Revised Proposal

Attachment 5.13.N

ADMS Project Justification

January 2019

Content

1 ADVANCED DISTRIBUTION MANAGEMENT SYSTEM

1.1 Program description

The Advanced Distribution Management System (ADMS) program will transform Ausgrid's network management environment by implementing a world class ADMS with more robust, adaptable and effective processes and tools across its operations.

This will reduce the risks associated with current systems and enable Ausgrid to take advantage of future industry and technology developments to better serve its customers and stakeholders.

The replacement of the existing systems with an ADMS will also permit the rationalisation and integration of several legacy ancillary systems which support operations, planning and design. This will lead to more efficient and effective processes, further reduction in support systems will be achievable over time, with commensurate service improvement and reduction in future expenditure requirements. This program continues the implementation of the ADMS first established in the FY14-19 period.

What is an ADMS?

An ADMS provides an integrated set of tools to remotely monitor and control the network, manage system outages, improve planned and emergency event management, optimise power-flow management, fault location analysis, and fault isolation and restoration capabilities. It also enables integration of distributed energy resources and network optimisation capabilities. An ADMS enables digitised field operations to streamline the day-to-day management of the network, including intelligent field crew dispatch. It is a platform to integrate core, ancillary network and corporate systems to deliver best practice asset management.

1.2 Summary

In our Initial Proposal we proposed to invest $41 million in an Advanced Distribution Management System (ADMS) in 2019-24. This expenditure is at the centre of a program to replace our aged control system and transform our network management environment to take advantage of technological change and better serve the needs of our customers.

The ADMS was proposed to replace the legacy distribution network management system (DNMS). The ADMS will also permit the rationalisation and integration of several legacy ancillary systems which support operations, planning and design.

In its Draft Decision, the AER considered that, while there may be a need for the ADMS program, we had not provided sufficient information to justify the proposed replacement program. The AER did not include capex for the ADMS in its substitute estimate. Customers indicated that they supported the ADMS in principle and wanted to understand the benefits of the investment for customers.

In response to the AER's and customers' concerns, we have further developed the cost-benefit analysis following vendor design workshops and updated vendor pricing. The analysis compares six potential options to address the legacy distribution network management system. The options are compared against the continuation with the current distribution network management system (the base case). The cost-benefit analysis, qualitative and quantitative assessment supports implementing the full ADMS option against the base case and all other options.

Following the submission of our Initial Proposal, further planning and design workshops were held with vendors and the relevant Commonwealth authorities, resulting in a change to the

scope of the ADMS requirements. This changed scope included introducing a staged implementation approach to de-risk the implementation and address the requirement to onshore all Ausgrid data during implementation.

The increased scope of requirements changed the project cost from $41.3m to $59.9m during FY20-24. This approach was validated by reference site visits and calls and aligned schedules for staged implementation and cutover. The revised approach also includes strengthened governance and additional compliance requirements to meet Ausgrid's Critical Infrastructure Licence Conditions.

This detailed planning has enabled Ausgrid to undertake detailed modelling of six options, identifying that the full ADMS project provides the greatest benefits to customers when considering both the quantified and qualitative benefits.

The project delivery of the ADMS implementation is planned in three phases:

- Phase 1 – Replacement of the DNMS;
- Phase 2 – Replacement of the Outage Management System (OMS) and satellite systems; and
- Phase 3 – Alignment to Vendor baseline product and delivery of ADMS Advanced Applications.

Following further customer consultation and after additional top-down review of the ADMS project, the majority of costs associated with operationalisation of the advanced applications of Phase 3 are to be self-funded by Ausgrid. The implementation of these advanced applications will also incorporate the advice from the Network Innovation Advisory Committee.

The implementation of a full ADMS provides a positive Net Present Value of $22.8m when compared to the 'Do Nothing' base option for a capital cost during the FY20-24 period of $59.9m. The detailed business case is included in attachment 5.13.N.1 for further information.

Following Ausgrid Board approval the ADMS implementation commenced in December 2018.

1.3 Background

Ausgrid's current Distribution Network Management System (DNMS) is a bespoke vendor and in-house developed hybrid system dating from the 1990s. It incorporates network Supervisory Control and Data Acquisition (SCADA) and visualisation components. The product is at end of life, with limited support, no vendor roadmap for development and elevated risk of failure due to limited knowledge of the underlying software code to resolve issues when data or functionality limitations are encountered.

The system also lacks the breadth of functionality required to deliver modern operational management in a utility environment, a critical shortcoming considering elevated security risks and the significant increases in industry practice enabled by more recent technology. The current system is unable to support the core functions required by modern distribution utilities.

An ADMS is a necessary first step in delivering the services expected by customers and stakeholders in a rapidly changing industry, with increasing levels of distributed generation, customer engagement and network and customer concerns for energy prices. The need to integrate greater quantities of new and innovative technology is driving the need to have a modern and adaptive control system.

1.4 Needs analysis

Ausgrid commenced preparation for implementation of an ADMS in 2017. Whilst our initial assessment at the commencement of the FY14-19 regulatory period was to maintain the existing system and prepare for replacement, change in recent years to customer expectations, product support, regulatory requirements and increasing security concerns required a reassessment of this strategy. In the FY14-19 regulatory period, critical risks emerged with the existing system, including:

- Inadequate cyber security capabilities to manage current and emerging threats to compliance with state and federal legislative requirements;
- High costs to maintain and difficulty in achieving necessary contemporary cyber security protections;
- Significant risks for legacy software and hardware at end of life and without on-going vendor support;
- Inefficient connection of new types of network equipment due to the lack of a modern network system providing asset and connection integration capabilities;
- High development and support costs solely funded by Ausgrid; and
- Capacity limitations for the database size which is impacting the ability for Ausgrid to commission substations, equipment and telemetry for the Sydney region

The core features of a modern network management system to address these risks require an integrated application framework which operates on current operating systems and vendor supported hardware. It also utilises contemporary testing, maintenance and patching processes. These features result in key benefits such as:

- A simplified and modernised Operational Technology environment to comply with our regulatory obligations, including management of escalating cyber security threats to critical infrastructure as required by our Distribution Licence Conditions and current and future federal legislative requirements;
- Streamlined & standardised industry best practice processes;
- An ability to better integrate with Ausgrid's enterprise systems to ensure a consistent real time situational view (that is not dependant on staff entering and updating information in multiple systems);
- Aligned data between corporate and operational systems to maximise operational and capital delivery efficiencies; and
- An adaptable platform with advanced capability to support the needs of a rapidly changing network and technology landscape as expected from our customers such as provision of a platform for the integration of distributed energy resource management systems as well as other corporate systems to support emerging Distribution System Operator (DSO) industry models.

The core benefits assessed for the implementation and use of an ADMS are described in Table 1.

Table 1 - ADMS core benefits

Benefits	Description
Risk Mitigation	Mitigates legacy-system risk (including cyber risk) to as low as reasonably practical
Operational Efficiency	Drives significant operating efficiencies across the major operational groupings
Enabling Platform	ADMS provides a platform for existing system and process capability integration and enables simple integration of future capabilities
Safety	Greater visibility of the operational state of the network and aligned data will improve safety by providing all personnel operating on the network with improved situational awareness
Customer	Helps meet increasing customer expectations via the provision of accurate and timely outage information through the ADMS which would be in real-time between field operations and customers using our online outage information systems and the contact centre
Compliance	By meeting Ausgrid's Critical Infrastructure Licence Conditions we will continue to deliver safe, efficient and reliable electricity supply to customers. Ausgrid's Critical Infrastructure Licence Conditions[1] include obligations to ensure *"by using best industry practice for electricity network control systems, that operation and control of its distribution system, including all associated ICT infrastructure, can be accessed, operated and controlled only from within Australia, and that its distribution system is not connected to any other infrastructure or network which could enable it to be controlled or operated by persons outside Australia"*

1.5 Transformation support

To meet the changing needs of our customers and stakeholders, and deliver best practice efficient network operations, Ausgrid is undergoing a significant period of transformation. The ADMS is a core part of this transformation and, as a key foundation system, will ultimately be integrated with a range of initiatives in areas such as field force management and automation, self-healing networks, digital network integration and information management. The full benefits of this integration will be realised following the FY20-24 regulatory period and have the long-term potential to transform service delivery and meet changing customer and stakeholder expectations over the next decade, as articulated in the ENA/CSIRO Electricity Network Transformation Roadmap.

