DGA Consulting

Independent Review of System Security Roadmap Operational Technology Upgrade Costs – Contingent Project Application

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1. Executive Summary

1.1. Background and Assessment Scope

The electricity network in NSW is undergoing significant transformation which presents complex operational challenges for Transgrid, the owner and operator of the NSW/ACT transmission network. Without intervention, the increasing complexity may lead to more frequent binding of constraints on power system operations in NSW and a higher likelihood of outages with Unserved Energy.

This report provides an independent assessment of the System Security Roadmap Operational Technology Upgrade Capital and Operating costs, delivery schedule and risks as presented for the Contingent Project Application. The assessment considers the reasonableness of the schedule, the approach and the cost for the single integrated program being proposed by Transgrid. This report does not assess the financial models presented in the Contingent Project Application.

1.2. DGA Experience and Approach

DGA Consulting (DGA) is a specialist Power System Operations, Operational Technology (OT) and management consulting company. Our key differentiator the depth of subject matter expertise in Supervisory Control and Data Acquisition (SCADA), Energy Management Systems (EMS), Generation Management Systems (GMS), Advanced Distribution Management Systems (ADMS), Utility Control rooms and power system operations.

DGA's assessment has relied upon information provided by Transgrid, the System Integrator (SI) respondents and Transgrid's current SCADA/EMS vendor, General Electric Vernova (GEV), as well as knowledge derived from the DGA Consultants' expertise and experience in EMS and Operational Technology Projects worldwide. The provided information was supplemented by an interactive process of discovery with Transgrid's representative and the SIs.

DGA's experience with and recorded/unrecorded knowledge of other EMS/OT projects, and the individual knowledge of the consultants performing the assignment, formed the basis of DGA's assessment. This collective experience covers over 4 decades of detailed involvement with the specification, procurement and implementation of complex OT projects, covering SCADA/EMS deliveries from all major suppliers into Australia, New Zealand and SE Asia, plus associated projects involving enterprise network model management systems. This included roles in over 20 SCADA/EMS projects, covering a period from the late 1970s to the current day. An overview of some of the recent assignments is provided in Appendix A.

In making our assessment, DGA have considered the scope and constraints of the project being implemented by Transgrid. Some of these scope elements and constraints are different from other EMS/OT projects, and this has been considered in undertaking our review of the expected schedule and costs.

1.3. DGA's Review Framework

DGA has applied a review framework to the Integrated Program to facilitate our bottom-up understanding of the reasonableness of the individual project schedules and costs. This approach groups projects into several areas to allow comparison with other implementations DGA have observed. Whilst the grouping assists with DGA's assessment, the review is undertaken on the

basis that the whole program is delivered. An overview of this review framework is shown in the diagram below.

