Network Event & Alarm Transparency (NEAT)

NIA Closedown Report

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Electricity Distribution

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Name	Role
Lee Begg	Author
Ryan Huxtable	Reviewer
Jenny Woodruff	Approver

Contact Details

For further information, please contact:

nged.innovation@nationalgrid.co.uk

Postal

Innovation Team
National Grid Electricity Distribution
Pegasus Business Park
Herald Way
Castle Donington
Derbyshire DE74 2TU

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1 Executive Summary

New systems are being introduced to support the transition of our role from being a Distribution Network Operator (DNO) to that of a Distribution System Operator (DSO). These include Active Network Management (ANM) and System Voltage Optimisation (SVO) and further new systems are anticipated in the future. These systems are introducing additional alarms and events that are different to those which are familiar to the Control Engineers and the teams that support the Control Systems. These reflect new functions for real time dynamic network management and optimisation schemes. These new alarms require significant analysis to address and resolve them which makes the management of the network more complex. The project goal was to develop a robust tool for the analysis of alarms and events so that by understanding the root causes and interactions, they can be managed efficiently and effectively and ensure that the ANM, SVO and other DSO related systems can work reliably and optimally, minimising generator curtailment and saving support engineer time.

The Network Event and Alarm Transparency project (NEAT) applied a variety of analytical techniques to the available data, developing the most successful techniques into a prototype dashboard and carrying out a trial of the system. This trial involved data transfer from National Grid systems into the prototype dashboard and support analytics but did not include live interfaces to the systems. The project partners were PSC (Power System Consultants) and Harmonic, who have previously carried out an alarms management project for the New Zealand transmission system operator.

The project had an approximate budget of £500k, with an expected duration of 24 months. However, while the early work packages for the specification and design went to schedule, there were severe delays that impacted the deployment, testing and subsequent work packages for trial, analysis, dissemination and closedown. The project started during the COVID pandemic, which impacted on the project in terms of key staff availability due to illness but also due to staff turnover issues after COVID restrictions were removed. The project was also affected by being an early adopter of new technology, with both CyberArk and OpenShift being key to the deployment at a time before in-house support expertise had been developed. The situation was further complicated by the switch off of the SVO system, which meant historic data had to be used in the trial and also by the internal reorganisation and subsequent changing business priorities as Western Power Distribution (WPD) was taken over by National Grid.

The project discovered previously unknown data quality issues. Some of these reflected issues with the underlying data, but some had been inadvertently introduced by the data extraction process. One example was that no personal data was expected to be included within the key data extracts from PowerOn, and so an additional data cleansing process needed to be set up to ensure General Data Protection Regulations (GDPR) compliance when data was shared with the project partners in New Zealand.

The trial showed that the users found the system easy to use and that it was easy to navigate between the various screens and apply filters. However it was found that it was difficult to interpret switching information without a network diagram as this function was better provided from within PowerOn.

The events during the trial were less frequent than expected with two or three events a week being normal. Most events (16) were in the PowerOn category with ANM and SVO having 12 and 9 events, respectively. The majority of the event types were related to high alarm volumes. It was seen that the busiest three sites accounted for nearly 75% of the events suggesting that targeted investigations could reduce the number of alarms significantly. While additional data items were added to the Cornwall ANM zone, delays in the sites being enabled meant that we were unable to see the impact of this data. It is expected that additional data would provide further insights, so it is recommended to continue gathering event data.

It is now planned to incorporate SVO and ANM functionality within ANM but there may still be value in a BAU implementation to support telecoms and a further trial with a licence area experiencing more telecoms issues is recommended.

2 Project Background

The management of alarms and events within Distribution Network Operator (DNO) control rooms is well established. However, as DNOs are transitioning to become Distribution System Operators (DSOs) and more actively managing the network this is introducing new alarms into their control rooms. The addition of systems to enable Active Network Management (ANM) or System Voltage Optimisation (SVO) are being introduced to make better use of existing assets and defer traditional reinforcement. These new systems bring with them different types of alarm and event notifications relating to the processes they are carrying out. The ANM system covering Cornwall and the SVO system covering Devon and Somerset both include features to model the operation of the network and carry out power flow analysis. The SVO system also includes functionality for State Estimation to provide data to the power flow analysis where monitored values are not provided by the Supervisory Control and Data Acquisition (SCADA) system.