The ENA – CSIRO Electricity Network Transformation Roadmap

In 2017 the CSIRO and the ENA developed a comprehensive roadmap for the electricity system which could deliver 30% lower electricity network charges and net zero carbon emissions by 2050, whilst supporting significant levels of customer owned distributed energy resources. A key element of this roadmap is a pivot to a customer focused and intelligent network – enabled by advanced network management systems to facilitate a distributed energy resources market, network optimisation, and further real time communication and control.

http://www.energynetworks.com.au/electricity-network-transformation-roadmap

[1] Critical Infrastructure Licence Conditions (9,10 And 11) of the Ministerially Imposed Licence Conditions for The Operator of a Transacted Distribution System - Issued under the Electricity Supply Act 1995 (NSW)

1.6 Options Considered

As part of the planning and business case development, Ausgrid considered a range of options which included consideration of two options to allow Ausgrid to continue its control room operations utilising the current DNMS:

- Option 1 – Continuing with current DNMS
- Option 2 – Contemporising the DNMS

A review of the risks of continuing with or contemporising the DNMS against the risks of implementing a modern system indicates that these two options are much higher risk for Ausgrid to pursue and are not in the long term interest of customers. These options are also likely to fail to comply with the Capital Expenditure Objective and Capital Expenditure Criteria of the National Electricity Rules.

The high level of risk to implement these options means continuing with either DNMS option is not viewed as credible.

Four credible options implementing a modern network control system were considered:

- Option 3 – Like-for-Like (LFL) – Replacement of the DNMS using a modern platform sourced from a mainstream SCADA/DMS or ADMS vendor to provide the current DNMS functionality;
- Option 4 – Distribution Management System (DMS) – This extends the LFL solution and includes key incremental functionality such as switching management;
- Option 5 – Part Advanced Distribution Management System (ADMS) – This extends the DMS solution adding the Outage Management System (OMS) module, field deployment of relevant ADMS functionality (enabling non-verbal communication) and improved power flow modelling; and
- Option 6 – Full ADMS – A fully functioned ADMS solution sourced from a mainstream vendor that has advanced tools enabled and applications to manage the network;

The options considered have been further detailed in section 1.16 Appendix 1 – Option Details.

1.7 Compliance with Capex Objectives and Criteria

Compliance with Capex Objective

The table below summarises how each of these modern system implementation options meets the compliance requirements of the capital expenditure objectives, and the non-credible options unlikely to meet these objectives.

Table 2 - Modern System Replacement Options Against Capital Expenditure Objectives

Mapping to the relevant "Capital expenditure objective(s)" (Chapter 6, National Electricity Rules) The forecasted capital expenditure is considered necessary to achieve:	
Objective	**Review**
6.5.7(a)(1) meet or manage the expected demand for standard control services over that period	Over the next ten years it is anticipated that there will be a large increase in the quantity of DER that will connect to Ausgrid's network. Facilitating this DER will require Ausgrid to develop solutions that provide visibility and allow control or provision of signals to the market for DER to avoid the need for unnecessary network augmentation. The current DNMS (Options 1 & 2) and Like-for-Like (Option 3) will not provide this capability. Option 4 would be a relatively low cost to expand to this capability. Option 5 and 6 will provide a full power flow analysis solution enabling assessment and management of DER impacts on the network. All major ADMS vendors are in the process of developing modules to facilitate better control of DER and these should be available with a shared development approach in the next couple of years. This functionality is not currently included in the replacement project as it is still in development and hence the costs/benefits cannot be definitively established. As the need to manage DER increases either of these options (5 or 6) could be adapted to meet the evolving requirements. However, costs will be lower under the ADMS options, which offer much of the core functionality immediately.
6.5.7(a)(3) maintain the quality, reliability and security of supply of standard control services	Options 3, 4, 5 and 6 would implement a modern system which would be expected to provide a secure and reliable distribution management system with the appropriate cyber security provisions. These would be supported on an on-going basis by the respective vendor. As such all these options would be expected to comply with the objective for maintenance of the quality, reliability and security of supply for standard control services.
6.5.7(a)(4) maintain the safety of the distribution system through the supply of standard control services.	A modern control system is required to maintain system reliability to avoid a deterioration in management of safety impacts. All credible options would provide a secure and reliable distribution management system with the appropriate cyber security provisions and would therefore meet this objective. Options 1 and 2 have a significantly higher risk of increasing system reliability issues and subsequently increase the likelihood of safety impacts.

Capital Expenditure Criteria

The table below summarises how each of these modern system implementation options meets the compliance requirements of the capital expenditure objectives, and the non-credible options unlikely to meet these objectives.

Table 3 - Modern System Replacement Options Against Capital Expenditure Criteria

Mapping to "Capital expenditure criteria" (Chapter 6, National Electricity Rules) *The forecasted capital expenditure reasonably reflects each of the following:*	
Criteria	**Review**
6.5.7(c)(1) the efficient costs of achieving the capital expenditure objectives; 6.5.7(c)(2) the costs that a prudent operator would require to achieve the capital expenditure objectives; and	The results of the cost benefit analysis demonstrate that the implementation of a Part ADMS or Full ADMS provide an efficient investment for the long term interest of customers. In considering the total benefits (both quantified and qualitative) the Full ADMS provides the least cost to customers in the longer term. The most efficient option has been assessed following the cost benefit review that demonstrates the net impact of the different solutions. Ausgrid has taken several steps to ensure that the selected option is efficient. This includes: • Selecting the software vendor through a transparent and comprehensive sourcing exercise. An overview of this process is provided as Appendix 2. • Ensuring a proven, on-going product is selected to share the costs of future developments and support amongst a large installed base. • Decision to implement a standard product, minimising customisations and hence future costs.
6.5.7(c)(3) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives.	Cost inputs used are based on reasonable estimates with the process followed described in Appendix 3 of the business case (attachment 5.13N.1).

Cost Modelling of Options

All six options were modelled including both costs and benefits to customers. Modelling identified the costs of all options to provide the functionality currently delivered by the DNMS and other supporting legacy systems within the control system environment. The cost modelling included the costs of development, operation, maintenance and upgrades for the options considered as well as any satellite systems such as the existing Outage Management System (OMS) and Switching Request Register (SRR) if retained.

The costs were assessed over a 15-year period, which is a period less than 10 years after the proposed full ADMS is cutover and is in full operation.

Ausgrid has continued engagement with Commonwealth Government departments responsible for critical infrastructure during 2017 and 2018. During this time technical architecture and implementation approaches that conform to stringent data security constraints consistent with Ausgrid's obligations under the Critical Infrastructure Licence Conditions, have been incorporated into the implementation schedule and cost forecast.

Costs that apply to these requirements apply to all Options (3-6) that implement a modern platform and they represent the incremental project costs of retaining Ausgrid specific data on Ausgrid premises.

1.8 Benefits of the Options

An assessment has been made of the incremental benefits of all modelled options. Benefits were grouped into categories covering:

- Safety;
- Efficiency;
- Customer Benefits;
- Reliability;
- Regulatory Reporting/Audit; and
- Avoided Capital Investment.