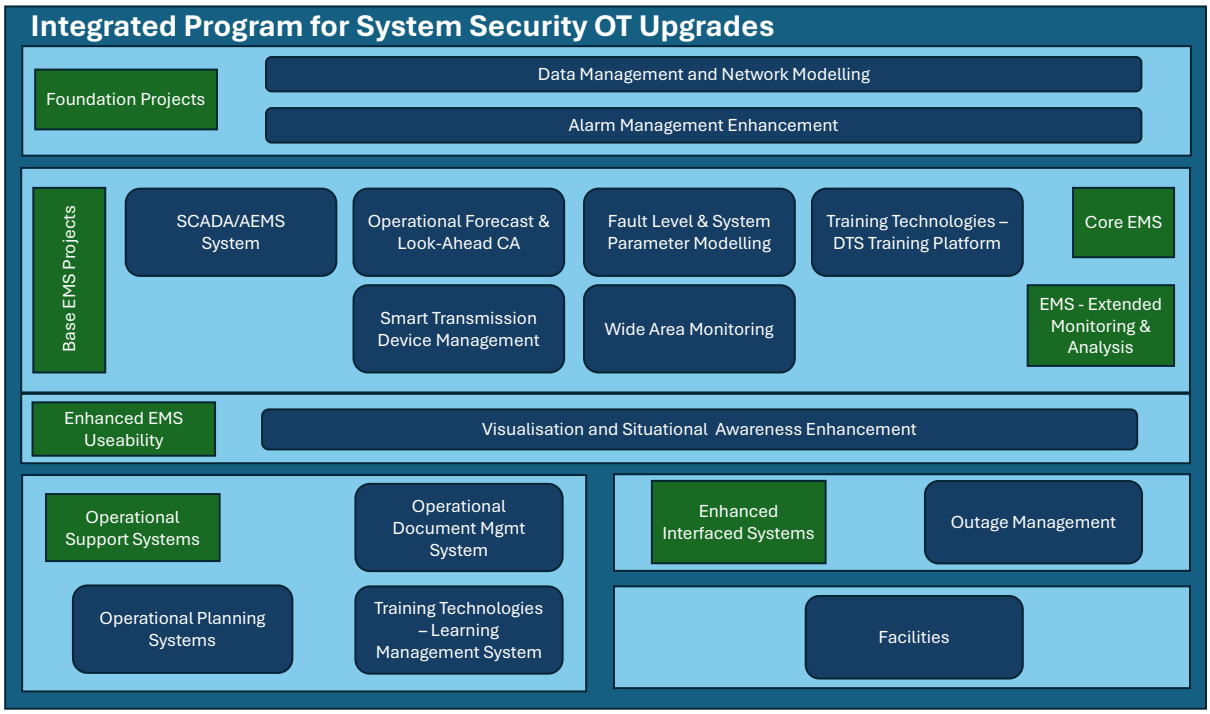

Figure 1 Overview of DGA Review Approach to System Security Roadmap Projects

1.4. Review of Project Delivery Approach and Schedule

Transgrid are applying a practical approach using a SI model for the delivery of a single integrated program. The SI approach optimises the delivery schedule by leveraging external experience and resourcing to partner with Transgrid's relatively small operational teams. An important benefit is that it provides a single contracting entity that can be held responsible for delivery of the program including any sub-contractors. Managing multiple contracts with multiple suppliers is not recommended due to the risk of introducing technology gaps that would not deliver the full functionality and/or timely completion with a potential conflict around responsibility.

The project timescales and sequencing have been reviewed with respect to their potential impact on the project costs and this is shown in the chart below. DGA support the approach of a phased program delivery as this is more achievable, realises earlier benefits and is lower risk than a single "big bang" delivery for the full integrated program. DGA has reviewed each of the individual project durations as well as the project scheduling and relationship between projects and considers this to be an efficient timeline for delivering this integrated single technology program.

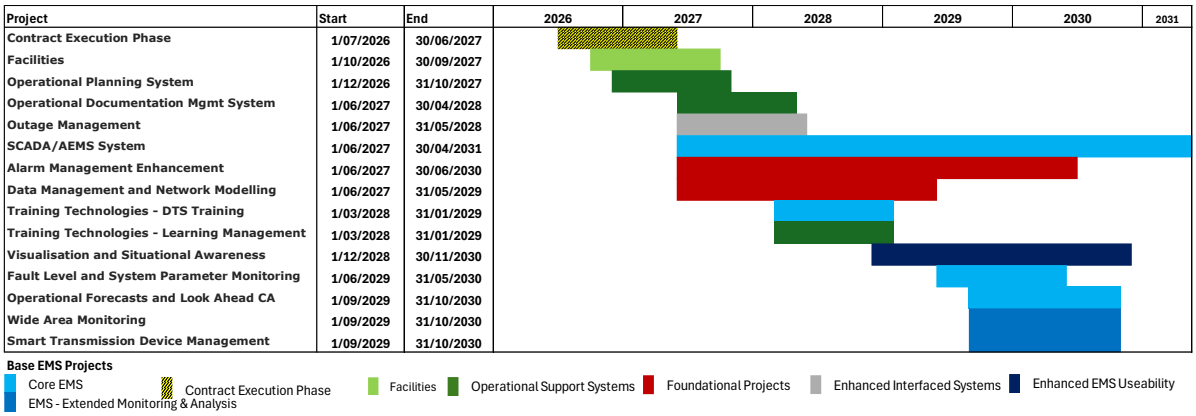

Figure 2 Project Timeline for Contingent Project Application

1.5. Review of Capital Costs

The capital costs for the projects are shown in the table below and excludes assessment of the actual cost incurred to date for Early Works.