These systems therefore have new types of alarms and events relating to;

- the state estimation system failing to provide data with a sufficient confidence factor
- the power flow analysis failing to converge
- the power flow analysis identifying overloads/voltage violations in real time or in the short-term future.

Where these issues affect the systems, they may not be able to operate properly and default to a fail-safe position. While currently there are few connected generators whose output would be curtailed by resorting to a fail-safe position, this will become increasingly important as more generators connect and the changes to the regulatory environment from the implementation of the Access Significant Code Review (SCR) changes that apply from 1st April 2023 gives the DNOs financial incentives to ensure customers are not constrained unnecessarily.

Ensuring these systems operate effectively will require continued monitoring and responding to the alarm and event notifications. The experience with the SVO system to date has shown that understanding the conditions that caused the events is far from simple as the context of the events can be difficult to determine retrospectively from within the system itself.

The processing of these new alarms require a different approach and level of analysis to rationalise and resolve them. They require significant analysis to address and resolve which makes the management of the network more complex. As a result this can lead to a higher risk of error, reduced effectiveness and lower morale amongst control room engineers. The project goal was to develop a robust tool for the analysis of alarms and events so that by understanding the root causes and interactions, they can be managed efficiently and effectively.

The project was initiated to address the problem of growth in alarms by analysing the relationship(s) between alarms and other system events, including configuration changes and measurements.

The investigation considered how the alarms in the new ANM and SVO systems relate to the alarms within PowerOn or to each other. However, the approach taken and prototypes developed were generalised as far as possible so that it could be applied to future systems yet to be developed, or systems in use by other DNOs.

Similarly, while the relationships between some PowerOn alarms and other PowerOn alarms (e.g. where networks are nested) are not specifically excluded from the analysis, as these alarms are well established and their management is routine, this is not expected to be the key area of benefits. Also, the existing alarm and event management facilities within PowerOn already provide a number of features to simplify and prioritise the information provided to the control engineers and the project does not intend to duplicate these.

The project analysis aimed to create rules or information that can be used to either refine the alarm system to better sort and separate alarms or to help controllers improve decision making when controlling the network and alarm operations.

3 Scope and Objectives

The scope and objectives for NEAT are given in the table below.

Table 3-1: Status of project objectives

Objective	Status
Understand the data that can be used to provide context for the alarm and event analysis	✓
Assess the quality of this data and where possible correct quality issues	✓
Derive preliminary insights from the data to inform the selection of models	✓
Carry out advanced analytics to understand the relationships between alarms and events in different systems and the external datasets	✓
Create a prototype dashboard to allow the analysis to be run regularly and present the user with results	✓
Trial the use of the dashboard using real data over a period of time	✓
Consolidate and share the learning from the project	✓

4 Success Criteria

The success criteria for NEAT are given in the table below.

Table 4-1: Status of project objectives

Success Criteria	Status
The project has gained an understanding of the new types of alarms and events associated with new systems supporting DSO functions, how these differ from “traditional” control system alarms and how the needs for their management differ to traditional alarms and events.	✓
The data sources that are available to contextualise these alarms has been explored and relationships between data items and the alarms and events have been found.	✓
The learning gained from analysing relationships between alarms and events and the contextualising data has been incorporated into a dashboard which is suitably generic in design to anticipate future systems to support DSO functions that are not yet known.	✓
A dashboard to assist with the management of these alarms and events has been developed and tested. Learning from the trial has been used to recommend changes to datasets, processes, systems etc. to reduce alarms and events in the future and/or the way in which alarms and events are managed has been improved to reduce the time spent on their management.	✓

5 Details of the Work Carried Out

The project involved:

- Evaluating the sources of data to provide context for the alarms and events and understanding the relationships between them, their quality, how and when they are updated etc.;
- Assessing the potential methods of analysing the data and different visualisations to be presented
- Specifying and developing a support tool that would help with managing alarms and events on the new DSO systems
- Deploying the support tool and using it during a trial
- Evaluating the results from the trial to draw out learning
- Disseminating the project learning.

