Investment Decision Pack

NGET_A14.10_IEMS (SCADA) Replacement

December 2019

As a part of the NGET Business Plan Submission

national**grid**

national grid

Engineering Justification Paper IEMS (SCADA) Replacement			
Asset Family	IT System – CNI		
Primary Investment Driver	Maintaining the resilience of Critical National IT Infrastructure and ensuring ET has fit for purpose system that can enable efficiencies in the next regulatory periods.		
Reference	A14.10		
Output Asset Types	IT System		
Cost	▮▮▮ (ET share)		
Delivery Year(s)	2019-2026		
Reporting Table	D4.3A		
Outputs included in RIIO T1 Business Plan	No		
Spend Apportionment	**T1**	**T2**	**T3**
	▮▮▮▮	▮▮▮	▮▮▮

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Executive Summary

The iEMS (Integrated Energy Management System) is a Critical National Infrastructure (CNI) operational tool used extensively by both National Grid Electricity Transmission (ET) and National Grid Electricity System Operator (ESO). The single iEMS system collates data direct from ET's substations (and other TOs and OFTOs) and presents such data in the form of operational displays and information within the Transmission Network Control Centre (TNCC) and Electricity National Control Centre (ENCC). The iEMS also facilitates the management and control of the GB Transmission Grid System and enables the provision of safe access to the system for construction and maintenance for the England and Wales transmission system. It is critical to ensuring that the UK has a safe and reliable network that is protected from external threats.

Support for the existing iEMS will expire in 2022-2023 and it will experience availability, supportability and reliability issues unless there is significant mitigation. Even a temporary or partial iEMS outage would result in interruption to the operation of the network for customers and stakeholders and ultimately have a significant impact on connected customers and end consumers, both in terms of cost and energy supply.

Following customer and stakeholder feedback and a formal consultation process, Ofgem published its decision for the legal separation of the ESO within the National Grid Group in July 2017. Subsequent organisational changes and 'soft separation' of systems and data enabled ET and ESO to operate as separate businesses from 1 April 2019.

Legal separation has highlighted a clear functional divergence in the future business requirements between ET and ESO with ET utilising SCADA (supervisory control and data acquisition) to focus on remote control of assets and data acquisition to support efficient asset management whilst ESO focuses on enhanced situational awareness capability, real time network analysis, monitoring and simulation. Following analysis carried out in early 2019, both ET and ESO recognise there is a necessity to change the current model of one shared system between ET and ESO and this paper outlines the scope, cost and timeline of an independent SCADA system for ET.

Although this paper does not comment on a preferred SCADA product, it does narrow the preferred ET/ESO system configuration to four distinct and ranked options. The first preferred option is for an independent out of the box (OOTB) solution for ET that caters for ET's functional requirements, which differ to those of ESO. This can most effectively be achieved by use of support mitigations to align ET and ESO activities to implement separate solutions by 2025, at a cost of ███ to ET. This approach is fully supported by ESO as our key external stakeholder.

Whilst upgrading and continuing to use a shared system is a lower cost IT option, this does not deliver a clean separation, and will limit wider benefits and efficiencies in both ET and ESO. This sub-optimal arrangement would continue through until the next cycle of asset replacement, toward the end of RIIO-T3.

Introduction

The current iEMS architecture consists of common systems and communication infrastructure for both ET and ESO and is driven from a single database. All high voltage GB network infrastructure additions or amendments must be replicated within the iEMS, to allow National Grid ESO and National Grid ET to operate the GB system safely and economically and the iEMS database and array of displays are continuously updated to reflect the changing GB system. These updates are currently undertaken by National Grid ESO.

Currently the ESO manages the user administration for iEMS and leads on support and development of the system. This is reflective of ESO 'owning' the system historically and has led to:

- A large number of manual tasks/interfacing in ET processes
- Compromise solution not excelling for either SO or ET
- A considerable portion of bespoke customised application code
- A complex testing programme against changes
- Complex and manually intensive visualization curation and simulation environment management
- Update complexity and frequency generating lifecycle support frequency and cost issues

Legal separation of ET and ESO activities became effective from 1 April 2019. This highlighted a clear functional divergence in the future business requirements between ET and ESO with ET utilising SCADA (supervisory control and data acquisition) for remote control of assets and data acquisition to support efficient asset management whilst ESO focuses on enhanced situational awareness capability, real time network analysis, monitoring and simulation.