Cost Category	Cost ($2024/25)	Explanation
SI Costs	98.0m	This is the SIs costs needed to deliver the suite of project after Transgrid adjustments. This includes all the GEV costs.
Internal Costs[1]	$49.0m	This is the sum of labour, equipment and materials cost including already expended cost for alarms. It includes external costs for facilities and allowance for custom code changes.
Contingency (P50 Confidence Level)	$16.5m	SI and internal costs were calculated without contingency for risks. This contingency provides for a 50% probability of the total project cost not being exceeded based on Transgrid's review of identified risks.
CPA Costs[2]	$6.1m	Costs for undertaking the RIT-T and preparing the CPA submission.
Total Project Cost	$169.6m[3]	

Table 1 Capital Costs

[1] This includes all costs not incurred via the SI. It includes some requirements that are externally procured.
[2] DGA have noted the inclusion of CPA costs but not reviewed this cost item. This is a sunk cost and should not impact any decision on how to proceed with this investment.
[3] DGA are aware there is a small difference between the capex costs reviewed of $169.6m and the CPA modelling of $172.5m. This is primarily driven by changes in the assumed hours worked by Transgrid's provided labour along with several smaller adjustments. Given the magnitude of the difference (less than 2%) this will not materially impact any of the conclusions reached in this report. DGA have assessed the line items that make up the cost estimates and notes that Transgrid has transposed these costs into the CPA along with the small difference of $2.9m.

DGA has reviewed the proposed capital cost estimates for the program and considers them to represent an efficient and reasonable level of expenditure to deliver the proposed capability. The estimates appropriately reflect the scope, timetable constraints, and resource availability, including the necessary use of SI services to achieve the required outcomes. DGA supports the capital cost estimates as a sound basis for delivery of the proposed scope.

1.6. Review of Opex and Refresh Costs

DGA has reviewed the operating expenditure and refresh cost estimates and considers them to be reasonable and appropriate for ongoing operation of the enhanced capability.

The estimates reflect the costs associated with system licensing, support arrangements, and the additional operational resources required to sustain improved functionality. Overall, DGA supports the opex and refresh costs as a credible and proportionate representation of the expected costs of operating and maintaining the proposed solution.

2. Background and Project Scope

2.1. Background

The electricity network in NSW is undergoing transformation, transitioning from a few large thermal generators to numerous small distributed generator connections and storage resources. This shift presents complex operational challenges for Transgrid, the owner and operator of the NSW/ACT transmission network. Without intervention, the increasing complexity may lead to more frequent binding of constraints on power system operations in NSW and a higher likelihood of outages with Unserved Energy.

This report provides an independent assessment of the System Security Roadmap Operational Technology Upgrade Capital and Operating costs, delivery schedule and risks as presented for the Contingent Project Application. The assessment considers the reasonableness of the schedule, approach and cost for the single integrated program being proposed by Transgrid. This report does not assess the financial models presented in the Contingent Project Application.

2.2. Scope of work

The scope of this assessment is to provide an independent review of the costs (Capex and Opex) for the project. The cost review includes a review of the schedule, risks and delivery approach for the project.

2.3. DGA Experience

DGA Consulting (DGA) is a specialist Power System Operations, Operational Technology (OT) and management consulting company. Our key differentiator is the depth of subject matter expertise in SCADA, EMS, GMS, ADMS, Utility Control rooms and power system operations. DGA applies this knowledge with proven consulting skills to advise electricity and gas companies on the best use of these operational technologies with projects throughout Australia and in South-East Asia.

Examples assignments for the Consultants engaged for this project are shown in the table in Appendix A.

2.4. DGA Consulting Approach

DGA's assessment has relied upon information provided by Transgrid, the SIs and GEV, as well as knowledge derived from the DGA Consultants' expertise and experience in EMS and Operational Technology Projects worldwide. The provided information was supplemented by a process of discovery with Transgrid's representative and the SIs.

DGA's experience with and recorded/unrecorded knowledge of other EMS/OT projects and the individual knowledge of the consultants performing the assignment formed the basis of DGA's assessment. This collective experience covers over 4 decades of detailed involvement with the specification, procurement and implementation of complex OT projects, covering SCADA/EMS deliveries from all major suppliers into Australia, New Zealand and SE Asia, plus associated projects involving enterprise network model management systems. This included roles in over 20 SCADA/EMS projects, covering a period from the late 1970s to the current day.

In making our assessment, DGA have considered the scope and constraints of the project being implemented by Transgrid. Some of these scope elements and constraints are different from other EMS/OT projects, and this has been considered in undertaking our review of the expected costs.

3. Project Scope, Timeline and Cost

3.1. Scope of the Project

The scope of the System Security Roadmap Operational Technology Upgrade Project review covered an integrated program of initiatives listed below. Some of these initiatives are split into more than one project in the assessment.