This was achieved through a series of work packages that are described below.

5.1 WP1. Specification

This involved gathering detailed business domain knowledge to ensure a solid understanding of the National Grid Electricity Distribution network region, business processes and availability of data.

Data was provided from;

- PowerOn, the control room system,
- ANM systems Inter Control-room Communications Protocol (ICCP) configuration
- The SVO database and ICCP configuration
- Integrated Network Model (INM)
- CROWN (NGED Asset Register)
- HISTAN and TSDS (NGED Time Series Databases)
- NGED's Network Capacity Map (to provide a simplified network hierarchy)
- Electric Office (Network schematics)
- Weather data

The system specification outlining the functionality of the tool to be delivered was produced. The tool was required to be Python based and accessible via a browser interface from National Grid systems. The IT infrastructure required to support the project was agreed with NGED's IT team and this included discussions to agree COVID secure arrangements for server installation. The output of this Work Package was the Specification document which captured the data inputs and the functional requirements for the tool.

5.2 WP2. Design

This work package generated a design of the NEAT platform to meet the specification produced in WP1 which captured the algorithms to be used when analysing the alarm and SCADA information. This also involved a data quality assessment, data analysis and identification of advanced

analytical techniques. This included checking the data is complete and whole, identification of outliers or other logical inconsistencies and ensuring that the joining of datasets does not lose information or incur further data issues. Where feasible, data quality problems were addressed. This involved reporting back issues to the data providers and correcting problems with the data extraction process but also investigating an unusual event that had hampered data extraction due to the volume of data that had been unexpectedly created.

During this stage it was also found that a data extract which was not expected to include any Personal Data as defined by GDPR did include some staff names and contact details. A new process was created to cleanse the data extracts before these were shared with Harmonic which involved risk evaluation and sign off from the legal team.

Preliminary insights and observations were made following an initial data assessment. Initial tests of the various model types informed preliminary selection for further development during the build phase. The design phase set out the overall process for the tool along with the user interaction and thoughts on the data analysis methodologies.

The Work Package produced two deliverables,

- WP2 - D1 - Data Quality Assessment Summary and
- WP2 – D2 – NEAT Design Document

5.3 WP3. Build

The advanced analytical techniques and dashboard development was completed during the Build work package. This built on the learning from the Exploratory Data Analysis (EDA) which included; clustering analysis, network association analysis and spatial analysis, time series analysis and predictive forecasts. The analytical techniques were integrated into the NEAT dashboard and also included the development of a data loading process to ingest data from the databases into the analytic tool. Once the design was agreed this was then used to produce a test book that could be used for user acceptance testing. This was reflected in the work package having the two deliverables below;

- WP3 - D1 - User Acceptance Testing Book
- WP3 - D2 - Build report

During this phase it became apparent that the data that was currently being provided from the ANM systems was very sparse. A new ANM zone was being commissioned during the project timescales that offered the opportunity of comparing what might be possible with additional data and so additional work was commissioned to increase the data flowing through the ICCP link. The deployment of this ANM zone was then delayed so that the additional data points were unavailable during the trial.

5.4 WP4. Deploy and Test

This Work Package included the work to deliver the NEAT dashboard within National Grid's IT infrastructure. This stage also involved ensuring that the scripts that load data from the databases into the analytic tool were formalised and available to run on a regular basis.

