely with our control engineers and outage planners, we determined the best times to capture the test extract data.

Another challenge was to ensure that the CAS accurately reflected the data loaded from DMS. The data which had been captured was essentially snapshots of electrical infrastructure change events – making it difficult to compare the entire KASM network on both systems (CAS and DMS) side by side. A workaround solution was to snapshot the DMS at the same time the change took place. This required close coordination with the control engineer to take timed snapshot printouts (pdf network drawings) of the network state before and after the change.

In summary, Workstream 2 delivered CAS Release Zero and contributed to the delivery of SDRC 9.2. Release Zero (the foundation for Release One) highlighted a number of non-critical issues/defects which will be resolved during Release One. The KASM project is now in a very good position to deliver the additional Release One functionality.

1.3 Workstream 3

This workstream is responsible for developing and testing the load and generation forecasting modules that will be used in conjunction with the Look Ahead (LA) mode of the CAS tool.

This reporting period has seen the delivery of SDRC 9.3, which details the overall architecture of the forecasting modules and shows how the output of the forecasts interfaces with the CAS in the LA mode. In addition, SDRC 9.3 demonstrates the successful installation of the forecasting module and provides initial analysis of the individual and aggregated forecast performance.

During this reporting period the forecasters underwent FAT and SAT. Both of these testing phases were completed successfully and signed off by the relevant parties. During the testing phase some minor defects were raised and documented in the defect log; these will be captured and fixed in the development updates for Release One. None of the defects was considered critical to the overall functionality of the Forecasting Module

The initial performance of the forecasts is shown below. Further detail on the testing is captured in our SDRC 9.3 report, submitted on 30 November. Accuracy of the forecasts has been demonstrated using a variety of performance metrics, as presented below.

To monitor performance throughout the 0-120 hour time period, the project has plotted the forecast output and the metered output on a number of graphs (see the example in Figure 1 below). The 'aaa' plot is the BSI forecast while the 'meter' plot is the metered data from UK Power Networks' SCADA systems.

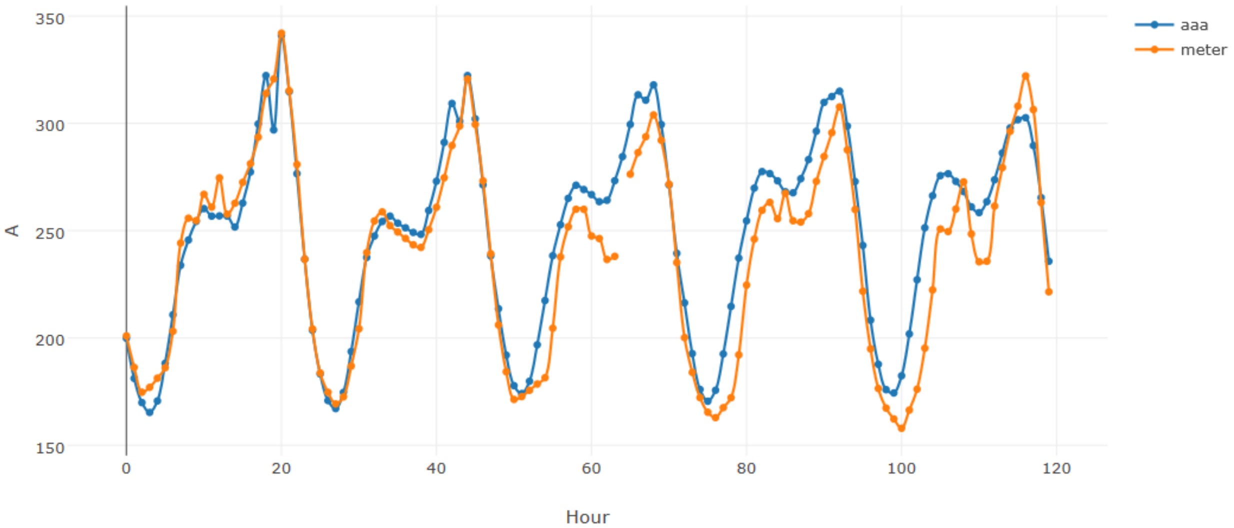

Figure 1: Load forecast compared with metered load

To benchmark the forecasts against existing industry literature[1], two performance metrics were used. Mean Absolute Percentage Error (MAPE) was used to determine the accuracy of the load forecasts. Wind and solar generation forecasts used Root Mean Square Error (RMSE)/Capacity to compare BSI's forecasts with other industry forecasting tools. The two performance metrics are widely considered to be appropriate for measuring forecast accuracies.