- Outage management
- Alarm Management, Visualisation and situational awareness enhancement
- Fault level and system parameter monitoring and power system analysis capability
- SCADA/AEMS system
- Facilities
- Data management and network modelling system
- Training technologies, operational documentation management system and operational planning systems
- Operational forecasts and look-ahead contingency assessment
- Wide area monitoring
- Smart transmission device management

3.2. Project Timeline

The project timeline for each of the projects is shown in the table below

Project	Start	End	Duration (months)
Contract execution phase	01/07/2026	31/05/2027	11
Facilities	01/10/2026	30/09/2027	12
Operational planning systems	01/12/2026	31/10/2027	11
Outage management	01/06/2027	31/05/2028	12
Operational documentation management system	01/06/2027	30/04/2028	11
Data management and network modelling system	01/06/2027	31/05/2029	24
Alarm management enhancement	01/06/2027	30/06/2030	37
SCADA/AEMS system	01/06/2027	30/04/2031	47
Training technologies	01/03/2028	31/01/2029	11
Visualisation and situational awareness enhancement	01/12/2028	30/11/2030	24
Fault level and system parameter monitoring and power system analysis capability	01/06/2029	31/05/2030	12
Operational forecasts and look-ahead contingency assessment	01/09/2029	31/10/2030	14
Wide area monitoring	01/09/2029	31/10/2030	14
Smart transmission device management	01/09/2029	31/10/2030	14

Table 2 Timeline by Project

3.3. Project Capex Costs

The Project cost reviewed were from 'SSR Operational Technology Upgrade CPA cost inputs –v1.0. These costs are all in real 24/25 dollars.

A summary of these Project capex costs is shown in the table below. This excludes assessment of the actual cost incurred to date for Early Works.

Cost Category	Cost ($2024/25)	Explanation
SI Costs	$98.0m	This is the SIs costs needed to deliver the suite of project after Transgrid adjustments. This includes all the GEV costs.
Internal Costs[4]	$49.0m	This is the sum of labour, equipment and materials cost including already expended cost for alarms. It includes external costs for facilities and allowance for custom code changes.
Contingency (P50 Confidence Level)	$16.5m	SI and internal costs were calculated without contingency for risks. This contingency provides for a 50% probability of the total project cost not being exceeded based on Transgrid's review of identified risks.
CPA Costs[5]	$6.1m	Costs for undertaking the RIT-T and preparing the CPA submission.
Total Project Cost	$169.6m	DGA are aware there is a small difference between the capex costs reviewed of $169.6m and the CPA modelling of $172.5m. This is primarily driven by changes in the assumed hours worked by Transgrid's provided labour along with several smaller adjustments. Given the magnitude of the difference (less than 2%) this will not materially impact any of the conclusions reached in this report.

Table 3 Capex Costs

[4] This includes all costs not incurred via the SI. It includes some requirements that may be externally procured.
[5] DGA have noted the inclusion of CPA costs but not reviewed this cost item. This is a sunk cost and should not impact any decision on how to proceed with this investment.

4. DGA Review Approach

4.1. Overview of DGA's Review Framework

DGA has applied a review framework to the Integrated Program to facilitate our understanding of the reasonableness of the individual project schedules and costs. This approach groups projects into several areas to allow comparison with other implementations DGA have observed. Whilst the grouping assists with DGA's assessment, the review is undertaken on the basis that the whole program is delivered. An overview of this review framework is shown in the diagram below.