The benefits assessed as significant for the categorises of efficiency, reliability and network augmentation were further quantified for each option.

Table 4 below provides an overview of these quantified benefits. Some of the benefits will have both reliability and efficiency benefits and have been described under the area of the largest benefit, but the benefit components have been separately allocated in later sections.

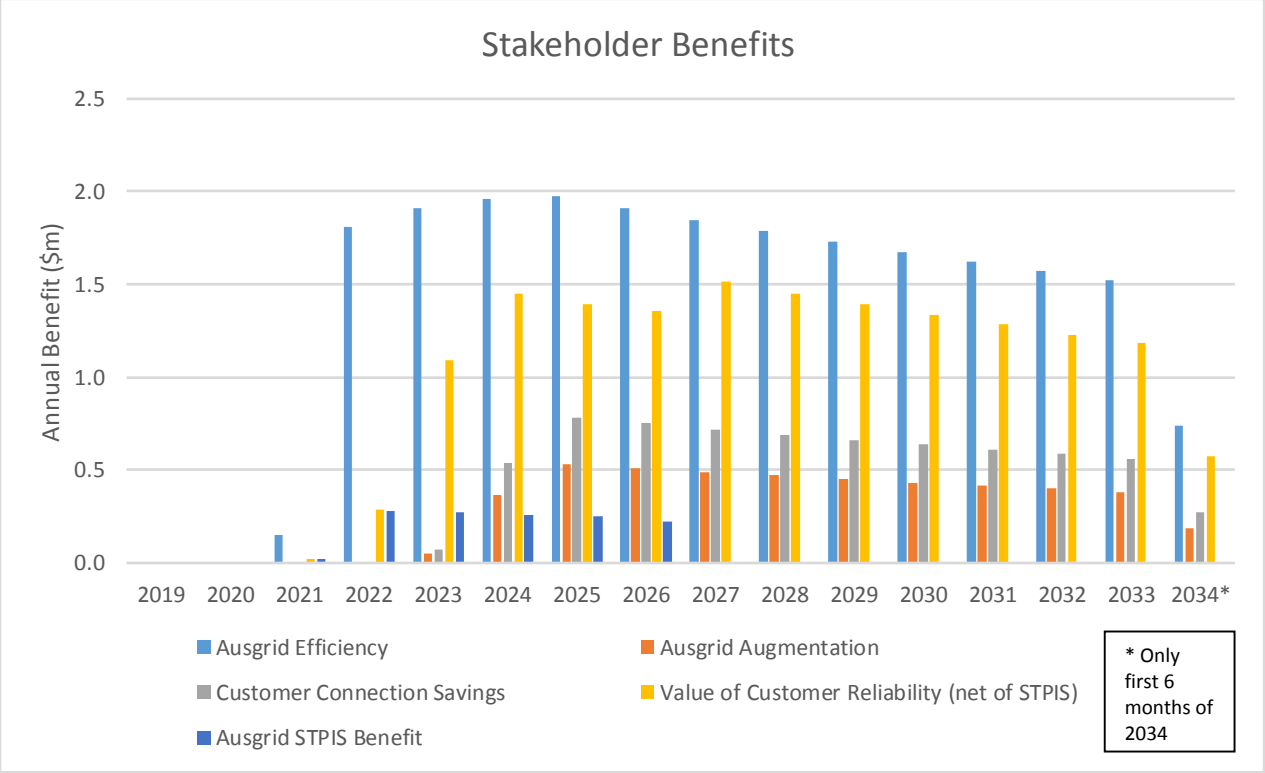
Table 4 - Value of Benefits for ADMS

Benefits	LFL (Option 3) ($M)	DMS (Option 4) ($M)	Part ADMS (Option 5) ($M)	Full ADMS (Option 6) ($M)
Time Saved in Writing/Checking Switching Instructions	-	$10.0	$10.0	$10.0
Grouping NARs and Reducing Job Cancellations	-	$2.4	$2.4	$3.3
Time Saving from use of a Single Data Model	$6.1	$6.1	$8.4	$8.4
Reduced Augmentation Capex Costs	-	-	$2.5	$4.7
Reduced Customer Cost of Connections	-	-	$3.6	$6.9
Faster Resolution of Complex Unplanned Outages	-	$3.0	$10.9	$10.9
Faster Resolution in a Storm of Complex Unplanned Outages	-	$1.5	$4.8	$4.8
Reduction in Number of Switching Errors	-	$1.8	$1.8	$1.8
Total	**$6.1**	**$24.8**	**$44.3**	**$50.6**

1.9 Allocation of Significant Benefits between Stakeholders

The allocation of the full ADMS option benefits between stakeholders is shown in Figure 1 below. There are significant benefits for both Ausgrid and also customers with improved reliability and connection cost savings.

Figure 1 - Stakeholder Benefits by Group



1.10 Efficiency Benefits

The main efficiency benefits assessed for the ADMS are shown in the chart below with a cumulative value of more than $22m for the Full ADMS over the project assessment period. The project assessment finishes in December 2034.