At this stage the project suffered a sequence of events which all introduced incremental delays, which compounded to delay deployment and testing for several months. The most significant cause of the delays was the use of the new technologies CyberArk and OpenShift. CyberArk is a cybersecurity tool designed to ensure safe, secure access by third parties. National Grid is a target for cyber-attacks and requires the most stringent levels of protection. One protection measure is that most laptops are not able to connect to the internet which then made it harder to support deployment as screen sharing or other remote access options were not available. With new products there is inevitably a lack of experience to draw upon within the existing staff and

therefore external expert support was required to ensure that the system was configured correctly. These external resources were not available at short notice. Similarly there were also issues with getting the OpenShift software to be configured correctly. These major issues were further confounded by other issues around staff availability due to resurgence of COVID and staff turnover. Resource availability was also adversely affected by an internal reorganisation which preceded further changes that resulted from the take-over of Western Power Distribution with National Grid. The merger itself required considerable support from IT resources which changed the prioritisation of previous planned work.

During the same period of time other changes in staff resulted in a re-evaluation of the process used to extract data. While data extraction had previously been carried out manually during the day, due to the size of some of the data extracts the normal means for automating the reports was not considered to be appropriate due to the potential for the report to fail and interrupt other vital overnight reports. This required a solution to vastly reduce the size of the automated reports so that the very largest files were managed manually. This change in process required changes to the data upload procedures.

Another significant change that occurred during the period that the system was being deployed was the decision to switch off the SVO system. The decision to turn off this system reflected the decision to recreate the SVO functionality within PowerOn in the future, which meant that the existing system had a limited life going forward. It also reflected the high licencing costs associated with the ongoing provision of the SVO system which were not deemed to provide value for money.

The User Acceptance Testing (UAT) was carried out in accordance with a UAT workbook which was prepared during the build phase. The UAT was passed with the proviso that some of the functions which could only be tested once a certain volume of events had occurred e.g. displaying more than one page of issues in a list.

This also raised an issue over the display of dates as to whether the better format would be YYYY – MM- DD or DD –MM-YYYY.

5.5 WP5. System Trial and Findings Analysis

After the UAT was successfully concluded, the System Trial was undertaken. The System Trial sought to gather experience of using the system with real data and real users. The UAT had already demonstrated that the system navigates between dashboards and event details correctly including filtering events and creating related graphics.

The purpose of the System Trial was to;

- Investigate the events that the system identifies.
- Confirm whether the system is supporting the functional requirements documented as expected. E.g. if root causes which have already been determined are correctly associated with similar subsequent events.
- Consider the requirements of a user supporting ANM and SVO systems and evaluate whether improvements could be made to the design of the system

The System Trial took place over a three month period from the end of November 2022 to the end of February 2023 with integrated review cycles to allow, where possible, tweaks to the system to be deployed to reflect learning that was captured early.

During the System Trial the Trial Log was updated whenever the system was assessed. This assessment was undertaken by the NEAT project manager from NGED. Cybersecurity limited access to the system to NGED and Harmonic therefore no testing could be carried out by PSC.

Routine assessment of the events was complemented by User Reviews by other members of staff within NGED. Unfortunately no member of staff has a role that is exactly equivalent to the

foreseen role of the NEAT user. However, these user reviews brought additional perspectives from those who:

- Currently design and deploy ANM systems.
- Are involved in innovation projects.
- Are involved in supporting our existing control system.

To widen the range of feedback a number of usability assessment sessions were undertaken with relevant staff to capture their view of the functions and visualisations in the tool and to suggest improvements. These culminated with a short usability questionnaire.

The System Trial was amended to include the provision of historic data so that the events on the SVO system could be viewed using the NEAT prototype.

The learnings from the System Trial were captured in a findings report and the key points have been summarised in section 9.

5.6 WP6. Dissemination and Closedown Report

This findings from the trial were disseminated via a webinar in April 2023 which was attended by staff from other DNOs, engineering consultants, ANM system providers etc.

The webinar slides are available on the NEAT website[1].