Figure 2 presents the day ahead performance of the load forecasts. The box plot shows that the average MAPE across the 600 load data points is approximately 9%. A few outliers provide high levels of error which are outside the upper quartile of the box plot. These high errors could be due to a number of issues including poor data quality, masked embedded generation or limited data availability. When comparing this to industry literature it can be concluded that the BSI load forecast provided good accuracy within acceptable limits. Industry literature suggests that system load forecasting can be as accurate as 1-2% MAPE, while individual data point levels can have accuracy levels of up to 30% MAPE. Considering the 600 load points are individual data points, the BSI forecast performs well within 30% MAPE.

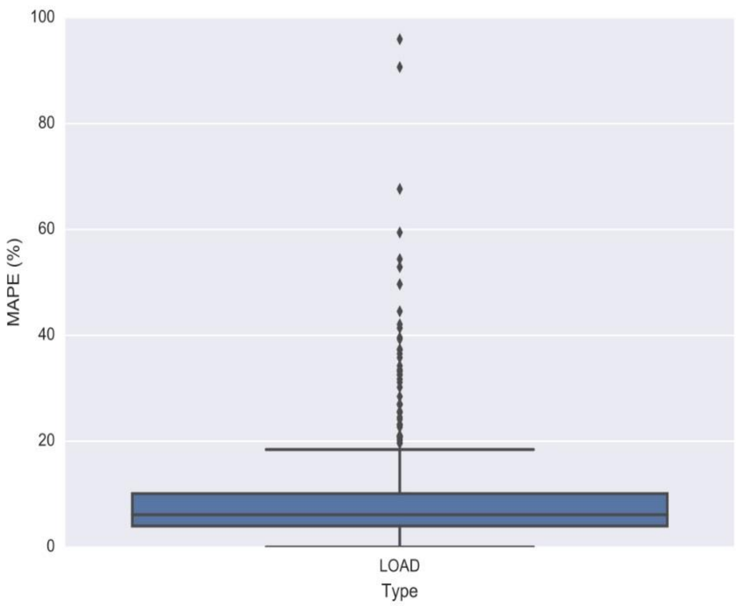

Figure 2: Day ahead performance of load forecasts

[1] R. Sevlian and R. Rajagopal, "Short Term Electricity Load Forecasting on Varying Levels of Aggregation," *Work. Pap.*, pp. 1–8, 2014.

Figure 3 shows the average accuracy of the solar and wind forecasts. Both the solar and wind forecasts display an average RMSE/Capacity of approximately 10% for solar generators and 17% for wind generators; this compares favourably to wider industry forecasts, which achieve 10-20% error at day ahead forecast horizons [2] [3].

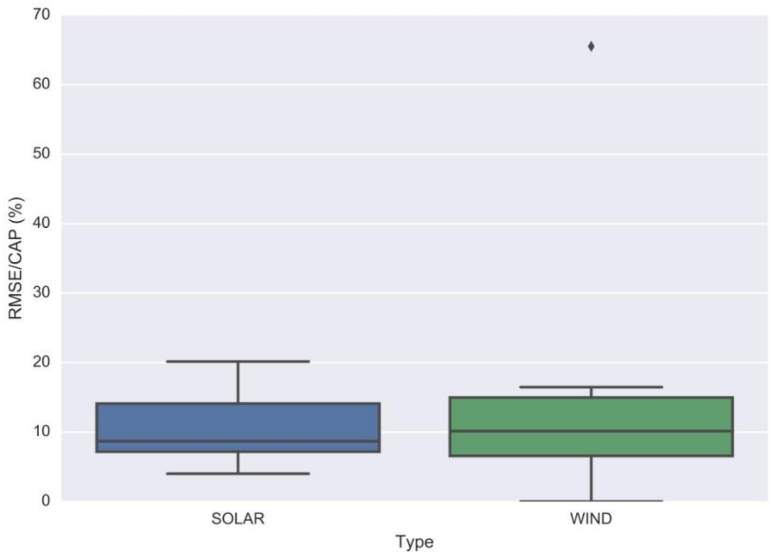

Figure 3: Day ahead performance of solar and wind forecasts

[2] A. M. Foley, P. G. Leahy, A. Marvuglia, and E. J. McKeogh, "Current methods and advances in forecasting of wind power generation," Renew. Energy, vol. 37, no. 1, pp. 1–8, 2012.