Figure 2 - NPV of Efficiency Benefits

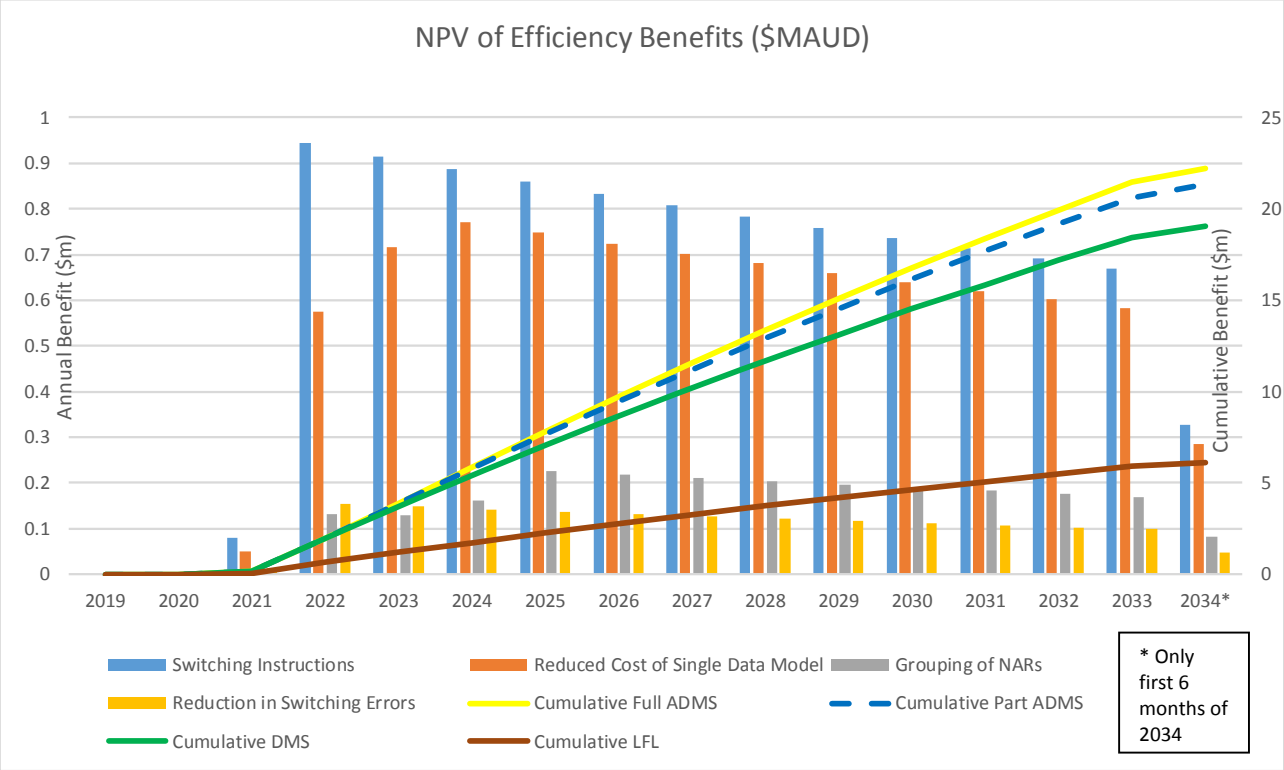


Table 5 - Efficiency Benefits

Efficiency Benefits	Description
Efficiency in Switching Instructions	Benefit is based on the adoption of detailed switching instructions in the Sydney Control Room. This change is required for safety and efficiency purposes and would be undertaken independent of the replacement of the DNMS. This benefit is the time saving in writing and checking detailed switching instructions compared to the business as usual option of continuing with the SRR.
Retirement of Satellite Systems	Benefit is primarily in the savings related to the legacy SRR and OMS systems. These satellite systems have vendor support and upgrade costs as well as internal support resources. Note: Whilst these savings are significant, they are reflected in the lifecycle costs of running the Outage Management series of systems and have therefore not been recorded separately as a benefit.
Reduced Costs of Single Data Model	Ausgrid operates three independent vendor systems, which all use a version of Ausgrid's network connectivity model. The quantified benefit claimed is the efficiency benefit of utilising a single data model. This delivers efficiency benefits in not having to maintain duplicate systems, and it allows ADMS (including OMS) to operate using the same network model. This will lead to additional efficiencies and safety benefits that have not yet been quantified.

Efficiency Benefits	Description
Improved Grouping of Network Access Requests (NARs) and Reduced Cancellations	The ADMS can be set up to include assessment of the potential for grouping of NARs (as well as for detecting potential clashes). There are two main benefits from each NAR that is avoided: 1) Efficiency saving from a single outage – There is a reduced cost when only running one NAR with the avoided administration cost of the NAR and fewer truck rolls, reduced field crew times, etc. 2) Reduced unserved energy – Customers will only have a single outage rather than two (or more) within a short period, and therefore have less unserved energy. Alongside the grouping of NARs there is the capability to reduce the number of cancelled jobs.
Reduction in the Number of Switching Errors	The automated writing and checking of switching instructions with the ADMS should lead to a reduction in the number of switching errors. The benefit is derived from three elements: • Reduced cost of investigating incidents; • Reduced damage caused by incidents; and • Reduced time off supply for customers impacted by incidents.

1.11 Reliability Benefits

An overview of the reliability benefits for the ADMS is shown in the chart below with a cumulative benefit of around $17m.

Figure 3 - NPV of Reliability Benefits

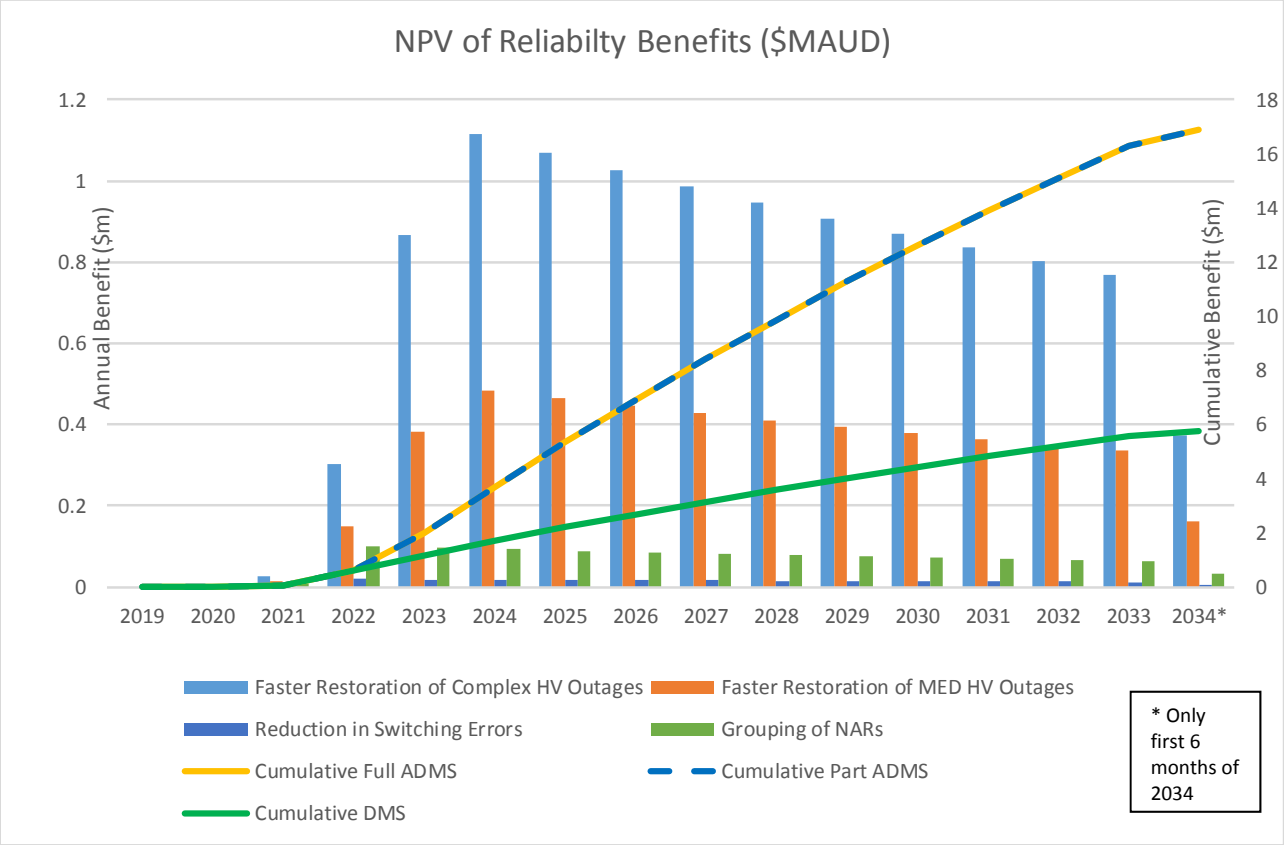


Table 6 - Reliability Benefits

Reliability Benefits	Description
Faster Restoration of Complex Unplanned HV Outages	This benefit consists of two features of the ADMS that allowed faster restoration of HV customers during a complex outage namely: • Faster development of switching plans – The switching management and network analysis applications would assist in the development of switching plans for complex outages. • Electronic (non-verbal) communication of unplanned switching instructions to field crews – This will include time currently taken to make phone calls to operators to run through the switching process and confirm what actions have been taken by field based operating staff.
Faster Restoration following a Storm Event	This benefit applies only on Major Event Days (MED) that were due to storms (i.e. excludes sub-transmission faults causing Major Event Days). It is similar to the complex unplanned outages, but the non-verbal communications benefit is assumed to apply to a greater number of customers.

1.12 Benefits in Avoiding Network Augmentation Costs

An overview of the benefits for avoiding augmentation is shown in the chart below with a cumulative value of $11.6m.