[1] https://www.nationalgrid.co.uk/innovation/projects/network-event-and-alarm-transparency-neat

6 Performance Compared to Original Aims, Objectives and Success Criteria

Table 6-1: Performance compared to project objectives

Objective	Status	Performance
Understand the data that can be used to provide context for the alarm and event analysis	Complete	This was completed and documented in the early exploratory data analysis work and then later in the document WP2 - D1 - Data Quality Assessment Summary
Assess the quality of this data and where possible correct quality issues	Complete	This was achieved with the deliverable WP2 - D1 - Data Quality Assessment Summary. This did find data quality issues which were corrected that related to the way data was being extracted from PowerOn
Derive preliminary insights from the data to inform the selection of models	Complete	This was documented in the Exploratory Data Analysis work and discussed at the routine project meetings to determine if business knowledge was consistent with the findings.
Carry out advanced analytics to understand the relationships between alarms and events in different systems and the external datasets	Complete	This work built on the Exploratory Data Analysis and refined it further. The resulting methods were included in WP2 - D2 - Design Report.
Create a prototype dashboard to allow the analysis to be run regularly and present the user with results	Complete	This was completed to help provide user feedback as part of the work to create WP2 - D2 - Design Report.
Trial the use of the dashboard using real data over a period of time	Complete	The trial tested the system for 12 weeks and included usability assessments from key members of staff.

Objective	Status	Performance
Consolidate and share the learning from the project	Complete	The NEAT learning was shared via a webinar in month and also via the publication of the webinar slides, webinar recording and this closedown report.

Table 6-2: Status of project success criteria

Success Criteria	Achieved	Performance
The project has gained an understanding of the new types of alarms and events associated with new systems supporting DSO functions, how these differ from “traditional” control system alarms and how the needs for their management differ to traditional alarms and events.	✓	The NEAT system has filtered out the normal network management related alarms and events so that those relating to the ANM, SVO and Telecomms systems can be more clearly seen by support staff. While initially limited information was available from the ANM systems this was increased by an amendment to the ZIV system in Cornwall to pass more data via the ICCP to PowerOn so that this could be picked up by the alarm and event management process.
The data sources that are available to contextualise these alarms has been explored and relationships between data items and the alarms and events have been found.	✓	This was achieved in the Data Exploration phase of the project. A wide range of data sources was explored including the CROWN asset register and work programming system, the Integrated Network Model, HISTAN/ TSDS time series data, Electric Office (GIS) as well as PowerOn, SVO and ANM systems. This confirmed the known issue of difficulties in linking asset records in the separate systems together which was one of the driving factors behind establishing the Integrated Network Model. Issues around Aliases were also explored as these can change when assets are replaced.
The learning gained from analysing relationships between alarms and events and the contextualising data has been incorporated into a dashboard which is suitably generic in design to anticipate future systems to support DSO functions that are not yet known.	✓	This was achieved during the work packages for design and build. The prototype system tested would be easy to adapt for additional systems as the general ideas of being able to track events over time or by category would be the same as would be the process to manage and investigate the events. The process to analyse existing data to determine thresholds for unusual activity could also be repeated.

Success Criteria	Achieved	Performance
A dashboard to assist with the management of these alarms and events has been developed and tested. Learning from the trial has been used to recommend changes to datasets, processes, systems etc. to reduce alarms and events in the future and/or the way in which alarms and events are managed has been improved to reduce the time spent on their management.	✓	This was achieved during several of the project phases. The build, deployment, test and trial phases allowed for the trial to take place and the learning to be captured. The learning from the project has been fed back to owners of the data where this was found to contain errors or to be extracted in an unsuitable format. The ability to provide useful learning from the trial that would reduce future events was hampered by the switch off of the SVO system which provided the majority of the events for NEAT to manage. However, events relating to the ANM system have been fed back for further investigation and management.

7 Required Modifications to the Planned Approach during the Course of the Project

7.1 Additional work to anonymise data for GDPR compliance

During the design stage it became apparent that a data extract which was not expected to include any Personal Data as defined by GDPR did include some staff names and contact details. This required a new process to be developed to anonymise this data before it was sent to Harmonic to ensure GDPR compliance. This involved creating a cleansing database through which data extracts were processed. This also involved a risk evaluation process with the legal team.