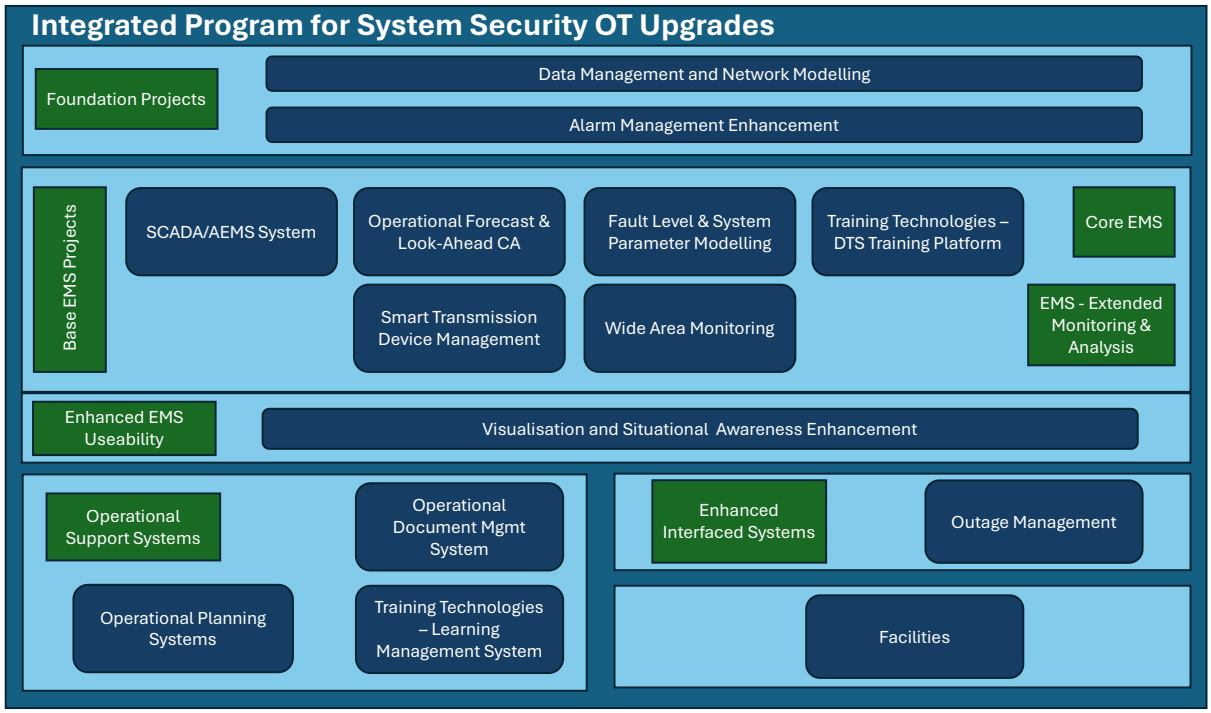

Figure 3 Overview of DGA Review Approach to System Security Roadmap Projects

4.2. Framework Components for Cost Analysis

4.2.1. Foundation Projects

The Foundation Technology Projects are enabling investments to establish underlying alarm management systems, and data capabilities required for the overall program. These are:

- **Data Management and Network Modelling** – The creation of a Single Version of the Truth network model management solution is a clear, but complex, goal for many transmission and distribution network businesses. Once created this provides data sharing with other systems using CIM data exchange. There is significant work in this foundation initiative in aligning business processes, aligning asset hierarchy and nomenclature and ensuring the ability to send, receive and process CIM models.
- **Alarm Management Enhancement**– Implementation of an Alarm Management Lifecycle to deliver Transgrid's Alarm Philosophy requires significant requirements definition, development, configuration, integrations and then testing. This is a critical part of the solution with provision of data for alarm settings across multiple platforms to aid the goal of rationalisation and reduction in alarms.

4.2.2. Base EMS Projects

There is a group of projects that are considered "Base EMS", as they are functions that are delivered by EMS-based applications, are focused on delivering capability to EMS users, and would fit into a relatively "standard" delivery for an overall EMS solution. These EMS Centric Projects are further divided into 2 sub-groups:

- **Core EMS –** This sub-group incorporates the following projects:
    - SCADA/AEMS system.
    - Operational forecasts & Look-ahead contingency assessment.
    - Fault level and system parameter monitoring and power system analysis capability. and
    - Training technologies (Dispatcher Training Simulator)[6]

  In DGA's view these capabilities are delivered as standard or common deliverables of most current-day EMS implementations, by the broad group of the EMS industry's technology suppliers, including GEV. While these solutions are considered an enhancement to Transgrid's current EMS, they are now standard product offerings in many implementations worldwide and will provide Transgrid with many of the facilities already available to transmission operators internationally. This includes better modelling of renewable sources, improved state estimation, improved forecasting, look ahead and contingency analysis, fault level monitoring and an improved Dispatcher Training Simulator (DTS).

- **EMS Extended Monitoring and Analysis** – This sub-group covers:
    - Smart transmission device management; and
    - Wide area monitoring.

  Both projects primarily cover the collection, processing, analysis and visualisation of data from new and additional data sources in the power system. These data acquisition and analysis functions are provided by existing EMS functionality.

As Base EMS capabilities and extensions, these projects are seen as those that would fit into the typical scope of an EMS implementation or upgrade. This means that typical EMS budget and timeline assumptions derived from our experience can be applied to the analysis of cost.