[3] J. Antonanzas, N. Osorio, R. Escobar, R. Urraca, F. J. Martinez-de-Pison, and F. Antonanzas-Torres, "Review of photovoltaic power forecasting," Sol. Energy, vol. 136, pp. 78–111, 2016.

Figure 4 compares the aggregate of each individual BSI forecast with the aggregate of metered data for generation connected to a Grid Supply Point (GSP). As a reference point, the graph displays the generation capacity associated with these generators. It can be observed that for this specific time point there is a large difference in the forecast or metered data when compared with the aggregate of the relevant generator capacities. When performing network studies, current business processes use maximum generation capacity values rather than forecast data. By using forecast data in network studies rather than maximum capacity data, the user could potentially free up capacity on the network that was previously considered to be constrained. The full benefit of using forecast data will be captured during the trial period and reported in our SDRC 9.5 report (Completion of trials and implementation of reliability management, outage management and network capacity management), due in December 2017.

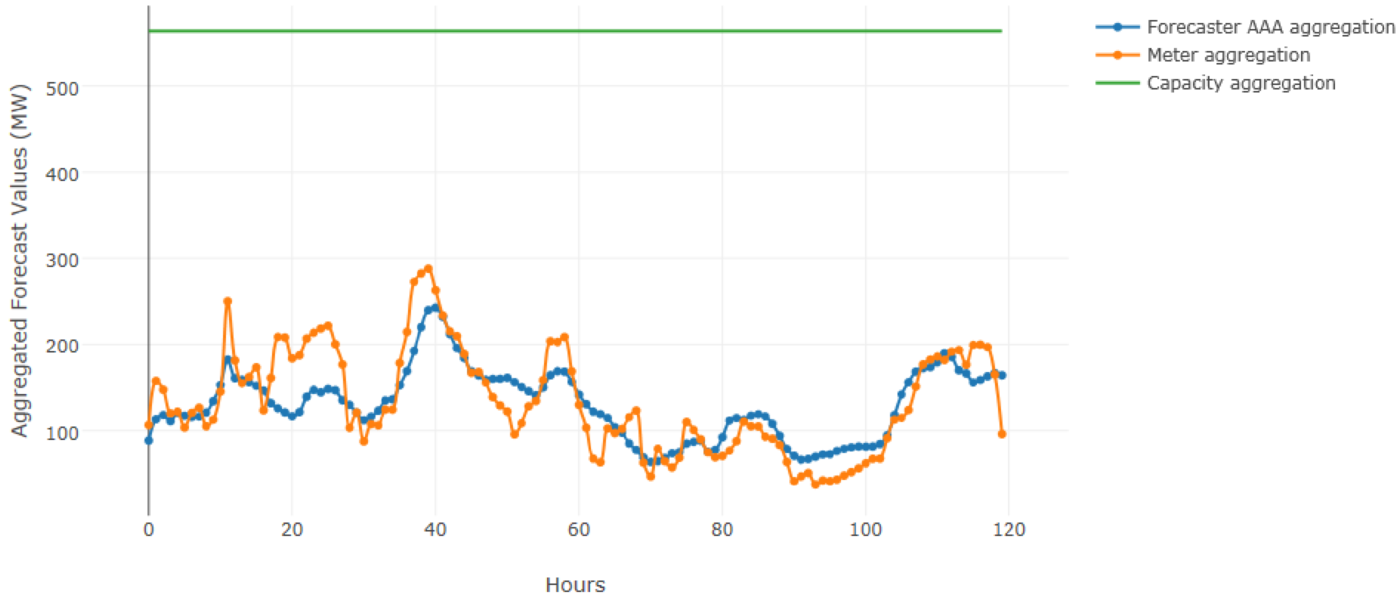

Figure 4: Aggregated forecast and metered generation data

The graphs in this section demonstrate the progress that has been made in determining the accuracy of the forecasts following successful installation. The project team will continue to monitor the accuracy of the forecasts with a view to understanding how this impacts the proposed business process for outage planning.

