

RIIO-ED2 Investment Decision Pack

Advanced Distribution Management System Developments (ADMS+)

Investment Reference No: 17/SSEPD/IT/OT/ADMS+



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Definitions and Abbreviations

ADMS	Advanced Distribution Management System
AI	Artificial Intelligence
ANM	Automated Network Management
APRS	Automated Power Restoration System
BPDT	Business Plan Data Table
CAPEX	Capital Expenditure
CI	Customer Interruptions
CIM	Common Information Modelling
CML	Customer Minutes Lost
DMS	Distribution Management System
DnA	Data and Analytics
DPF	Distribution Power Flow
DSO	Distribution System Operator
EHV	Extra High Voltage
EJP	Engineering Justification Paper
FDIR	Fault Detection, Isolation and Restoration
FEP	Front End Processor
GIS	Geographical Information System
ICCP	Inter-control Centre Communications Protocol
IDP	Investment Decision Pack
IP	Internet Protocol
IT	Information Technology
KV	Kilovolt
LEO	Local Energy Oxfordshire
LV	Low Voltage
MERLIN	Modelling the Economic Reactions Linking Individual Networks
NIST	National Institute of Standards & Technology
NPV	Net Present Value
OMS	Outage Management System

Definitions and Abbreviations

OPEX	Operational Expenditure
OT	Operational Technology
PFA	Power Flow Analysis
PoC	Proof of Concept
PSA	Power System Analysis
SEPD	Southern Electric Power Distribution
SHEPD	Scottish Hydro Electric Power Distribution
SSEN	Scottish & Southern Electricity Networks
WAM	Work & Asset Management
WSC	Whole System Coordinator

1. Executive Summary

Our Advanced Distribution Management System (ADMS) is the core to the day to day management of our network and will become even more critical as Flexibility Markets further develop. A major change will be the inclusion of our LV Networks (including LV Monitoring) in the system which will be vital to manage Flexibility. The ADMS will need to be able to fully integrate with the Whole System Coordinator function, and have enhanced modelling capabilities, as well as use standards for data exchange, namely ICCP and CIM. To manage these new requirements the system will need to be updated, and currently these updates are expected in 2023 and 2027, some FEPs will need to be replaced, and additional desktop equipment needed in control rooms. We will also add operational improvements such as mobile outage and switching management for our field staff and primary substation outage restoration, to reduce both CI and CML. These changes will help us to deliver Net Zero and improve system reliability. There are alternatives for some areas of the project (e.g. Mobile Outage and Switching, where we could continue without these facilities, but then fail to deliver the IIS benefits), but in many cases (e.g. LV Networks) we have no viable alternative if we are to deliver our part of national programmes (e.g. Net Zero).

2. Investment Summary Table

Summary Table			
Name of Scheme / Programme	Advanced Distribution Management System Developments (ADMS+)		
Primary Investment Driver	Progress to Net Zero		
Scheme Reference / Mechanism or Category	17/SSEPD/IT/OT/ADMS+		
Output References / Type			
Cost (CAPEX)	■		
Delivery Year	RIIO ED2		
Reporting Table	CV11		
Outputs Included in RIIO ED1 Business Plan			
Spend Apportionment	ED1	ED2 ■	ED3

3. Introduction and Background Information

In RIIO-ED1 we made many changes to our Distribution Management System (DMS). The prime change was an upgrade to GE’s PowerOn Advantage suite, giving us access to many other tools, including their latest Outage Management System (OMS), which replaced a legacy in-house developed application. The work also included a number of modules to aid management of the network, such as Automated Power Restoration System (APRS) to undertake automatic switching on our HV network, overall providing us with an Advanced Distribution Management System (ADMS), along with mobile tools to enable basic functions in the field. The work also included improved Cyber Security facilities (to align with the NIST requirements) and separation of the Distribution and Transmission instances of PowerOn.