4.2.3. Enhanced EMS Useability Project

EMS systems have powerful tools for displaying information about the power system. However, these tools have very traditional development roots that date back to when computer-based graphics were in their infancy. This often results in less-than-optimal use of currently available display technologies and contributes to concerns about lack of situational awareness in control rooms – particularly when coupled with the ever-increasing amount of raw data that is available to the Control Room.

This 'Visualisation and Situational Awareness Enhancement' initiative is a project, based upon new GEV product capability (Vision). The project itself is EMS-Centric but based upon relatively new EMS tools and therefore not Base EMS capability.

[6] This project is split in our approach with 50% of the costs allocated to Core EMS (to reflect the DTS) and 50% to Operational Technologies. This may be an underestimate of the Core EMS percentage, but any difference is not expected to alter our conclusions.

4.2.4. Operational Support Systems Projects

The Operational Support Systems are a set of three initiatives that are related to the Transgrid's operational environments and capabilities, but not closely related to the EMS. They cover:

- **Operational Document Management System –** This is a system to capture and maintain operational knowledge with enhancements allowing improved access to operational manuals.
- **Operational Planning Systems –** Covers licences for Plexos (with an updated model), PSCAD and hardware as well as automating the production of planning scenario for PSSE OPDMS snapshots.
- **Training Technologies** – **Learning Management System** – This project was split in our approach between the uplift to the DTS (which is core EMS) and uplift in the Enterprise learning management system to document, track, report and deliver educational courses.

This is a relatively low risk set of improvements, which is reflected in the implementation timeframe.

4.2.5. Enhanced Interfaced Systems Project

There is only a single solution in the enhanced interfaced systems projects. This is described below.

- **Outage Management –**The scope of this project is the automation of inverter switching workflow with generators. This excludes upgrading Transgrid's current in house Outage Management System (OMS)

5. Review of Project Schedule

5.1. Project Delivery Approach

Transgrid are applying an SI model for the delivery of the suite of projects. This approach assists with two project objectives:

1) **Ability to Deliver technology programs to schedule** – The choice to use an SI to deliver the suite of projects overcomes the challenges of trying to manage multiple sub projects with many interactions. The SI's Transgrid have approached are large global organisations with the ability to quickly scale up/down resourcing levels and acts as a single responsible entity that can commit to the required timescales. The SI approach reduces risk by sourcing a team of SMEs and project experts and provides a coordinated approach across a complex program of work. This supports timely delivery and prudent project spending and minimises the impact on Transgrid's business as usual operations.

2) **Market Based Cost Assessment –** Using an SI has allowed Transgrid to prepare a holistic market based assessment of the expected total program costs from the SIs. The process has provided several benefits for the scoping and estimating of the program including:
    - **Refining requirements** – The SIs have experience and an understanding of market trends and developments in the industry. These insights have informed Transgrid's scope and provided increased confidence of delivering the program of work in the timescales specified.
    - **Consideration of Alternative Integrated Solutions** – The process provided for holistic delivery of the solutions and consideration of alternative non-GEV solutions outside the EMS.
    - **Improved Cost Estimates** –The process has provided the opportunity to gain cost, schedule, high level design and risk estimates from the SIs.

DGA notes that these costs are non-binding with an accuracy of -10% to +25%. Whilst there is a risk that these costs change when subject to a binding proposal, it is in the SI's interest, to provide realistic estimates. The initial SI costs were refined and reduced after significant iterative engagement between the SIs and Transgrid, which should have reduced the likelihood of a misunderstanding of scope or schedule and reduced any duplicated cost elements.

Transgrid are applying a practical approach using a SI model for the delivery of the suite of projects. The SI approach optimises the delivery schedule by leveraging external experience and resourcing to partner with Transgrid's relatively small operational teams. An important benefit is that it provides a single contracting entity that can be held responsible for delivery of the projects including any sub-contractors. Managing multiple contracts with multiple suppliers is not recommended due to the risk to full functional delivery and/or timely completion with a potential conflict around responsibility.

5.2. Decision to Retain GEV EMS

DGA support the decision to continue with the GEV EMS, rather than undertake another EMS product procurement. The GEV EMS represents one of the leading EMS products in service in the world. It is one of only two EMS products deployed in Australia – the other being the OSI/Emerson EMS.