Two key challenges during the period were:

- Benchmarking forecast accuracy against industry literature – different forecasts use different inputs, meaning that a direct comparison is not always suitable for drawing detailed conclusions
- Developing integration of the forecasting modules with the CAS – currently this is a manual process, but it will be automated for Release One

1.4 Workstream 4

Workstream 4 is responsible for understanding the value streams and business process impacts of the CAS and forecasting modules.

The key highlight during the reporting period has been the approval of a change to the Grid Code. In addition, the Workstream 4 Lead has continued to engage with trial participants during the FAT and SAT testing phases.

Following a review by Ofgem, the Grid Code change recommended by UK Power Networks was approved by the Gas and Electricity Markets Authority and made effective on 28 July 2016. As previously mentioned, the change allows DNOs to use the same National Grid network models for operational and planning purposes. This change will be important in improving visibility of National Grid's network to DNOs. From a KASM project perspective, it allows the same network models to be used within the CAS, which ensures a more efficient solution architecture.

The Workstream 4 Lead has continued to engage with trial participants during this period, specifically during the FAT and SAT testing phases. In addition, the Outage Planning users have been involved in reviewing the accuracy of the load and generation forecasts which will be utilised in the newly proposed business process. Having reviewed the results presented in our Workstream 3 update (see the previous section), the trial participants agreed that the initial results demonstrated the value of using forecast data in current business processes. However, it is important to continue monitoring the accuracy of the forecasts during the trial period in order to fully understand the benefit of using forecast data rather than 'worst-case' scenario cases in the outage planning processes.

Following the change to the project plan, which resulted in delivering SDRC 9.4 in June 2017 rather than December 2016, the trial period has been reduced. The Workstream 4 Lead continues to engage with trial participants to ensure they remain engaged with the project. The focus of the next reporting period will be on finalising the detailed plans for the trials which are scheduled to commence in May 2017.

1.5 Technical Design Authority

During this reporting period the Technical Design Authority (TDA) focused on three key activities:

- Generating multiple PowerFactory Common Information Model (CIM) files and PowerOn XML models for development and testing. There has been a focus on automating the file exports and generating Release One files
- SCADA measurement improvements to help with alleviating power flow residual errors reported by the CAS state estimation tool
- Supporting technical evaluations during the FAT and SAT testing phases. Further detail on testing is provided in our SDRC 9.2 and SDRC 9.3 reports, submitted on 30 November

The following bullets summarise key progress in respect of the data models and data quality improvement efforts for the analogue measurements:

- A script was developed and deployed to automatically generate PowerOn XML models at five-minute intervals. These models are saved on a shared folder which is accessible to the CAS. The CAS then periodically picks the required models for processing

- A DIgSILENT Programming Language (DPL) script was developed and deployed to automate production of the PowerFactory CIM model and extract transformer vector group data into Excel spreadsheets. Further work is being carried out to allow for the two files to be saved in a shared folder which is accessible to the CAS to periodically process these files as required.

- Initial PowerOn XML models and associated PowerFactory CIM models were generated for the Release One boundary and shared with BSI to commence data mapping for the Release One model development.

- A data survey exercise was carried out using Power Quality Monitors on selected 132kV sites within the KASM network area. A report was prepared and highlighted sites where the measurement analogues were found to be accurate within acceptable error tolerances of 3%[4]. However, the report also confirmed initial views that some network measurements would require improvement. These measurement analogues will feed into the ongoing business-as-usual replacement of measurement transducers.

1.5.1 Data model exchange

The following sections provide further detail on the data model exchange.

As previously mentioned in our June 2016 progress report, the PowerOn model does not contain all the data required by the CAS. Accordingly, both PowerOn and PowerFactory models were used to meet the data requirements for the CAS. Component mapping was carried out between the two models to combine the pertinent data from each extract. The remainder of this section captures the data export methodologies.