In RIIO-ED2 we will continue this work, especially in regard to the full establishment of LV networks in the ADMS (at present they are only represented in a logical form). This work will require changes to the data structures in the system, to align with the latest standards, especially Common Information Modelling (CIM). Not only will this aid integration with existing and new tools, especially those being deployed for the Flexibility Markets, but it will also help in terms of coordination with others. It will build on the work already completed on the Inter-control Centre Communications Protocol (ICCP), and of course supporting Open Data. We will also incorporate LV Monitoring into the system, in line with our proposals in EJP-ED2-LV Monitoring. In conjunction with our Automated Network Management (ANM) solutions the ADMS will support some automated control in the Flexibility Market, subject to agreement with Market Participants.

4. Business Plan Fit

This project can be mapped to following strategic themes:

Progress to Net Zero	Safe, resilient and responsive networks	A trusted and valued service to customers and communities	Positive Impact on Society
✓	✓	✓	✓

5. Optioneering

As we have invested significantly into our ADMS system in RIIO-ED1 period, our current plan is to maximise that investment, making use of the facilities offered by the PowerOn Advantage suite. Specific changes will include:

- Upgrading the data model to the latest standards, enabling simpler integration with internal tools (e.g. our Geographical Information System and the new Flexibility Market tools) and aiding external data sharing.
- Fully incorporating the LV network into the system, to enable granular monitoring and control.
- Enabling new monitors and controls to be incorporated into the system, including the LV network:
 - Additional capacity in IP FEPs.
 - Additional capacity in iHost system to provide supplier agnostic connections for LV monitoring devices.
- Enabling all of the available tools to be used at all voltage levels (where beneficial), including:
 - ANM, including Flexibility Market systems (where agreed with participants).
 - Extend Automated Power Restoration System (APRS), providing Fault Detection, Isolation and Restoration (FDIR) functionality to as many parts of the network as practicable.
 - Switching Advisor, providing tools to assess restoration options.
 - Distribution Power Flow (DPF).

- Able to integrate fully with Flexibility Market tools, in particular the Whole System Coordinator (WSC) and Power Flow Analysis (PFA).
- Open Data sharing in standard formats (e.g. CIM).
- Improved communications information available for ICCP.
- Optimised operation of assets and dispatch services.
- Enable Curtailment Assessments and Load Disaggregation Modelling.
- Automation of control room processes, potentially including AI (e.g. automated actions to manage system inertia).
- Mobile tools for managing outages and switching in the field.
- Where permissible, use of Smart Meter data.

The work listed has been split into a number of work packages, to ensure integrity of operation is not compromised.

5.1.1 Primary Substation Outage Restoration

In RIIO-ED1 we implemented an Automated Power Restoration System (APRS) system into our ADMS. In RIIO-ED2 will enhance the capabilities of the overall ADMS system by implementing functionality designed to automatically isolate faults which occur within primary substations, and subsequently co-ordinate with the APRS module to restore electricity supply to affected customers from other sources. The module will be effective in improving supply quality by operating quickly in situations where a primary outage affects large numbers of customers and complex restorations are required. The system will be deployed on our extra high voltage system, i.e. 33kV and above.

5.1.2 LV Networks

Building on the work in RIIO-ED1 to fully develop a connectivity model across our core systems, in particular our Geographical Information System (GIS) Electric Office and our Work and Asset Management (WAM) system Maximo, in RIIO-ED2 we will ensure that our ADMS system has a full LV model. Our ADMS already has LV capabilities, but this project will increase the details to a full LV model, including smart metering data and customer connection details. The model will be updated and shared in near real time between our core systems (especially GIS and ADMS), as well as with the new tools we will deploy to help deliver our accountabilities in a new more flexible market.