The primary requirement for ET SCADA is for remote operation of assets and data capture to support efficient asset management. Remote operation is primarily focussed on switching for:

i)   Safe access to the network (outages for maintenance and construction)
ii)   Commissioning of new assets
iii)   Reconfiguration of the network in response to faults and/or operational requirements

Data capture to support efficient asset management includes the acquisition and display of asset condition and operational performance data, including alarms for real time decision making and historic trend analysis.

A solution that is out of the box (OOTB) and separate from ESO would allow ET to:

- Choose the best of breed applications as opposed to the 'stretching and adapting' of current system functionality.
    - An off the shelf system will increase system reliability and reduce compatibility issues which have increased since the recent upgrade and have driven disruption in the efficiency of switching activities on the network.
    - In addition, a modular solution for ET will allow for the cost-effective integration of other data sets and functionality within the broader IT system landscape, particularly around work planning and management.
- Implement safety and efficiency improvements in the field, planning teams and control centre.
    - The automation and integration of switching and safety documentation into a SCADA system will reduce manual errors, reduce phone conversations with operations and ultimately increase the volume of switching activities that ET will be able to carry out. The resulting efficiency underpins our commitment to make it easy for Customers to connect and use the network and to efficiently upgrade our network.
    - The automation of alarm handling will improve situational awareness, reduce the amount of out of hours visits to sites and reduce the number of precautionary switching activities carried out.

- Assure physical separation of ET and ESO data and provide a fit for purpose solution as ET and ESO requirements diverge.

Background Information

The original iEMS was procured from GE in 2000 and went live in 2004. An "evergreen" strategy was adopted to ensure the reliability of the system and has been upgraded twice since (2009 and 2017). The 2017 upgrade took the iEMS system from GE PowerOn Reliance Software version 10.2 to version R17. R17 was installed in November-2017 and its origins dates back to 2013, which more accurately reflects the version status.

The TNCC was established in 2013 in ET following the merging of the electricity safety switching tasks that were carried out by the Network Operations Centre (NOC) at Warwick and operational switching that was carried out at the ENCC at Wokingham. It is responsible for the real time operational control of the high voltage electricity network in England and Wales, consisting of over 14,000km of circuit, nearly 800 super-grid transformers and 340 substations. The control room operates on a 24/7 basis, with workload dictated by planned outages and unplanned faults or events.

Version changes of the iEMS take between 5 and 7 years to install, with the majority of this time taken for procurement, database & display conversions, custom functionality-builds, vendor and user acceptance testing, system integration testing and user-training. The most recent upgrade commenced in 2012 and completed in 2017 at a cost approximately ▮▮▮.

Optioneering

There is clear functional divergence in the future business requirements between ET and ESO with ET requiring the ability to monitor and operate the network whilst ESO focuses on enhanced situational awareness capability, analytics, monitoring and simulation. The current solution is a compromise for ET and out of step with other TOs and DNOs which results in a large amount of manual assurance in the control centre and field.

In addition, a solution that is OOTB and separate from ESO would allow ET to:

- Choose the best of breed applications as opposed to the 'stretching & adapting' of current functionality and move to a modern solution comparable to market offerings and DNO solutions that enable safe and efficient delivery of access to the HV network
- Improve integration between interfacing applications to improve efficiency and accuracy and reduce the multiple manual layers of assurance in place to reduce the risk of safety levels being compromised
- Implement safety and efficiency improvements in the field, planning and control centre
- Increase collection and visibility of real-time TO asset data, that would facilitate future investment requirements that meet the rapidly change network and whole life asset replacement decisions.
- Manage a simpler, easier and clearer split with ESO by introducing physical separation of ET and ESO systems and data, rather than the current 'soft-separation'.

Functional Fit and Strategy Options

Building on the 'iEMS Futures' project in 2018 which explored a future shared system between ET and ESO, ET has, in partnership with an external consultancy, explored further options. Twelve potential options were identified and following an initial assessment this was narrowed down to four credible options. Further functional analysis has confirmed that an ET specific out of the box solution is the preferred option. Functional options considered are set out in greater detail in Appendix A.