[4] Tolerance limits as per Engineering Recommendation P28

PowerOn

The source of the network model to generate the CAS base case is derived from the data within PowerOn. Out of the possible three different network trace options, the TDA worked with the Control Systems and Automation team and GE to produce progressive XML models for the Release One network to enable initial data mapping. Two versions of the model (Current View and Design View) were easily exported from PowerOn, and a third version (Scheduled View) could be produced with some development:

1. Current view – extracts the current live network, i.e. active components only (dead components are excluded). This is the only view that contains real-time metering data
2. Design View – extracts the network with normal running arrangements and excludes areas of dead network that are normally switched out
3. Scheduled view – extracts a switched network. A switching schedule can be imposed on the current model to close all switches, or execute the current schedule to simulate the future state of the network

The XML models generated from PowerOn are produced by running a power analysis study on a KASM segment of the SPN network. These studies are traditionally setup and invoked manually, but the KASM project required an automated process to provide study output every five minutes, as shown in Figure 5 (note the file name updates). The TDA worked with GE to deploy the script within PowerOn. The process to generate the study XML output has been tested but can be highly dependent on where the study is invoked from and on the state of the actual network at the time of the study.

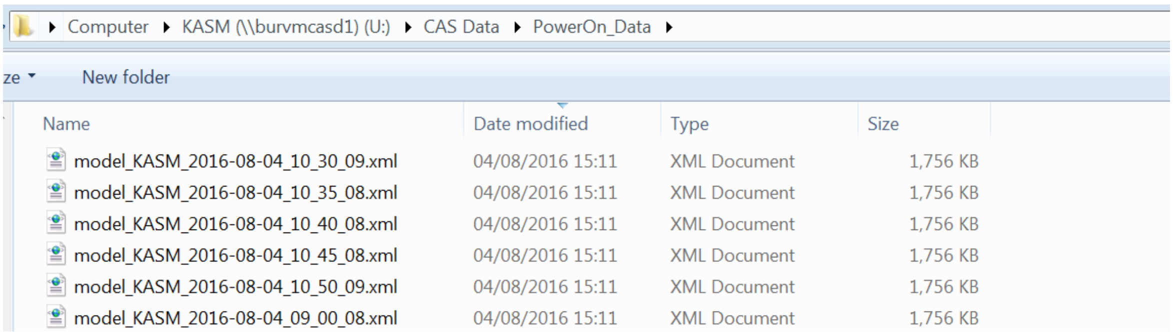

Figure 5 - Screenshot of folder showing sample XMLs

A power analysis study is launched from a specific point (seed point) and the boundaries of the power analysis ‘area’ are set via attributes on required network components within the DMS. Any changes in the status of the seed point that the study is launched from could impact the output XML file. To ensure that the XML files contain all the network elements within the KASM area, the script process was designed to start the power analysis study/trace from different components (seed points) in order to guard against a single seed component going into a ‘Dead Zone’ of the network, which is possible when the network configuration is changed for operational purposes. Starting from a different point inside that ‘circuit’ will build the same trace, meaning that the model will be the same. This feature was tested and implemented to ensure that the structure and format of the XML file was consistent and sustainable. The XML generation is working reliably and producing the data in the correct format.

PowerFactory

Equivalence elements issue

The TDA continued work on resolving issues with equivalence networks (Impedance per unit (Zp.u.)) generated during the transmission network reduction process in PowerFactory. The equivalence networks are a result of the equivalent mutual impedance created between different points of reduction in the network. Transmission network reduction is necessary to reduce the size of the transmission network model ahead of exporting the PowerFactory CIM model for the CAS. The equivalent networks created show a connection between two different voltage levels. This caused data mapping issues within the CAS, as the Zp.u. is read as a network element within CAS and is expected to be connected on the same voltage level. Different PowerFactory reduction methodologies were tried and it was observed that the Zp.u. elements highlighted are created no matter which reduction option is picked. To overcome this, a manual workaround was developed. This will be a temporary fix to the problem and the values obtained at the points of reduction would have slight variations, as the mutual impedances are ignored. A permanent solution is scheduled for completion for Release One.