The core work in this project will be:

- An update to the main ADMS data model in line with the latest manufacturers recommendations for managing LV networks.
- Ensuring that this model can be shared with other key tools.
- Updates to the Outage Management System (OMS), which is part of the ADMS suite, to ensure this can take full advantage of the detailed LV model.
- Making use of the detailed mapping facilities available within the ADMS system.
- Increasing server and storage capacity to ensure the additional network details do not compromise the overall performance of the ADMS system, particularly in regard to safety and power restoration.

As a full LV model to this level of detail has not been implemented in the United Kingdom before, we currently have a Proof of Concept (PoC) project underway to confirm the details of the work required, which does give rise to some uncertainty as to deliverables required from this project. There are also uncertainties around the details of the requirements for the Flexibility Market. We expect to be able to manage these uncertainties within the general programme risk allowance; we may need to revisit this area should the PoC or Flexibility Innovation projects demand far more functionality.

5.1.3 Increase monitoring capacity

During RIIO-ED1 we started to deploy a number of new monitors onto LV equipment. These ranged from basic load monitors, to others that allow some basic forms of LV Automation. In RIIO-ED2 we will significantly increase the number and coverage of monitors at LV level, and expect to be deploying about 4,000 per year by the end of the period (see LV Monitoring Rollout EJP: 421_SSEPD_OT_LV_MONITORING). This project will ensure that the output from these monitors is made available in near real time for all appropriate systems, which includes our ADMS and all associated analytics

systems. The data collated here will be combined with other data, in particular the feeds from Smart Meters, to give meaningful insights into the load profiles, capacity, constraints, availability and overall health of our network.

5.1.4 Mobile Outage and Switching Management

In ED1 we replaced our legacy Outage Management system with the PowerOn system. This, along with an upgrade to PowerOn, has provided a modern fully integrated Advanced Distribution Management System. In RIIO-ED2 we will ensure much of the functionality of this ADMS is available in the field, using integrated mobile facilities. This in particular will cover the Outage Management System, so field operatives can have full access to up to date information about any outage, and can in turn make updates themselves, leading to a much more efficient management of any outage (either planned or unplanned). The tools will also allow authorised engineers to undertake switching in the field, subject to suitable safety and security protocols.

5.1.5 ICCP Expansion

The Inter-Control Centre Communications Protocol (ICCP) allows communication of control signals between network management organisations. Initially developed as a system that allows control centre information to be passed between the large network management organisations, such as Transmission Operators, the system will expand in RIIO-ED2 to encompass many of the larger participants in the Flexibility Market. This project will be an on-going series improvements and works will include:

- Internal and external secure gateways.
- New north and south servers, both to ensure capacity and reduce risk.
- One new major ICCP link per year (i.e. secure routing in and out of our system).

5.1.6 CIM capabilities

Common Information Modelling (CIM) is becoming the standard to allow exchange of electricity network data, both asset and transactions. Our core systems (e.g. ADMS, GIS, WAM) already use CIM, however there are variations between the specifics of CIM in the systems. In RIIO-ED2 we will work with other in the industry, as well as our partners and supply chain, to ensure that any data being transferred using CIM is in a form that the receiver can use. This project is to ensure that the ADMS system is able to align with that objective, in particular with data related to switch positions.

5.1.7 WSC Integration

Our Advanced Distribution Management System will need close integration with the Flexibility Market tools, in particular the Whole System Coordinator (WSC) function. This work is set out in our DSO Management (Optimiser) project, so costs and details are not included here.

5.1.8 Enhanced modelling capabilities

The Flexibility Market will require Power System Analysis models that can run in near real time based on current network connectivity. Work to ensure we have this capability has been covered in our PSA+ project, so is not included here.

5.1.9 ADMS Refresh

Our ADMS supplier has already indicated that there will need to be two updates to the core system during RIIO-ED2 in order to meet the developing needs of the Flexibility Market, as well as to ensure the system is kept current with industry good practice. This project covers both updates, one small update towards the start of the period, and a larger update towards the latter part of the period. The work in this area also includes the refresh of other equipment that will become obsolete, namely APRS Hardware Replacement, iHost Hardware Replacement and Qualitrol Hardware Replacement.