Figure 4 - NPV of Avoided Augmentation Benefits

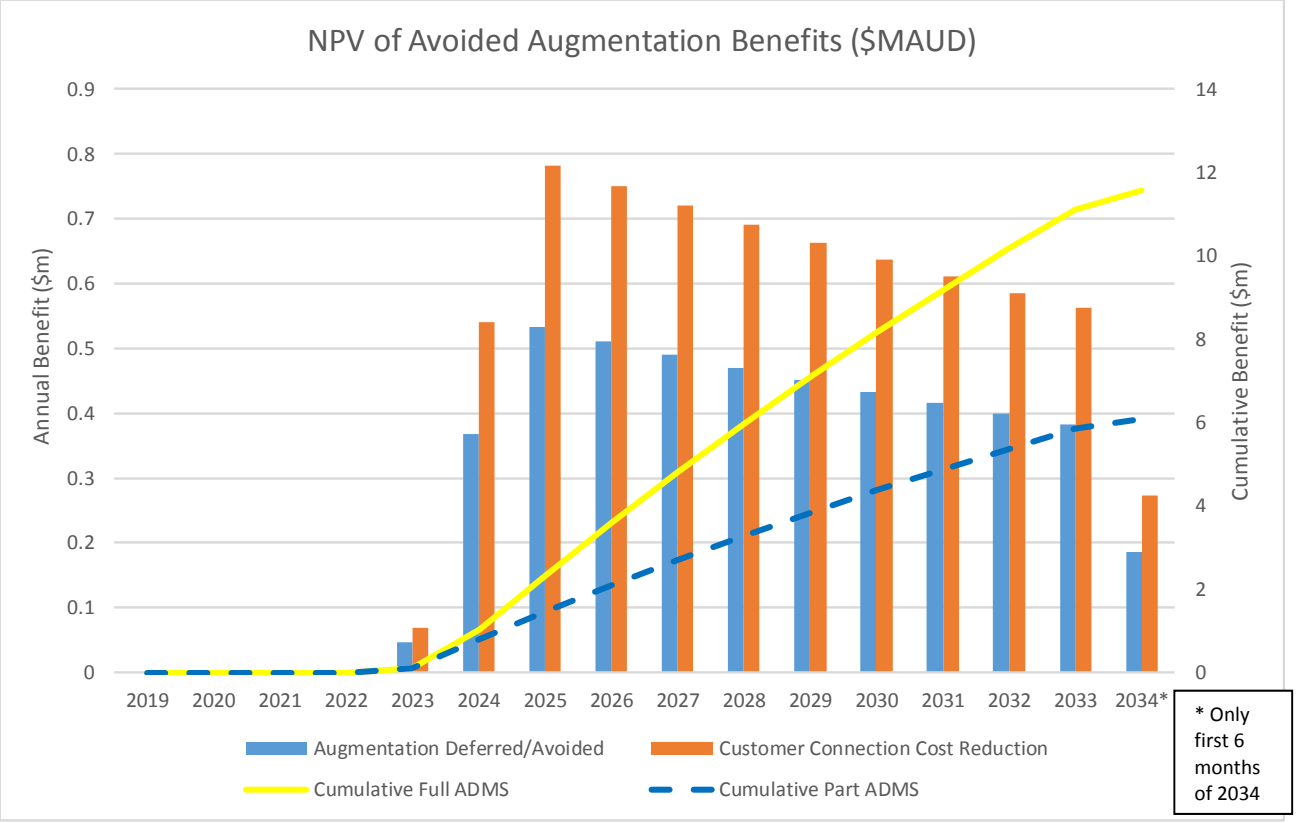


Table 7 - Avoiding Network Augmentation Costs Benefits

Avoiding Network Augmentation Costs Benefits	Description
Reduced Augmentation Capex	Several of the applications in ADMS provide Operators with more visibility and control of the network and the ability to run the network harder. Key modules are: • Power Flow Analysis; • Dynamic Ratings; • Load Forecasting; • Network Security Analysis; and • Volt-Var Control. The suite of advanced network analysis (DMS) applications would provide two benefits: • Avoidance of augmentation expenditure • Deferral of augmentation expenditure
Reduced Customer Connection Costs	Connecting customers are expected to fund more than $500m of connection costs directly attributable to them over the next regulatory period. Part of these costs will relate to network augmentation as capacity is not expected to be sufficient for the customer load or generation capacity. There are two benefits in which ADMS may assist in reducing these costs in the future: • The suite of network applications will provide more visibility and control of the network allowing Ausgrid to run the existing assets harder and to determine that more load/generation can be included without customer funded network augmentation cost. • The ability to control and curtail (rather than switch off) small scale generation may lead to avoided customer augmentation cost.

1.13 Qualitative Benefits of Full ADMS

The majority of quantified benefits are those that can be achieved with the functionality available with the DMS or Part ADMS. The Full ADMS, delivered by Phase 3 of the ADMS project, expands some of these benefits, but more importantly it provides a platform to manage increased levels of DER and the variable effects of unpredictable DER injections in addition to achieving improved network optimisation and reliability as more modern field or customer equipment is deployed.

Table 8 – Comparison of Qualitative Benefits of Part ADMS and Full ADMS Options

Option 5 - Partial ADMS	Option 6 – Full ADMS
Switching advisory capability	Fault Location Isolation and Supply Restoration (FLISR) - FLISR technology provides a centralised function that uses multiple telemetered and controllable devices, and other network state information, to determine the location of network faults, and to recommend (or issue) controls of switching devices to isolate faulted network and to restore as many customers as possible as quickly as possible. When used in an automatic mode FLISR will reduce the number of customers off supply by automatically isolating the area of the fault and restoring other customers to adjacent circuits. When used in an advisory mode FLISR will reduce the duration of interruption for a number of customers through the provision of recommended isolation and restoration switching steps. In both modes the technology will also assist in enabling crews to more rapidly identify the location of the fault. These 2 features should have a material impact on reliability. However, in addition to the ADMS, the functionality will require strategically placed field equipment like automated feeder switches and reclosers and telemetered line fault indicators to realise its full benefit.

Option 5 - Partial ADMS	Option 6 – Full ADMS
Voltage control and state estimation capability	Reduction in losses through running more of the sub-transmission network in parallel – Several of the ADMS Advanced Applications (Contingency Analysis and State Estimator) provide Ausgrid with a more accurate view of the network and the ability to gain a fuller understanding of potential events based on the current conditions on the network (rather than a worst-case scenario). This enhanced information should provide more certainty on when there is a need to radialise the network and when it can continue running in parallel, resulting in lower losses. Reduction in losses through improvement in distribution network Power Factor with controllable network/customer equipment – Losses on the network could be reduced by improving the power factor. This requires not only the ADMS, but also field/customer equipment that can be controlled. With increased communications it is expected that over time there will be more controllable network equipment or customer equipment with appropriate commercial agreements that the ADMS can control in areas of poor power factor and therefore reduce losses on the network. All loss reduction benefits will assist retailers, but it is hoped that the benefit would ultimately flow through to customers. Reduced damage and improved operation of customer equipment through voltage control – One of the issues with increased levels of solar generation is that voltage excursions on the network result in most current inverters tripping off once a pre-set voltage level is reached. This reduces the customers' generation, but likewise consistently running the device at high voltage before it trips could damage the equipment. Over time it is expected that more on-line tap changers and remotely controllable customer equipment will be available to the ADMS to assist in voltage management. However, it is unclear when this equipment will be available and/or the magnitude of the impact on customers equipment. Improved safety from increased skills of operators from the training simulator – With the training simulator it will be possible to expose all operators to the actual historical emergencies that have been experienced anywhere on the network. This compares to the current situation, where an individual operators' emergency experience is limited to that occurring on his/her shifts. All operators are therefore more likely to have been trained on all credible emergency events and be able to take the appropriate action to minimise risk to the public and Ausgrid personnel

Option 5 - Partial ADMS	Option 6 – Full ADMS
Distributed Energy Resource Management System (DERMS) capability – Basic embedded generation model capability	The Full ADMS will provide a platform for the introduction of the DERMS module currently being developed by the selected Vendor. This has not been included due to lack of definitive cost forecast to implement, but is expected to provide 3 main benefits namely: • Short Term Forecasting – More sophisticated and accurate short-term forecasting of intermittent generation (using cloud cover projections, wind forecasts etc) and other input parameters to assist in network operations in response to varying conditions • Visibility of Network Impacts - Monitoring large DER in real time and modelling it with power flow solutions to assess the impact of likely injections on voltage levels and power flows on the network to determine actions in conjunction with control to optimise the utilisation of renewable energy resources • Control of DER – Either large individual DER or smaller equipment via an aggregator could be controlled by the ADMS and assist in managing the network and to facilitate energy trading at a distribution network level. With the continued emergence of disruptive technology this list only represents a subset of the benefits that may exist with the enhanced visibility and control from a Full ADMS. Continued review during the FY20–24 period and use of the network Innovation Advisory Committee to assess and advise on the implementation timing and customer value. These tools will be required to manage the operation of the network in the future and minimise the cost to customers and enable a significantly higher take-up and use of DER, such as solar generation, energy storage and electric vehicles.