DPL script – CIM export and transformer vector group data

To improve CIM model exports, a DPL script for exporting PowerFactory CIM and also extracting the transformer data (with the Vector group) from PowerFactory into an Excel spreadsheet was developed and deployed. The DPL script carries out the following functions:

1. Triggers CIM export
2. Triggers transformer vector group data spreadsheet extraction
3. Automatically saves the transformer vector group data spreadsheet with a file name associated to the CIM file name
4. Both the CIM model and the associated transformer vector group spreadsheet data files go into the same predefined location

CIM Import/Export licence

The TDA successfully facilitated the addition of the CIM Import/Export Tool within the two PowerFactory Server Licences held by UK Power Networks. The KASM project requires periodic export of the PowerFactory model in CIM format (ENTSO-E 2009 profile) to the CAS. CIM provides capability for UK Power Networks to share standard models in the future. A growing trend is observed for the need to share network models within the industry for collaborative schemes that enhance the visibility, planning and management of electricity networks. The CIM Import/Export functionality was added to the PowerFactory servers as part of the PowerFactory upgrade in August 2016.

Business case update

The business case remains consistent with our June progress report. Based on regular engagement with the potential users of the KASM solution, there remains a strong case for implementing the CAS and Forecasting Module.

The initial results from the forecasting modules confirm that value can be obtained from using forecast data rather than worst-case planning assumptions. This is clearly demonstrated in Figure 4 (see page 14).

Progress against budget

This section is provided as a confidential appendix.

Successful delivery reward criteria (SDRC)

	SDRC	Progress	Scheduled Date
9.1	***Criterion*** *Development of the strategy for inter-control room communication protocol for the purposes of KASM.* ***Evidence*** • *Published report on key technical and commercial challenges relevant to inter-control room link and the KASM project, whether proposed by the KASM team or raised by stakeholders, including other DNOs;* • *Implementation guidelines for the inter-control room communication link in consultation with National Grid for use by the project.*	• SDRC completed and submitted on 29 December 2015	December 2015
9.2	***Criterion*** *Completion of the system integration of CA software into UK Power Networks systems, excluding a real-time link to National Grid.* ***Evidence*** • *Sign-off on set up of CA software;* • *Sign-off on successful demonstration and testing of CA software; and* • *Published report on CA software integration that includes the control room IT architecture, lessons learned, engagement with other DNOs, and identified risks.*	• SDRC completed and submitted on 30 November 2016	November 2016

SDRC		Progress	Scheduled Date
9.3	***Criterion*** *Completion of installation of forecasting modules that will link the DNO control room with other data sources.* ***Evidence*** • *Sign-off on installation of forecasting modules;* • *Forecast data, benchmarked for accuracy against historical data;* • *Published report demonstrating forecasts including each of solar, on-shore wind and off-shore wind;* • *Forecast error curves plotted at primary substation, 132kV circuit, and GSP levels;* • *Description of integration architecture with the overall solution; and* • *Published report on data aggregating forecasting modules that includes lessons learned and identified risks.*	• SDRC completed and submitted on 30 November 2016	November 2016
9.4	***Criterion*** *Demonstration of use of real-time CA in the control room*. ***Evidence*** • *Demonstration of contingency results from live SCADA readings, supplied within 15 minutes of them being collected;* • *Completion of user survey identifying the most critical forecast time periods perceived by control room users (e.g. next 15 mins; tomorrow; next shift); and* • *Published report with description of the solution, the user interface, and the capabilities.*	• The Grid Code was amended on 28 July 2016 following approval by the Gas and Electricity Markets Authority. • Delivery of this SDRC has been impacted by the delays to SDRC 9.2 and SDRC 9.3. On 14 September, following discussions with Ofgem, we submitted a notification to reschedule delivery of this SDRC from 31 December 2016 to 16 June 2017.	June 2017

	SDRC	Progress	Scheduled Date
9.5	***Criterion*** *Completion of trials and implementation of reliability management, outage management and network capacity management.* ***Evidence*** • *Published results from functional trials and the achieved benefits in reduced DG curtailment;* • *Published report demonstrating data collection from Grain, Kemsley, Cleve Hill, Canterbury North, Sellindge, Dungeness and Ninfield 400kV network and sensitivity of the CA results to this data;* • *List of connection offers that have been linked to reinforcement when assessed using conventional processes, and identification of those that have been revised to remove the reinforcement requirement after being assessed using the trialled methodology; quantification of the released network capacity based on the comparison of the above list; and* • *Published report on considerations for selecting, designing and installing CA software for each use case*	• This SDRC remains on schedule to be delivered as planned.	December 2017