5.1.10 FEP Re-architecture

The architecture of our ADMS relies on geographically dispersed front-end processors (FEPs) to aggregate signals from remote terminal units for onward transmission to the control rooms. As we transition to IP based communications, the

need for geographically located FEPs changes. We plan to remove a number of our FEPs, concentrating on a smaller number of secure sites. Hardware will be refreshed and FEPs established in a virtualised environment.

5.1.11 Control Room Upgrades

In order to service the Flexibility Markets, a number of changes will be required to the Control Rooms to allow for the necessary staff and management of the network. These upgrades are described in our Control Room Upgrade EJPs (see Control Room EJPs: 415_SEPD_DSO_CTRL ROOM and 416_SHEPD_DSO_CTRL ROOM). There is also a need for updated and additional desktop systems (PCs, screens, etc.) to support those changes, and the costs for this equipment is held in this project.

5.1.12 Project Methodology

Our current plan is to maximise our RIIO-ED1 investments, and we expect to undertake much of this work in-house supplemented by our partners and supply chain. Each block of work will follow the most appropriate methodology, for example adding the LV Network to our ADMS system will be a waterfall project, whereas adding LV monitors to the system will use an iterative approach. The work is however in a developing area (especially in the management of LV networks), so we will continue to work with our overall supply chain, research bodies (including academia) and the rest of the industry to continue to offer the best value, particularly in regards to resilience and supporting the Flexibility Market. A major consideration in all works will be ensuring any change does not compromise Cyber Security. All costs to follow Secure by Design principles for the works listed above are included in this paper. Additional works to enhance security of our existing ADMS are included in the Cyber Resilience OT plan.

5.1.13 Alternative Options

The drivers for this project are:

- Provide a critical foundation for Flexibility (DSO)
- Continue to ensure a secure operational system in the face of increasing threats, appropriate for critical national infrastructure
- Provide standard communication channels with industry partners
- Improved IIS, as set out in the benefits

All of the above could only be provided by an Operational Technology platform. There are alternatives for a few parts of this project, but for others no viable alternative, and this is set out in the table below:

Project area	Alternative?	Impact of alternative
FDIR Expansion to EHV	BAU	IIS improvements missed
LV Networks	None	N/A
Increase monitoring capacity	BAU	LV Monitoring not possible (Net Zero impacts)
Mobile Outage and Switching Management	BAU	IIS improvements missed
ICCP Expansion	None	N/A
CIM capabilities	None	N/A
ADMS Refresh	Replacement	Long duration project with cost exceeding █████
FEP Re-architecture	BAU	Increased costs for equipment refresh
Control Room Equipment	None	N/A

The proposed solution has been based on the best value IT solutions that are currently available. However, given the pace of IT development, the market will be re-examined at each sub-project commencement to ensure the best value solution at that time is chosen for delivery.

6. Stakeholder Evidence

From our ED2 customer priority surveys 'providing an electricity network that is efficient and responsive' was ranked as the 2nd most important priority for consumers, only behind 'delivering value for money services'. In general, stakeholders communicated that the reliability of the network is increasingly important due to the growing dependency of consumers and businesses to have a constant and consistent supply of energy. Restoring electricity supply as quickly as possible in the event of a power cut was ranked as the most important of the priorities tested in the ED2 consumer priorities survey related specifically to a 'safe, resilient and reliable network'. Our ADMS+ changes are fundamental to delivering these key outcomes.

More details of overall stakeholder engagement are set out in the ***Digital Investment Plan (Annex 5.2)***.

7. Analysis and Cost

Costs have been built up using a bottom up approach and have been based on the best currently available solution. IT systems in this arena are rapidly changing, therefore the market will be re-examined prior to delivery, and the best value option to meet the requirements set out above will be chosen. The project has been assessed over a 5-year lifecycle, with both Opex and Benefits equated for that operational period, as IT solutions often need updating after 5 years. NPVs of both 5 and 45 years have therefore been quoted below.