The project business case provides detailed analysis of the viable options for replacement of the existing DNMS. The assessment of these options determined the preferred approach to be the implementation of Option 6 – Full ADMS replacing the existing legacy systems. The implementation of a full ADMS will deliver:

- A reduction in the risks of a non-compliance with Ausgrid's license conditions;
- Alignment to industry trends, as identified in the ENA ENTR Roadmap;
- Strong vendor roadmaps aligned with industry trends;
- Long-term solution with a supported platform;
- Reduced support costs and platform risks through a standard implementation;
- Increased cyber security and ability to detect and respond to threats;
- Enhanced business and systems capabilities, including the ability to monitor and detect operational issues;
- Improvements in safety, quality and reliability of the network; and
- Opportunities to reduce operational expenditure in the longer term with more efficient processes and technology.

Furthermore, the ADMS project will:

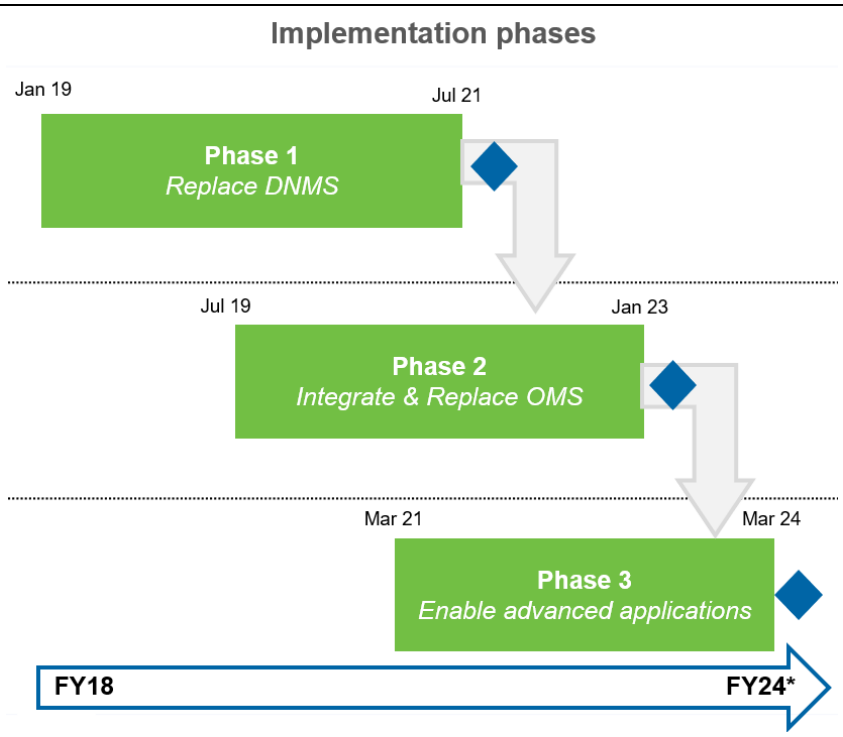
- Significantly reduce the time required to meet minimum industry standards and the risk of non-compliance with Ausgrid's Critical Infrastructure license conditions;
- Mitigates the need and associated risks (timing and costs) with uplifting existing system to minimum modern standards;

- Reduces the risk of catastrophic failure of applications due to the limited support of Ausgrid's current bespoke DNMS;
- Removes the current limited functionality of the DNMS, including the lack of switching Management functionality and integration between OMS and DNMS functions; and
- Ensure that Ausgrid's has a reduced risk of a compromised ability to monitor and detect operational issues with the DNMS network and application and increased risk of successful cyber-attack due to the inability to apply remedies to newly discovered security issues.

ADMS Implementation Plan

The ADMS implementation has been planned in conjunction with the preferred vendor to reduce execution complexity and therefore delivery risk. Three phases of work have been identified, with the high-level objectives of each phase described in Table 9.

Table 9 - ADMS Project Phasing



Phase	Description and Key Outcomes
1	Replacement of DNMS • Deliver core, mission-critical monitoring and control functionality (SCADA) • Switching management and switch planning processes digitalised & automated in ADMS • Digital drafting and execution of switching instructions • Sub/T network security analysis (potentially Phase 2)
2	Replacement of Outage Management System (OMS) and satellite systems with load analysis • Digitalisation of the Network Access Request process • Fully integrated Outage Management • Non-verbal communications between control room and field operators • ADMS enabling automatic National Energy Customer Framework (NECF) breach detection

3	Enablement of Advance Applications Capability • Automated fault detection and Isolation Restoration and advanced applications to enhance the optimisation of the network, e.g. Distribution Energy Resource Management, Dynamic loads and ratings enabled • Advanced applications in place to enhance optimisation of the network • Enhanced Training Environment (training simulator) established • System alignment to vendor baseline roadmap including Ausgrid specific enhancements from Phase 1 and 2 implemented into baseline ADMS product.

The ADMS program has conducted a detailed pre-implementation phase which has considered full program preparation, technical and business integration preparation, including data integrity, alignment and remediation activities; and a full vendor selection procurement process and appropriate due diligence activities. This approach was taken to mitigate the potential of a poorly understood and planned implementation from insufficient early planning. A risk and complexity assessment has been conducted with the outputs included in the overall risk management activity for implementation.

As part of the pre-implementation planning for the ADMS project, extensive due-diligence works has been undertaken in the following key areas:

- External procurement probity review;
- Security architecture review;
- External legal advice on ADMS Vendor contract;
- External review of the ADMS business case conducted by Ernst & Young; and
- Detailed engagement with relevant Commonwealth agencies

During the detailed engagements with relevant Commonwealth Departments, the Commonwealth have stated their support for the full domestic implementation of the ADMS to deliver improved security outcomes as well as a more effective delivery of the services.

Given Ausgrid's Critical Infrastructure Licence Conditions and placement on the register of Australia's Critical Infrastructure Assets, it is required to ensure its data security obligations are being met in alignment with discussions with relevant Commonwealth Departments. This is an enduring obligation with which Ausgrid must comply during both the implementation of the ADMS system, as well as during its ongoing support and maintenance.

1.14 Option Modelling Outcomes

The modelling assessment reviewed all options to assess the present value of net economic benefit to all those who produce, consume and transport electricity in the NEM.

The summary NPV of each option is a comparison against the Base Case of continuing with the current DNMS and is focused only on the quantified benefits. There are many operational issues with the DNMS, and additional qualitative benefits for the Full ADMS, however these items have not been assessed for the purpose of this quantitative assessment.

The modelling included sensitivity analysis, which demonstrated that no individual parameters would result in the NPV for the Full ADMS option not being positive.