The table below offers a summary of this assessment against the key criteria of:

- Total cost of ownership - capital investment and associated operating costs borne by consumers and the need to ensure value for money
- Capacity to deliver - the level of risk associated with the ability of NG and its supply chain to deliver the option
- Business/strategic fit - the alignment of this option to our overall business direction
- Addressing the problem – how well the option resolves the identified issue
- Risk – the overall risk to the business associated with this option

Option	Total Cost of Ownership	Business / Strategic Fit	Risk	Capacity to deliver	Addressing the problem	Status
Continued Sharing of System [Options 1,2,3,4]	**AMBER** Positive • Maintains some efficiencies in IT cost to run one system (support, database mgmt.) Negative • Likely to result in increased Capex and Opex spend outside of IT to meet business requirements via other means • Continued inefficiency in some areas of project delivery such as testing if NG stay with heavily customised and integrated solution	**RED** Negative • Does not align to ET strategy to deliver a world class asset management capability • Does not enable physical separation of key ET and ESO systems and data. • Continued governance challenges of managing shared system	**GREEN** Positive • Will adhere to existing legal compliance • Will continue to support safe and reliable network • Could minimise potential IT development risk Negative • Will require rigorous governance around data and access	**AMBER** Positive • Continues the existing arrangements and so should be deliverable – although the legal split between ESO and ET will add complexity to working arrangements	**RED** Negative • Would address system health of existing system • Would not address business efficiency and safety driver	**REJECTED**
Independent Systems [Options 5,6,7,8,9,10,11,12]	**AMBER** Positive • Areas for project delivery efficiencies with OOTB solution such as testing • Efficiencies in cost to run business with new system	**GREEN** Positive • Clearly demonstrable separation any perceived/real conflicts of interest removed • Facilitates ET specific system developments	**GREEN** Positive • Will adhere to existing legal compliance • Will continue to support safe and reliable network • Will support improvements in operational safety	**GREEN** Positive • If an appropriate deadline is chosen, then delivery should be achievable	**GREEN** Positive • Choose the best of breed applications and move to a modern solution that enable safe and efficient delivery of access to the HV network	**RECOMENDED**

	(switching, further integration) **Negative** • Changed system likely to drive higher initial testing costs • Likely to result in higher IT costs to support system	**Negative** • Likely higher business change impact			• Improve integration between interfacing applications to improve efficiency and accuracy and reduce the multiple manual layers of assurance • Implement safety and efficiency improvements in the field, planning and control centre • Increase collection and visibility of real-time TO asset data • Manage a simpler, easier and clearer split with ESO	

Delivery and Timeline Options

ET and ESO have explored multiple different approaches and timelines for delivery. At a high level these options are:

1. ET and ESO working to the same timelines to achieve separation by 2023 in line with current support issues (2022-23)
2. ET and ESO working to the same timelines to achieve separation by 2025 with mitigation for the current support issues
3. ET and ESO deliver implementations at different timelines in RIIO-T2 with ET delivering an independent SCADA solution in 2023 and ESO delivering a situational awareness tool in 2026.

Option 2 offers the most economic and efficient delivery for consumers. During the remainder of RIIO-T1, ET and ESO will continue to work together to mobilise delivery and this decision will be driven by CBA and requirements of both businesses at the time of investment sanction.

Investment Cost, Benchmark & Cost Profile

CBA Summary

Below shows a summary of the output from the CBA contained in Appendix B. The recommended option's NPV over 10 years is ▇▇▇ which is ▇▇▇▇▇▇ than the baseline option. This CBA considers IT costs only as wider business benefits have not been quantified in this paper. As detailed above, the preferred option allows separation between ESO and ET comparable with other TOs and will better deliver ET's operational and customer requirements. Similarly, due to the uncertainty of forecasting beyond RIIO-T3 we have only looked at a ten-year horizon.

Option No.	Desc. Of Option	Preferred Option	Total Forecast Expenditure (£m)	Spend Area (*RRP Table Reference*)	Total NPV	Delta (*Option to baseline*)	10 Years	20 Years	30 Years	45 Years
1	Independent OOTB SCADA/EMS Solution	Y	▇▇	IT	▇▇	▇▇	▇▇	▇▇	▇▇	▇▇
2	Joint ET & SO modify & use existing shared solution with enhancements and modifications	N	▇▇	IT	▇▇	▇▇	▇▇	▇▇	▇▇	▇▇

Basis of costs

The forecast volumes and expenditure were built using the following inputs throughout 2018/2019.

Data Item

Previous Project Cost Analysis	• 2017 Upgrade of iEMS project plans, sanction information, requirements documentation, lessons learnt
Service Cost Analysis	• iEMS and CNI contracts and performance information • Service level documentation • Vendor roadmap documentation • ESO/ET GSA
Existing Systems and Technology Landscape	• System data flow documentation • iEMS refresh requirement documentation • National Grid Enterprise architecture and strategy documentation
Process and Safety Documentation	• Licence code documentation • Internal policies and procedures • Safety information and bulletins
External Consultancy	• Coeus Consulting • Gartner
Internal Interviews	• Senior leadership • Subject matter experts across IT, ESO, ET, CNI
iEMS Futures output 2018	• Full collateral from 2018 joint ESO/ET analysis
Legal Separation and SOFI Compliance Analysis	• TSI documentation • GSA documentation • Legal separation submission documentation