7.1 Cost Profile

This project has the following cost profile and will be delivered as a series of sub-projects, some waterfall, others iterations. The CBA covers the costs and benefits, however as stated in the Alternative Options section, very few elements of the overall project have viable alternatives. For this reason, no alternative has been set out in the CBA calculations. The full build-up of costs is contained in the ED2 IT Investment Plan (Non-Op Capex) Cost Estimate spreadsheet.

	Total £'M	2023/24 £'M	2024/25 £'M	2025/26 £'M	2026/27 £'M	2027/28 £'M
CAPEX (Total) - split as below	■	■	■	■	■	■
ED2 OPEX	■			■	■	■
ED2 Benefits	■			■	■	■
5 Year OPEX	■					
5 Year Benefits	■					
NPV (5 Year)	■					
NPV (45 Year)	■					

The table below provides a summary of the allocation of cost across the sub-projects, and due to 2 decimal place rounding rules in Excel these have been shown in £'s. The full build-up of costs is contained in the ED2 IT Investment Plan (Non-Op Capex) Cost Estimate spreadsheet.

Sub-Project	Total £'s	2023/24 £'s	2024/25 £'s	2025/26 £'s	2026/27 £'s	2027/28 £'s
FDIR Expansion to EHV	■	■	■			
LV Networks	■		■	■	■	
Increase monitoring capacity	■	■	■	■	■	■
Mobile Outage and Switching Management	■		■	■		
ICCP Expansion	■				■	■
CIM capabilities	■		■			
ADMS Refresh	■		■	■		■
FEP Re-architecture	■	■	■	■	■	■
Control Room Equipment	■		■			

7.2 Benefits

7.2.1 Financial Benefits

Benefits are shown for the first 5 years after the project is implemented.

	Total	Year 1	Year 2	Year 3	Year 4	Year 5
Reduction in EHV faults in SHEPD due to substation automation - assume 2 EHV faults (■) – ■ per customer	■	■	■	■	■	■
Reduction in EHV faults in SEPD due to substation automation - assume 2 EHV faults (■) – ■ per customer	■	■	■	■	■	■
OMS Mobile - Annual CML Saving 1.5 Minutes Per Fault - SEPD	■	■	■	■	■	■
OMS Mobile - Annual CML Saving 1.5 Minutes Per Fault - SHEPD	■	■	■	■	■	■
OMS Mobile -Broad Measure Improvement - SEPD	■	■	■	■	■	■
OMS Mobile - Removal of Prem Text - SEPD	■	■	■	■	■	■
OMS Mobile - Removal of Prem Text - SHEPD	■	■	■	■	■	■
FEP Benefit - work should prevent about 6 automation failures per annum (say ■ benefit per annum).	■	■	■	■	■	■

Note that without updates to core parts of the system, notably the LV Networks section, we would not be able to deliver on the new license conditions to support our plans to help deliver our desired low carbon future.

There are additional benefits that are difficult to estimate:

- Will enable benefits for the LV Monitoring programme.
- Is a fundamental building block for Flexibility.
- Meet requirements for control communications using ICCP.
- Meet requirements of sharing Open Data through CIM.
- Far greater network intelligence, reducing travel and effort of frontline (right people to the right place).
- It better enables flexibility offerings, particularly in LV. We can't currently issue flexibility instructions effectively to LV providers.
- Reduction in CAPEX estimations.

7.2.2 Non-Financial Benefits

The non-financial benefits include but:

- Reduced safety risk through increased network information (e.g. LV Monitoring) and secure access to the ADMS in the field.
- Improved network reliability through shorter supply interruptions.
- Improved flow of information to customers during supply interruptions.
- Provides a core foundation for managing Flexibility.
- Provides a much richer source of information for Stakeholders and Partners.
- Reduction in business carbon footprint.
- Reduction in waste to landfill and hazardous waste volumes and disposal needs.