7.2 Revised approach to SVO trial

During the project the SVO system, which was expected to be a major source of events for investigation, was switched off. This reflected a review of the plan for future system development that included incorporating the current SVO functionality within PowerOn. This brings a large advantage in reducing the workload associated with managing two separate network models and by having a single network model there is no need to replicate the switching operations from PowerOn onto the remote model. This reduces one of the likely triggers for errors on the SVO system. Having made this decision, maintaining the existing SVO system became uneconomic due to the significant licencing costs. This meant that by the time of the trial the SVO system was no longer available to send event data for analysis. Historical SVO data was investigated to determine if this could be fed into the NEAT system to see how it would be processed. While full SVO data couldn't be included, the issues identified during the NEAT development while SVO was running were replayed 2 years after they originally occurred during the trial. This ensured that SVO data and risk factors were present during the trial.

7.3 ICCP data extension ANM system deployment

During the Exploratory Data Analysis phase of the project it became apparent that while the ANM systems from both vendors, SGS and ZIV, exchanged data with PowerOn in order to function correctly the data exchanges were limited to the minimum dataset required. While there was some internal logging of events within the systems to support troubleshooting by the developers, they were not designed to be interrogated remotely or to provide routine reports. The Cornwall ANM system that was provided by ZIV was updated during the project to include additional items that were passed through the ICCP link and used to provide alarms within PowerOn that could then be added to the normal alarm reporting data extracts.

7.4 Delay to Trial system deployment

As outlined in section 5.4, there were a number of delays to the deployment of the trial system. This resulted in the project timescales being extended.

7.5 Change to data provision from PowerOn

The provision of data from PowerOn during the early stages of the project was on an ad hoc basis. While some of the reports took a long time to run they were supervised by the person extracting the data and would not interrupt other business processes if they failed to perform correctly.

However, in preparation for the deployment of the NEAT system some of these data extracts needed to be automated to run daily or weekly. This automated process was evaluated to be high risk.

8 Project Costs

Table 8-1: Overall Project Spend

Activity	Budget	Actual	Variance (-overspend, + underspend)
PSC & Harmonic Consultancy Costs	£322,000	£340,594	-£18,594
NGED Project Management	£93,208	£97,106	£3,989
IT Server and Licence costs	£40,000	£40,905	-£905
ZIV System Amendments	£0	£9,800	-£9,800
Total before contingency	**£455,207**	**£488,495**	**-£33,288**
Contingency	£45,521	Included in actuals £33,288	Remaining £12,233
Totals	**£500,728**	**£488,495**	**£12,233**

The project is within its overall budget.

The extension to the project timescales and the need to rework the data import processes was unexpected and incurred significant additional costs. This resulted in an additional payment being made from the contingency budget of £18.6k

The extension to the project timescales also resulted in the NGED project management costs being overspent with the costs being £3,989 over budget.

The IT server and Licence costs were also marginally overspent by £905 which reflected the uncertainty in estimating costs before the system requirements, and therefore the hardware and software requirements, are known.

The costs for the additional work by ZIV of £9,800 were not within the original budget but were considered to have the potential to provide useful additional data and so were funded from the contingency.

9 Lessons Learned for Future Projects and outcomes

A summary of the key learning points is given below. Further details of the learning were included in the dissemination event. The slides / video for that event can be viewed on the NEAT webpage.

9.1 Data Quality and Availability

NEAT used data that was not normally examined in detail and as a result a number of data quality issues were made visible for the first time.