Table 10 - Summary Costs and Benefits of Options ($M)

Costs/Benefits	Current DNMS (Option 1) ($M)	Cont DNMS (Option 2) ($M)	LFL (Option 3) ($M)	DMS (Option 4) ($M)	Part ADMS (Option 5) ($M)	Full ADMS (Option 6) ($M)
Costs	$77.9	$102.9	$83.9	$89.7	$96.1	$105.8
Benefits	$0	$0	$6.1	$24.8	$44.3	$50.6
Net Present Cost	$77.9	$102.9	$77.8	$64.9	$51.8	$55.1
NPV against Base Option	**$0**	**-$24.9**	**$0.1**	**$13.0**	**$26.1**	**$22.8**

The implementation of a full ADMS solution addresses existing and future system needs and risks as well as providing a platform that will support Ausgrid's ability to meet changing customer and network needs into the future. The full ADMS solution provides the most benefits to customers assessed over a 15 year period when considering the quantified and qualitative benefits.

The modelling summary shown in Table 10 shows the cost, benefits, Net Present Cost and NPV for each option against the Base option. The details in this table are modelled based on:

- ADMS capex implementation costs
- Opex implementation costs for the lifecycle assessment period (15 years) – for the Full ADMS option which totals approximately $23m of operating expenditure.

Further supporting evidence associated with this program can be found in the following attachments:

- ADMS business case (5.13.N.1);
- Independent review of the ADMS business case (5.13.N.2);
- Letter from Australian Government – Department of Home Affairs (5.13.N.3);
- Recommendation to award ADMS contract (5.13.N.4);
- ADMS business case model (5.13.N.5);
- DGA consulting business case approach (5.13.N.6);
- ADMS master agreement legal sign-off (5.13.N.7); and
- ADMS procurement probity report (5.13.N.8).

1.15 Forecast

Table 1. Advanced Distribution Management System ($,000s)

Program	2020	2021	2022	2023	2024	Total FY20-24
OTI_03.15	$14,696	$15,725	$16,121	$12,062	$1,242	$59,847

1.16 Appendix 1 – Option Details

A detailed option review considered six options as part of the planning and business case development. Ausgrid considered a range of options which included consideration of two options to allow Ausgrid to continue its control room operations utilising the current DNMS:

- **Continuing with current DNMS** (Option 1)
- **Contemporising the DNMS** (Option 2)

A review of the risks of continuing with or contemporising the DNMS against the risks of implementing a modern system indicates that these two options are much higher risk for Ausgrid to pursue and not in the long-term interest of customers. These options are also likely to fail to comply with the Capital Expenditure Objective and Capital Expenditure Criteria.

The high level of risk to implement these options means continuing with either DNMS option is not viewed as credible options.

Four additional options implementing a modern network control system were considered. These included:

- **Like-for-Like** (Option 3) - A Like-for-Like (LFL) replacement using a modern platform sourced from a mainstream SCADA/DMS or ADMS vendor to provide the current DNMS functionality;
- **DMS** (Option 4) – This is first phase of an ADMS solution including key functionality such as Switching Management;
- **Part ADMS** (Option 5) – This solution builds on the DMS and includes an integrated OMS as part of the ADMS solution and represents the first 2 phases of the ADMS Project; and
- **Full ADMS solution** (Option 6) – This solution builds on the Part ADMS and completes the ADMS by enabling the advanced applications within the solution

All options are based on delivery of Commercial Off The Shelf (COTS) software. A modern ADMS solution provides functionality that that is fundamentally embedded in the unified product suite. Consequently, ADMS options were not developed based on an incremental implementation of specific functionality but on the basis of the phases in Ausgrid's implementation plan which provides logical breakpoints.

A summary and review of all options is provided below. As Option 1 is the current business as usual position it is adopted as a base case for review against all other options.

Option 1 – Continuing with the current DNMS – "Do Nothing"

The "Do Nothing" option has been assessed as non-credible. A "Do Nothing" scenario leads to escalating costs and risks associated with operating a legacy control system without appropriate vendor support. This option would result in unacceptable security and compliance risks, embeds operational inefficiencies and does not deliver the service capability that our customers and stakeholders in the transforming electricity market expect us to provide.

With the age of the system increasing, and declining vendor support it is likely that the level of system reliability will decrease. This will have adverse impacts on the visibility and control for operators of the network, which in turn is likely to lead to an adverse impact on network reliability, performance and potentially safety.

This solution is unable to meet ongoing requirements with regards to Ausgrid's critical infrastructure licence conditions. Condition 9 of Ausgrid's critical infrastructure licence conditions requires Ausgrid to follow best industry practice for its control system environment including support, access and security (including cyber security). The vendor supporting the current system has advised Ausgrid that they regard the DNMS as a legacy 'Beta' product and this places hard constraints on what can be achieved. There are no expectations that the current DNMS can enable Ausgrid to continue to achieve full compliance as required by our obligations. The support model for the DNMS determines a practical end of support and life for the DNMS in 2021.

Option 2 – Develop and Contemporise DNMS to minimum Industry Standards

This option considered the scenario of retaining the current DNMS and other associated bespoke legacy systems that support the control system environment. The scope of this scenario is to:

- Undertake significant updates to the DNMS to achieve a modern supported operating system and platform environment;
- Undertake significant updates to the DNMS to incorporate minimum modern cyber security architecture and security controls to meet basic industry best practices for control system environments; and
- Establish minimum appropriate sustainable system support and maintenance arrangements for the existing DNMS code base, including associated bespoke legacy systems.

This option excludes enhancements of the DNMS to:

- Develop further core functionality to align with industry trends, as identified in the ENA ENTR Roadmap;
- Enable enhanced business and systems capabilities, including the ability to monitor and detect operational issues;
- Consolidate other systems that support the control system environment; and
- Implement opportunities to reduce operational expenditure in the long term with more efficient processes and technology.

A review of the risks of contemporising the DNMS against a modern system indicates that this option is a much higher risk option for Ausgrid to pursue with limited benefits. The high level of risk means continuing with the develop and contemporise DNMS to minimum Industry Standard option is not viewed as credible.

Option 3 - Like-for-Like Replacement

This scenario assessed the option to replace the DNMS with a modern platform sourced from a mainstream SCADA/DMS or ADMS vendor to provide only the same functionality as the current DNMS. As a feature of all modern systems, the solution would support the latest cyber security features and would be more reliable. It would also have on-going support from the system vendor with the capability for enhancements with additional modules of the product in the future. This includes the ability to develop a DER module and other supporting functionality (e.g load flow) once the level of DER penetration requires additional visibility and control.

The project scope for the Like-for-Like replacement maintains the same functionality in satellite systems with no material changes to their functionality.

Option 4 – Distribution Management System (DMS)

This extends the Like-for-Like replacement solution and includes key functionality such as Control Room switching management to deliver additional benefits to customers and to Ausgrid. As well as the core monitoring and control functionality, this option delivers:

- Integrated Switching Management and support for the broader switch planning process;
- Digital drafting and execution of switching instructions, eliminating paper based processes; and
- Sub-transmission network modelling real-time network security analysis.

Option 5 – Partial ADMS

This solution builds on the DMS option with a second phase of the project to replace the existing OMS using the embedded OMS extensions within the ADMS product. The option delivers in addition to the DMS option:

- Fully-integrated outage management;
- Embedded digitalisation of the processes used in requesting access to the network for planned work;
- Run-time network security analysis undertaken by operators;
- Non-verbal communications from field deployment of relevant ADMS functionality between control room operators and field operators; and
- Automatic National Energy Customer Framework (NECF) breach detection.

Both the OMS and the power flow analysis tools available in this phase of the modelling will provide material benefits to both Customers and Ausgrid and will eliminate the need for new system interfaces.