7.2.2.1 Foundation to other Projects/Initiatives

This project is a fundamental building block for DSO working, and without these changes we will not be able to support the Flexibility Market at LV level. Many projects, notably those in the DSO area, are dependent on this project. The functionality in DSO ANM (31/SSEPD/IT-DSO/DSO_ANM), which has a benefit of ■■■, will be dependent on the CIM export and ICCP capabilities delivered through this project.

7.3 Key Assumptions

The current programme and costings assume that all planned RIIO-ED1 system changes will be complete before the start of RIIO-ED2. If some of the current planned application changes are not completed, this will increase the complexity, and hence cost and timescale, of this project. The RIIO-ED1 projects critical to this work include:

- LV Connectivity Model and associated Asset data improvement (Connectivity+).
- Process Development and Culture Change.
- Mobile Capability, especially PowerOn DMS Mobile (ED1).
- PowerOn Advantage.
- PowerOn Transmission split.
- ANM Centralisation.

7.4 High Level Dependencies

National Agreement on ICCP and CIM standards will greatly improve the benefits of this work in regard to working with Stakeholders. Full access to Smart Meter data will also be of great benefit.

The project is also dependent on the completion of the following ED1 Projects:

- PowerOn Advantage.
- PowerOn Transmission split.
- ANM Centralisation.
- DnA Hotspot tool.
- DSO Transition Trials.
- MERLIN Project.
- LEO Project.
- Connectivity+.
- LV Monitoring.
- Flexible Power.

7.5 Deliverability & Risk

Our ***Ensuring Deliverability and a Resilient Workforce (Chapter 16)*** describes our approach to evidencing the deliverability of our overall plan as a package, and its individual components. Testing of our EJPs has prioritised assessment of efficiency and capacity, and this has ensured that we can demonstrate a credible plan to move from SSEN's ED1 performance to our target ED2 efficiency. We have also demonstrated that SSEN's in house and contractor options can, or will through investment or managed change, provide the capacity and skills at the right time, in the right locations. This assessment has been part of the regular assessment of our EJPs, IDPs and BPDTs and we have now refined our bottom up efficiencies and work plan phasing. Our ***Deliverability Strategy (Annex 16.1)*** and ***Supply Chain Strategy (Annex 16.2)*** are included in the Business plan Submission. Deliverability testing has identified a major strategic opportunity which is relevant to all EJPs.

- In ED2 SSEN will change the way Capital Expenditure is delivered, maximising synergies within the network to minimise disruptions for our customers. This is particularly relevant for a Price Control period where volumes of work are increasing across all work types.
- The principle is to develop and deliver Programmes of work, manage risk and complexity at Programme level and to develop strategic relationships with our Suppliers and Partners to enable efficiency realisation.

8. Conclusion

These changes to our Advanced Distribution Management System (ADMS) ensure that we can fully service the Flexibility Markets, as well as deliver improved network performance. We support the Flexibility Markets with the inclusion of all of our LV Networks in our management system along with the new LV Monitoring, enhanced modelling capabilities, and integration with the Whole System Coordinator function. We will coordinate with peers and stakeholders, so standards for data exchange, namely ICCP and CIM, are incorporated.

To manage these new requirements the system will be updated, and currently these updates are expected in 2023 and 2027. Some FEPs will be replaced and additional desktop equipment will be needed for our updated control rooms to be able to manage Flexibility. The operational improvements, such as mobile outage and switching management for our field staff, and primary substation outage restoration, will reduce both CI and CML. There are no viable alternatives to most of the elements of this project (■■■■), and where there are alternatives these will not deliver the IIS benefits set out. These changes will help us to deliver our commitments, in particular Net Zero, and safe, resilient and responsive networks, and will also improve value for our customers.