Item	Detail
Data Quality issues	Some of the data quality issues did not reflect issues with the underlying data sources but were introduced during the process of data extraction. This included the incorrect use of field delimiters which resulted in some data being reported in the wrong columns after a certain record in the data extract.
Prohibitive data volumes	There was a very large alarm flood in November 2020 with millions of records added in a single day. This prevented the normal system for reporting from working as it could not manage the volume of alarms. These were eventually identified as relating to a particular device, a Panacea PMAR which when connected via a DNP3.0 comms link to the host RTU, will exhibit an abnormal behaviour as the device is unable to recognise the acknowledgement of the alarm being sent back from the host RTU to the device.
12h and 24h time formats	These were often mixed within the same report. Sometimes the use of 12h time without an am/pm indicator made it impossible to tell the time of the event.
TSDS vs HISTAN data	While some initial analog value data was available from TSDS, it was decided to switch to the HISTAN system for the regular data extract of that data as it was more suited to the regular data extraction.
GDPR compliance	While none of the fields titles for the extracted data suggested personal information, there were items of personal data entered within comment text fields which needed to be located using standard text items as search terms. While not strictly necessary, additional anonymization was undertaken to remove the names of field staff who were despatched to faults or control staff that confirmed alarms.
ANM data availability	The data available for the Exploratory Data Analysis and the System Trial was less than expected reflecting both the delay in commissioning the Devon ANM, and the low levels of customer constraint during the winter months.
SVO data availability	The switch off of the SVO system during the project made it impossible to trial that element of the system in real time. It was, however, possible to adapt the system to handle historic data and replay it in real time. It was not known originally whether the changes in the rest of the network data in PowerOn would enable this but it appears that a sufficient majority of assets were unchanged to enable the data processing to work.
Network Model Update – built in validation	Wellington electricity will be using electric office to create PowerOn patches, this could provide a model for future development by NGED as a means to reduce the issues around network model update that can cause problems with the state estimation modules of ANM and SVO.

9.2 Specification & Design

Item	Detail
Filtering alarms	The data includes large amounts of irrelevant items such as bund pump alarms and radio alarms, excluding these allowed for more focussed analysis
Alarm data content	Some items do not have an electrical location but still might contain useful information. There is a difficulty associating these with other alarms
PowerOn Patches	It is not possible to easily determine the assets associated with a patch in PowerOn and hence whether a particular network amendment would be a likely cause for subsequent failures on the ANM or SVO systems.

9.3 Deployment & Test

Item	Detail
VPN	Unexpected VPN incompatibility issues resulted in delays while an alternative end point on Harmonic's side was set up.
Blind deployment	There was significant latency in some steps of the deployment while approaches were found and staff were unavailable to do some of the steps that Harmonic/PSC don't have access to do.
CyberArk	Using a Firefox browser was thought to be the reason behind a user getting stuck in a loop when trying to log in to CyberArk. WPD only has Chrome and Edge as supported browsers. This did not turn out to be the problem but the link provided was different to that used by WPD IR, it was missing "/V10" in the middle of the link.
OpenShift	OpenShift was deployed during the development phase of the project and was supposed to be ready for the deployment, but a number of unexpected issues delayed the availability of the platform and therefore the deployment of NEAT.
Security processes	Multi factor authorisation failed to work the first time for one user because their phone was set to a time that was more than 6 minutes off from the correct time.
Security processes	Using the WebEx to change passwords, the normal process to change initial passwords for security, was very complex with remote third parties. Having a separate zoom meeting to be able to talk to each other during the process was very helpful.
Testing data volume	Due to the low number of events due to the time of year and well-behaved systems, there was little current data to test with. It was not possible to import historic data because it was not kept in the expected format.
Nested IT Issues	Until the VPN issue was fixed we could not detect the CyberArk issue, until the CyberArk issue was fixed we could not detect the OpenShift issue. There is little opportunity for parallel work to resolve issues due to the serial way in which they are detected.

9.4 Trial

Item	Detail
Lack of a representative user	The majority of the trial investigation was carried out by the project manager as there was no-one in the role of the system user that could be called upon.
Event investigation	Without other references it was difficult to evaluate whether the information provided was sufficient to evaluate determine the root cause of the event.
Word Cloud	The word cloud did not work well for events that were triggered by multiple instances of the same alarm as there was no additional text items to include.
11/12 minutes past the hour	Incorrect date format in the export process caused alarms, switching events, and issues to have dates all 11 or 12 minutes past the hour until identified in NEAT. Data had not been used in this level of detail before.
Issue drill down	None of the issues that were examined could easily be related to work that had been identified as happening via the CROWN data. It is expected that this would be easier with a geographical visualisation of the CROWN events.
Trial Timing	The delays to the project resulted in the trials being held during the winter, when the chances of ANM operation to curtail generation were low. Given that it was possible to replay the SVO data it could have been possible to replay ANM data from the summer, however , it is believed that additional effort would be better spent testing a different licence area.
Event categories	PowerOn alarms were the most prevalent with ANM alarms being second and SVO third.
Event types	The Volume alarms e.g. a high number of stage 2 alarms being received in a 24 hour period, were the most frequently
Event locations	Three locations were responsible for nearly 75% of all the events identified suggesting that targeted remedial work would be very effective in bringing down event volumes
Overall alarm volumes	Overall alarm volumes were lower than expected suggesting that even with the additional focus on ANM systems following Access SCR changes, that this would not warrant data imports at a higher frequency than once a day.