SDRC		Progress	Scheduled Date
9.6	***Criterion*** *Development of business design to incorporate CA as business-as-usual.* ***Evidence*** • *Identification of business areas impacted by the introduction of CA in a Distribution Network Operator; and* • *Outline of proposed changes to systems, policies and processes required in the DNO operating model in order to incorporate CA as part the business as usual operation.*	• This SDRC remains on schedule to be delivered as planned.	December 2017

Learning outcomes and knowledge dissemination

1.6 Internal communications and knowledge dissemination activities

Since the last reporting period, the project has focused on development and testing of the CAS and forecasting modules. As a consequence, internal communication has mainly been focused on the users that will directly benefit or be impacted by the implementation of the CAS within the trial area. There remains strong engagement and interest from all identified lead users. In the next reporting period it is expected that the team will increase engagement with users from other UK Power Networks licence areas.

The project team engaged with key stakeholders during a lessons learned workshop which was held on 24 October 2016. The detailed lessons have been captured in SDRC 9.2.

Key learnings from the project have been shared with existing Low Carbon Networks Fund (LCNF) projects and recent UK Power Networks Network Innovation Competition (NIC) bid submissions including PowerFuL-CB and Transmission & Distribution Interface (TDI) 2.0. There is a strong alignment between the KASM project and TDI 2.0, therefore strong collaboration is required to ensure maximum value is delivered to customers.

1.7 External communications and knowledge dissemination activities

KASM continues to raise the profile of the project through a variety of communication forums:

Conferences and formal dissemination activities	Main Messages/presentation title	Date
Low Carbon Networks Innovation Conference (Manchester)	• Overview of challenges in East Kent • The KASM solution • The business impact • Lessons learned to date	11-13 October 2016
CIRED 2017 abstract submission (invited to submit full paper)	• 'Challenges in Model and Data Merging for the implementation of a Distribution Network Contingency Analysis Tool'	4 November 2016
IET Resilience of Transmission and Distribution Networks Conference 2017– abstract submitted (awaiting feedback)	• 'Enhancing Distribution Network Visibility using Contingency Analysis Tools'	25 November 2016
UK IT Industry Awards 2016	• Submission paper shortlisted for Infrastructure Innovation of the Year	16 November 2016

The project team is planning an interim dissemination event in Q1 2017 to share the learnings from development and testing of the CAS and forecasting modules.

1.8 Learning and Dissemination activities in the next reporting period

Conferences and formal dissemination activities	Main Messages	Date
SDRC 9.2 and 9.3 workshops	Disseminate learning from 9.2 and 9.3 through a number of presentations and Q&A sessions.	Q1 2017
SDRC 9.4 report	Demonstration of use of real-time contingency analysis in the control room	June 2017
Project updates (website, tweets, newsletter, targeted presentation as appropriate)	Update key stakeholders on progress	Q1-Q2 2017

Intellectual Property Rights (IPR)

During the period the following IPR (foreground or relevant foreground) was generated (July 2016-December 2016):

Workstream	IPR description	IPR Owner
WS2	P.0013.KASM SDRC 9.2	UK Power Networks
WS3	P.0014.KASM SDRC 9.3	UK Power Networks

Risk management

The KASM project has established a risk management process as described in detail in the KASM Project Handbook, which was submitted with our June 2015 progress report. It allows for the communication and escalation of key risks and issues within the project and defines where decisions will be made and how these will be communicated back to the workstream where the risk or issue has arisen. Risks are discussed on a weekly basis and are documented on a fortnightly basis during Project Board meetings. Key project risks are then escalated to the Project Steering Committee for review and approval of the mitigation on a monthly basis.