Assumptions and Risks

Assumptions

- ET systems will continue to be CNI classified and production environments will have the same level of SLA, CNI and security classification as the current system.
- The 'ownership' (development, testing, support) of the data interface method and comms between ET & ESO will follow a similar model used for the Scottish TO
- The methods & protocols used for data exchange will need to have options reviewed as part of the initial agreement
- Quantity of managed sites/assets/devices will not change materially throughout RIIO-T2 and T3.
- A greater portion of the ET solution will be OOTB
- Developing more OOTB will reduce the project time/effort on design/development/testing
- Operator codes and procedures can be adjusted, if needed, to accommodate data exchange and synchronisation between ET & ESO

Risks

Risk	Actions Taken
ET CNI Currently ET has little capability or experience in managing a CNI environment or database and display functions - this will need to be established (or sourced).	Analysis under way to understand impact
ET / SO independently choose conflicting options	ET and ESO to jointly develop strategy ahead of project mobilisation to reduce risk of conflicting options.
ET / SO choose solutions that are incompatible for data exchange	ET and ESO to jointly develop strategy ahead of project mobilisation to reduce risk of conflicting options.
NG Data Centre Migration Project NG's new CNI Data centres are set to host iEMS once complete. This is likely to technically require an upgrade	ET and ESO to jointly develop strategy ahead of project mobilisation to reduce risk of conflicting options.

of application and some hardware. If carried out this would delay the 'split' until at least 2030	
Short Term Component Support Issues There are a number of software and hardware components going out of support in Nov 2019. These will require mitigation.	Progress being made with GE to extend support

Conclusion

The iEMS is critical to ensuring that the UK has a safe and reliable network that is protected from external threats.

Following legal separation, ET and ESO's requirements are diverging and there is an opportunity, with iEMS requiring a system health driven upgrade, to move to distinct ET and ESO systems.

The preferred option is for an independent out of the box (OOTB) solution that caters for ET functional requirements and business priorities, which differ to those of ESO. This can most effectively be achieved by use of interim support mitigations to align ET and ESO activities to implement separate solutions by 2025. This approach is fully supported by ESO as our key external stakeholder.

The NPV for the recommended option is ▮▮▮▮ over 10 years which is ▮▮▮▮▮▮▮▮ than the baseline option. This CBA considers IT costs only, wider business benefits have not been quantified. Inclusion of business efficiencies over a longer period than 10 years will ▮▮▮▮ the NPV differential between preferred and baseline options. In addition, the preferred option enables full separation of ET and ESO systems and data, and will allow ET to implement safety and efficiency improvements.

Implementation of an ET specific SCADA solution can be achieved in 2025 at a cost of ▮▮▮▮ to ET in RIIO-T2.

Outputs included in RIIO T1 Plans

Investment to complete the hardware and software upgrade of the previous iEMS and to carry out an asset refresh of the IEMS Network. This delivered the following outputs:

- Reliability & Availability: Ensured that the transmission system continued to be reliably, securely and efficiently monitored and controlled and that incidents were quickly identified, understood and resolved without loss of supply.
- Safety: Ensured that the transmission system was operated within the required limits and provided the data to ensure this is done securely and efficiently.
- Customer Satisfaction: Ensured that National Grid was able to reliably and efficiently deliver energy to GB consumers.
- Environmental Impact: Allowed National Grid to manage the uncertainty of renewables and manage the power system more efficiently.
- Customer Connections: Supported the delivery of generation and demand connections by enabling the remote operation and monitoring of the transmission system.

Funding allowances were allocated to ESO. There is no expected deferral of either volume or cost into RIIO-T2.

Appendix A - Functional Analysis Optioneering

Proposed Preferred Options:

Note - all options include a hard split between ESO and ET

#	Option	Description	Split	Decision & Justification
8	**Independent** Diverse OOTB Solution	Individual "Out of the Box" solution which satisfies ET requirements and Individual "Out of the Box" solution which satisfies ESO requirements **Included in CBA as most likely option.**	Yes	**SELECTED – RANK 1** • Most of ET's requirements can be best delivered by OOTB (advanced distribution management system) ADMS and SCADA style solutions used by DNOs • ESO have indicated as well as federating OOTB solutions, they may consider different approaches for data analysis
11	ET select independent OOTB solution, ESO develops own solution	ESO develops their own custom solution; ET selects new OOTB solution; formal data interface from ET -> ESO established **Not included in CBA at this stage**	Yes	**SELECTED – RANK 2** • Most of ET's requirements could be best delivered by OOTB ADMS & SCADA style solutions used by DNOs • ESO requirements are more bespoke and may suit a greater level of custom development
10	ET select independent OOTB solution, ESO continues with current solution	ESO continue with periodic evolution of existing solution; ET selects new OOTB solution; formal data interface from ET to ESO established **Not included in CBA at this stage**	Yes	**SELECTED – RANK 3** • Most of ET's requirements could be best delivered by OOTB ADMS & SCADA style solutions used by DNOs. • Would allow ESO to phase their future plans – using current as either interim or long term; Keeps same interface for Scottish providers.
7	**Independent** Common OOTB Solution	Individual "Out of the Box" solution which satisfies both ET and ESO requirements **Not included in CBA at this stage**	Yes	**SELECTED – RANK 4** • Given the diversity of requirements, and ESO's specialist functional requirements, it is highly unlikely that the same OOTB solution will address both ET & ESO future requirements at a cost profile that is tolerable. • However with vendor solutions that are modular & granular there may be potential to identify a common vendor framework that has modules applicable to ET & SO.

Rejected Options:

#	Option	Description	Split	Decision & Justification
1	**Baseline** – No changes	Retain existing shared solution with no changes **Included in CBA.**	No – Displays only	**REJECTED** • Against IT asset health policy (referenced in IT strategy) and would provide significant increase in cyber and business risk • The current solution is sub optimal for both parties and there is a clear case for change
2	**Shared** Evolution of Current Solution	Joint ET & ESO modify & use existing shared solution with enhancements and modifications **Included in CBA.**	No – Displays Only	**REJECTED** • Would ensure long term soft separation of key ET/ESO system. • Current R17 solution is a minor iteration of previous solutions and the complexity of current architecture ensures major upgrades difficult. • The current solution doesn't address key functionality requirements for ET (Software interlocking on switching, view management, automation and analytics on certain activities, etc.)
3	**Shared** New OOTB Solution	Single shared "Out of the Box" solution for both ET and ESO requirements **Not included in CBA at this stage**	No – Displays Only	**REJECTED** • The LSP makes strategic use of a single shared system problematic; from both functionality & cost profiles
4	**Shared** New Developed Solution	Single shared solution purpose-built for both ET and ESO requirements **Not included in CBA at this stage**	No – Displays Only	**REJECTED** • Would ensure long term soft separation of key ET/ESO system. • ET does not have capability for application development • The requirements for ET and ESO are diverse, better approach is to split these diverse requirements
5	**Independent** Copies of Exact Current Solution	Identical single solutions for ET and ESO against new defined requirements. As per the "TSI Change Control – Legal Separation" doc, section 22 states "*Should a single system be retained, then a new programme of providing database and display separation between NGESO and NGET will have to be undertaken, to remain compliant.*" **Not included in CBA at this stage**	Yes	**REJECTED** • The current solution is regarded by both parties as sub optimal • Current R17 solution is a minor iteration of previous solutions and the complexity of current architecture ensures major upgrades difficult. • The current solution doesn't address key functionality requirements for ET (Software interlocking on switching, view management, automation and analytics on certain activities, etc.) • This would significantly increase costs • Additional programme/effort required to provide database and

				display separation between ESO/ET to remain compliant
6	**Independent** Evolution of Current Solution	Enhanced and modified current solution for ET, Enhanced and modified current solution for ESO **Not included in CBA at this stage**	Yes	**REJECTED** • The current solution doesn't address key functionality requirements for ET (Software interlocking on switching, view management, automation and analytics on certain activities, etc.) • The requirements for ET & ESO are diverse. ET would benefit from a ADMS/SCADA system, whilst ESO would benefit from an EMS
9	**Independent** Developed Solutions	Individual purpose-built solution for ET and Individual purpose-built solution for ESO **Not included in CBA at this stage**	Yes	**REJECTED** • ET does not have capability for application development. • ET requirements and core capabilities can likely be achieved from an OOTB solution.
12	Shared **3rd Party** Managed Service Provided to both by independent entity	Single solution owned and managed by a 3rd party and user access provided to both ET & ESO **Not included in CBA at this stage**	No	**REJECTED** • Whilst this has worked in other industry sectors (e.g. media & telco), this is not in alignment with the existing energy sector and with the model utilised for other SOs

Appendix B – CBA

Please refer to File

NGET_A14.10 IEMS (SCADA) Replacement_CBA01.xlsb