9.5 Project process

Item	Detail
Assumed levels of support from National Grid IT	The learning from previous projects had been applied in that there were 1) No interfaces to National Grid systems 2) Very early engagement with the IT staff, including the cyber team, to flag up future requirements for support.

Item	Detail
	It was expected that would be sufficient to allow for smooth installation, but the introduction of new systems, impact of covid, and the change in IT priorities during the corporate merger were highly unusual. This demonstrates the value in having projects that can extend their timescales and confirms the need for a moderate level of financial contingency for projects.
Lack of a representative user	This was problematic throughout the various stages of the project and suggests that the project may have been undertaken too early in the process of determining the strategy for the DSO support systems.
Working across time boundaries	There were several instances where time was lost due to the time difference between the UK and New Zealand.

10 The Outcomes of the Project

The outcomes of the project are as follows;

- A better understanding has been gained of the data within our PowerOn system, including the degree to which multiple alarms are created in the background of PowerOn which users are not aware of.
- We have developed greater awareness of where Personal Data is unexpectedly contained within datasets and how this data can be cleansed in order to allow it to be shared.
- We have gained an understanding of the rate of alarms and events experienced by the DSO support systems, their categories and their relative prevalence.
- A trial system has been developed and tested which can be modified for use with another licence area within NGED or a DNO that is not part of the NGED group.
- A view of what visualisations are helpful to a user trying to understand the correlations between events and alarms from different systems has been gained from the user reviews of the system.

11 Data Access Details

No new data was collected as part of this project but rather data extracts were taken from existing systems. Requests relating to the data used in this project should be addressed to the innovation team as the inclusion of Personal Data within alarm information makes it unsuitable for publishing on our website.
(/www.nationalgrid.co.uk/innovation/contact-us-and-more)

12 Foreground IPR

The algorithms produced for the analysis of the alarms were shared in the Design and Build documents published on the National Grid website. The source code for the NEAT trial system is available on request.

13 Planned Implementation

Following the changes in NGEDs strategy that will result in SVO and ANM systems ultimately being recreated within PowerOn, and the switch off of the SVO system, the business case for full BAU roll out has diminished. However, there is potential benefit in supporting the telecoms teams by making the events more visible to them and therefore it is recommended that further work is carried out to test the NEAT system but in a licence area that has more frequent telecoms issues than the South West. Keeping the system running to observe the impact of the additional ANM data points is also a low cost option.

14 Contact

Further details on this project can be made available from the following points of contact:

nged.innovation@nationalgrid.co.uk

Innovation Team

National Grid
Pegasus Business Park,
Herald Way,
Castle Donington,
Derbyshire
DE74 2TU

15 Glossary

Abbreviation	Term
ANM	Active Network Management
DNO	Distribution Network Operator
EDA	Exploratory Data Analysis
GDPR	General Data Protection Regulations (data protection)
GIS	Geographic Information System
GUI	Graphical User Interface
HISTAN	Historical Analogue
ICCP	Inter Control-room Communications Protocol
HV	High Voltage (6.6 and 11 kV)
INM	Integrated Network Model
MPAN	Meter Point Administration Number
NGED	National Grid Electricity Distribution
PowerOn	The Control System software used by NGED
SCADA	Supervisory Control and Data Acquisition
State Estimation	The process to use existing SCADA data and network models to estimate the state of the network where monitoring is not installed.
SVO	System Voltage Optimisation
WP	Work Package