1.9 Bid risks managed this period

Ref BID#	WS	Risk & Impact Description	BID Mitigation	Mitigation (update)	Status
B0003	WS1	The software solution fails to perform to specification, leading to system incompatibilities and unsatisfactory trial results.	The software solution will be subject to performance testing using benchmarking or simulators under various operating conditions. Software requirements to be defined at design stage and suitable software chosen for the purpose of the trials. UK Power Networks to agree Service Level Agreements (SLAs) for software solution.	Requirements and design phases involve all parties (suppliers and business users) to ensure that the software solutions meet the performance requirements. Clear test strategies have been implemented to check performance.	G
B0004	WS5	There is lost learning during knowledge dissemination and stakeholder engagement activities due to differing interests and learning styles of stakeholders.	Identify stakeholders early on. The dissemination workstream is fully engaged with technical workstream at an early stage and lessons learned are captured from the LCNF projects.	Early engagement with all of the project key stakeholders has taken place and will continue to ensure positive support of the project.	G
B0006	PM	The software partner goes out of business before the solution has been delivered.	Full financial due diligence undertaken as part of UK Power Networks' procurement procedure; identify alternative supplier.	Full diligence has been undertaken and an alternative supplier has been selected. The project team continues to work closely with the supplier to understand and avoid any financial issues.	G

Ref BID#	WS	Risk & Impact Description	BID Mitigation	Mitigation (update)	Status
B0007	PM	The software partner goes out of business after the solution has been delivered, resulting in lack of continuity/support.	Full financial due diligence undertaken as part of UK Power Networks' procurement procedure; arrange a software ESCROW (third party agent who stores source code) and novation of liabilities to Original Equipment Manufacturers (OEM).	Full diligence has been undertaken and an alternative supplier has been selected. The project team continues to work closely with the supplier to understand and avoid any financial issues.	G
B0008	WS4	The trials do not deliver the expected results.	Expectations are managed due to thorough planning and frequent reporting. Lessons gathered throughout process.	Initial trial participants have been identified and are being updated accordingly. The project team regularly engages with trial participants to provide updates on project progress.	G
B0011	WS1	Integration of software solution cannot be delivered in time, resulting in delays.	Progress reported weekly, project planning tools implemented.	Revised release strategy and plans agreed with all stakeholders. The project remains on track with the delivery schedule. All ICCP infrastructure implemented	G
B0012	WS5	UK Power Networks' staff are not actively engaged or in a timely manner, resulting in poor engagement and delays.	Ensure early engagement activities and stakeholder events for UK Power Networks' staff.	Early engagement with all of the project key stakeholders (including directors and senior managers) has taken place and will continue to ensure positive support for the project.	G
B0013	WS2	Visualisation of outputs from software tool not in line with operator expectations.	Engage with operators early in the process to help inform the design, to mimic existing Distribution Management System. Limited contingency added into timescales to allow redesign if necessary.	Operators are already on board and agreeing to the requirements and designs. This risk will be mitigated at User Acceptance Testing.	G

Ref BID#	WS	Risk & Impact Description	BID Mitigation	Mitigation (update)	Status
B0014	PM	Connectees commit to pay for significant SGT upgrades at both Canterbury and Richborough and overhead line upgrades, adding significant capacity to the network and removing the export constraints.	Monitor all new connection requests. Support any efforts by distributed generation developers to form group connections or joint connection requests.	The project is in close contact with UK Power Networks' Connections directorate to ensure early awareness of any potential connection requests.	G
B0015	PM	Exceeding the estimated budget for the project.	We have conducted detailed project planning and cost reporting based on our prior experience in delivering LCNF projects.	The project undertakes monthly financial reviews and through the contract negotiations, is ensuring value for money within the budget restrictions.	G
B0016	PM	Exceeding the estimated implementation timeline and underestimating required resources.	We have conducted detailed project planning, allowing comfortable implementation margins and a multitude of resources. UK Power Networks has significant experience internally in project management and IT project implementation.	A detailed project plan has been developed and progress and potential risks and issues to project delivery are discussed on a weekly basis. Any significant issues will be escalated as per the governance process.	G

Consistency with the full submission

There have been no changes to the project scope since the full submission.

Bank account

This section is provided as a confidential appendix.

Accuracy assurance statement

The project implemented a project governance structure as outlined in the project handbook that effectively and efficiently manages the project and all its products. All information produced and held by the project is reviewed and updated when required to ensure quality and accuracy. This report has gone through an internal project review and a further review within UK Power Networks to ensure the accuracy of information.

We hereby confirm that this report represents a true, complete and accurate statement on the progress of the Kent Active System Management Low Carbon Networks project in its fourth six-month reporting period and an accurate view of our understanding of the activities for the next reporting period.

Signed ....

Date ......16/12/16..

Suleman Alli
Director of Safety, Strategy and Support Services
UK Power Networks