Option 6 – Full ADMS

This option replaces Ausgrid's DNMS and other supporting legacy systems within the control system environment with a commercially available off the shelf ADMS product.

This scenario enables the simplification and modernisation of the Operational Technology and control system environment to comply with regulatory obligations, including management of escalating cyber security threats to critical infrastructure as required by our Distribution Licence Conditions and anticipated federal legislative requirements.

This scenario enables Ausgrid to:

- Streamline & standardise processes to achieve industry best practice processes;
- Align data between corporate and operational systems to maximise operational and capital delivery efficiencies; and
- Implement an adaptable platform with advanced capability to support the needs of a rapidly changing network and customer technology landscape as expected from our stakeholders including capability such as:
    - Dynamic loads and ratings enabling more efficient utilisation of the network;
    - Advanced applications to enhance optimisation of the network including automated fault detection, isolation and restoration capability (with advanced load flow analysis); and
    - Enhanced Training Environment (Operator Training Simulator).

1.17 Appendix 2 – Procurement Process

Ausgrid has been planning to replace components of its current operational technology infrastructure since 2016. This included a significant pre-implementation phase, which began in June 2017.

The pre-implementation phase of the DMS replacement project is aimed at:

- Conducting a robust requirement driven procurement process to recommend a suitable vendor (i.e. the Preferred Vendor – or 'PV');
- Completing the documentation of the current 'as-is' business processes;
- Undertaking core preparatory tasks to enable Ausgrid to be able to accept an ADMS (e.g. data alignment activities); and
- Refining and reducing assumptions and 'unknowns' with vendors regarding the implementation costs and risks of an ADMS.

In June and July 2017, Ausgrid undertook a substantive scoping exercise of the requirements for a replacement system, which culminated in a Pre-Qualification Questionnaire (PQQ). This engagement with the market was a closed tender process commencing with six vendors (all with a local Australian presence).

All six vendors were assessed/evaluated at this stage and Ausgrid down-selected to three potential vendors to progress to a Proof of Concept (PoC) and Initial Solution Plan and Offer (ISPO) stages over November to December 2017.

In January 2018, Ausgrid assessed/evaluated both PoC & ISPO material provided by vendors to-date and down-selected the potential vendors list to two vendors.

Ausgrid then conducted a week-long Joint Solution Design (JSD) workshop with each of these two vendors and supported the two work-streams of Business Integration and Technical Integration Support.

The JSD achieved:

- Confirmation of capability to meet required functionality – the JSDs generated broad confidence that both solutions could largely fulfil Ausgrid's functional requirements;
- Reduction of 'submission' risk – the risks to which both Ausgrid and the vendors would have been exposed on the basis of written tender submissions was significantly reduced during the JSD stage (this assertion is supported by both vendors); and
- Exposure to each vendors' 'way-of-doing business' – the program and broader Ausgrid teams were also exposed to the culture and way-of-doing-business of each vendor, which can only effectively be understood in a face-to-face environment.

Following the JSD, both vendors submitted a Final Solution Plan and Offer (FSPO), which is a refined ISPO by the vendors based on the JSD sessions. This allowed vendors to remove assumptions and any identified risks. Both vendors committed to almost full compliance with Ausgrid's requirements with no material non-compliances identified.

This market engagement process to refine the vendors' proposals in a collaborative manner resulted in a refined and de-risked proposal from the vendors removing core assumptions for both parties and enabling the forecast project costs to be further refined

Following receipt of the FSPO's, Ausgrid reviewed each submission and conducted a further risk-based assessment. This resulted in Ausgrid selecting a Preferred Vendor (PV) and a Held Vendor (HV). Detailed negotiations were undertaken with the Preferred Vendor including:

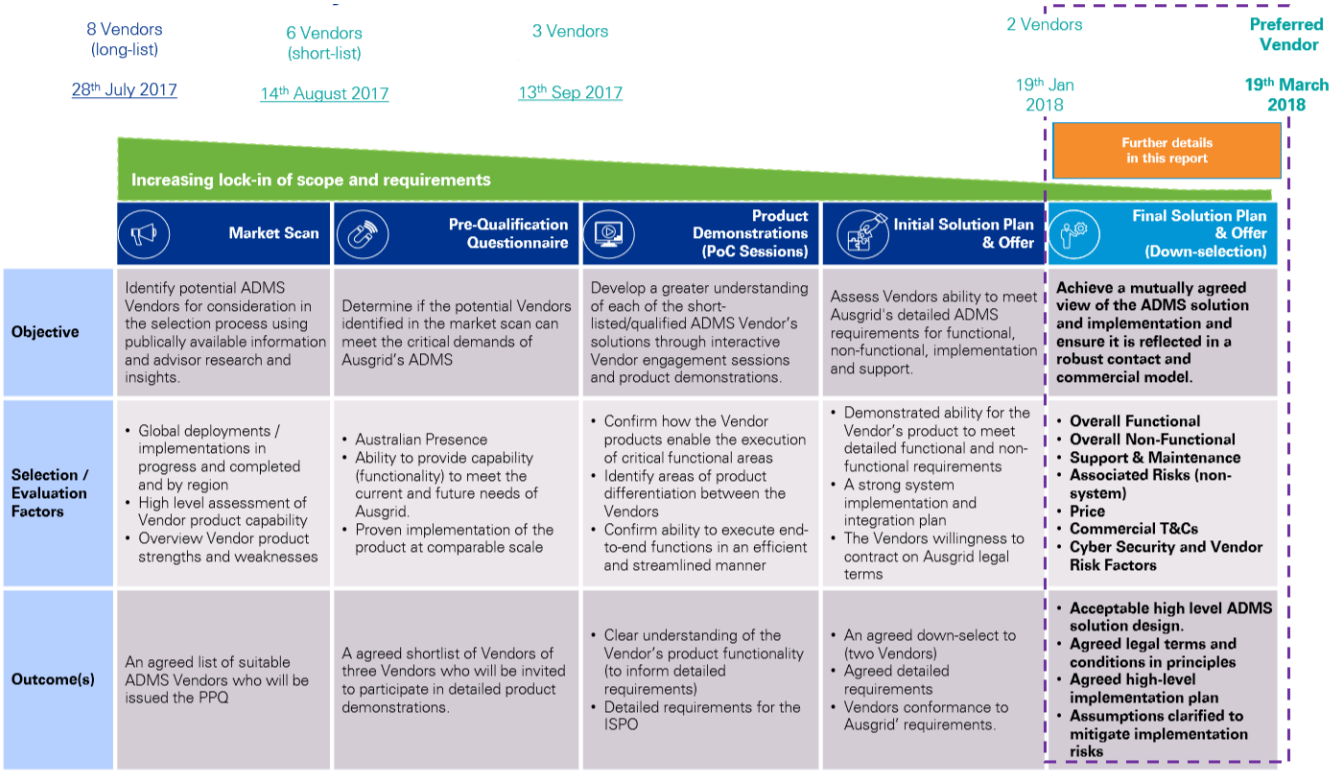
- A negotiation process to address all T&C issues, and any points of clarification; and
- An Initial Solution Design activity (ISD).

If issues had arisen with the PV which Ausgrid considered material and insurmountable, Ausgrid had retained the option to reverse its PV/HV decision, re-engage with the HV, and commence an ISD activity with the HV. However, the PV Initial Solution Design and negotiations aligned with Ausgrid's requirements and this step was not necessary.

The ISD activity focused on developing the program documents, which supported the Ausgrid ADMS business case. This includes the Statement of Works and the required underpinning documentation, which have been subsequently be contractually formalised as schedules.

A summary of the pre-implementation process is summarised below in Figure 5.

Figure 5 - Summary of Pre-implementation Stages



The selection process was collaboratively driven by the ADMS project team & was audited and approved by Probity Auditors of OCM.