The alternative option, to potentially use a different vendor's solution, could come at a higher cost, as well as introducing a major disruption to the business, and additional risk, through its implementation.

5.3. Overall Project Timescale

The project timescales have been reviewed with respect to their potential impact on the project costs. The project consists of interrelated initiatives over a 5 year duration, commencing July 2026 and concluding in July 2031 including time for project close out. DGA support the phased delivery approach of several clusters of functionality, with the first Major Release in May 2029 and a second Major release in April 2031. There are also other minor releases for the operational planning, outage switching execution and facilities initiatives.

This is a more achievable and lower risk approach than a single delivery for the full project scope. DGA consider the overall timescale and sequencing to be achievable.

5.4. Project Timescale Review

DGA reviewed the individual project timescales as well as the schedule for each of our framework categories to confirm whether the project timetable is appropriate. An overview of the projects aligned with our review framework is shown in the diagram at the end of this section. Key observations on the duration of each category (and the initiatives within them) are:

- **Enhanced Interfaced Systems (12 months)** – This is the Outage Management project and has a limited scope with no SI involvement. The timetable is considered achievable.
- **Foundation Projects (37 Months) –** This category has two distinct projects
    - **Alarm Management Enhancement (37 Months)** – This project has a realistic timeframe and some of the asset naming convention work has already been undertaken successfully.
    - **Data Management and Network Modelling (24 months)** – This timescale is relatively tight, but achievable despite the challenges of engaging multiple Transgrid stakeholders. It requires defining an over-arching network data model, identifying all key data sources, aligning data models, cleansing data, adjusting work processes of multiple work groups, populating the new model and implementing CIM data flows between all target user systems.
- **Enhanced EMS Usability (24 Months)** – This is the Visualisation and Situational Awareness initiative. The project utilises relatively new GEV capabilities and the schedule factors in the higher effort before testing and operator engagement to implement to the satisfaction of the control room. This timetable is considered achievable.
- **Core EMS Projects[7] (47 Months)** – This has the longest duration of 47 months and is staged over two phases with the base upgrade part of Major Release 1 to unlock initiatives like training technologies alongside alarm management. The subsequent Major Release 2 will incorporate the wide area monitoring and smart transmission device management as well as other improvements. The timescale is considered achievable.

[7] This includes the SCADA/AEMS System (47 months), Operational forecasts and look ahead contingency assessment (14 months), Fault level and system parameter monitoring and power system analysis capability (12 months) and DTS training platform (11 months).

- **EMS Extended Monitoring and Analysis[8] (14 months)** - Both projects should be viewed as integrated sub-projects of the EMS Upgrade which are being delivered together and close to the end of the Core EMS Projects. This timetable is considered achievable.
- **Facilities (12 months)** – This is an enabling project and includes delivery of updates to control room facilities. The timetable is considered achievable.
- **Operational Support Systems[9] (11 months)** - Well understood set of operational support systems and not highly inter-dependent. The timetable is considered achievable.

5.5. Conclusion on Project Schedule

DGA has provided a bottom-up review of the integrated program confirming there are the required relationships between projects with achievable schedules. DGA considers the sequencing to be logical and appropriate and the timetable achievable for delivering this comprehensive program with the planned phased delivery approach.

[8] This includes Smart transmission device management and Wide area monitoring, which both have a 14 month duration.
[9] Thie cover Training technologies (LMS) (11 months), Operational Document Management System (11 months) and Operational Planning Systems (11 months)

Project	Start	End
Contract Execution Phase	1/07/2026	30/06/2027
Facilities	1/10/2026	30/09/2027
Operational Planning System	1/12/2026	31/10/2027
Operational Documentation Mgmt System	1/06/2027	30/04/2028
Outage Management	1/06/2027	31/05/2028
SCADA/AEMS System	1/06/2027	30/04/2031
Alarm Management Enhancement	1/06/2027	30/06/2030
Data Management and Network Modelling	1/06/2027	31/05/2029
Training Technologies - DTS Training	1/03/2028	31/01/2029
Training Technologies - Learning Management	1/03/2028	31/01/2029
Visualisation and Situational Awareness	1/12/2028	30/11/2030
Fault Level and System Parameter Monitoring	1/06/2029	31/05/2030
Operational Forecasts and Look Ahead CA	1/09/2029	31/10/2030
Wide Area Monitoring	1/09/2029	31/10/2030
Smart Transmission Device Management	1/09/2029	31/10/2030

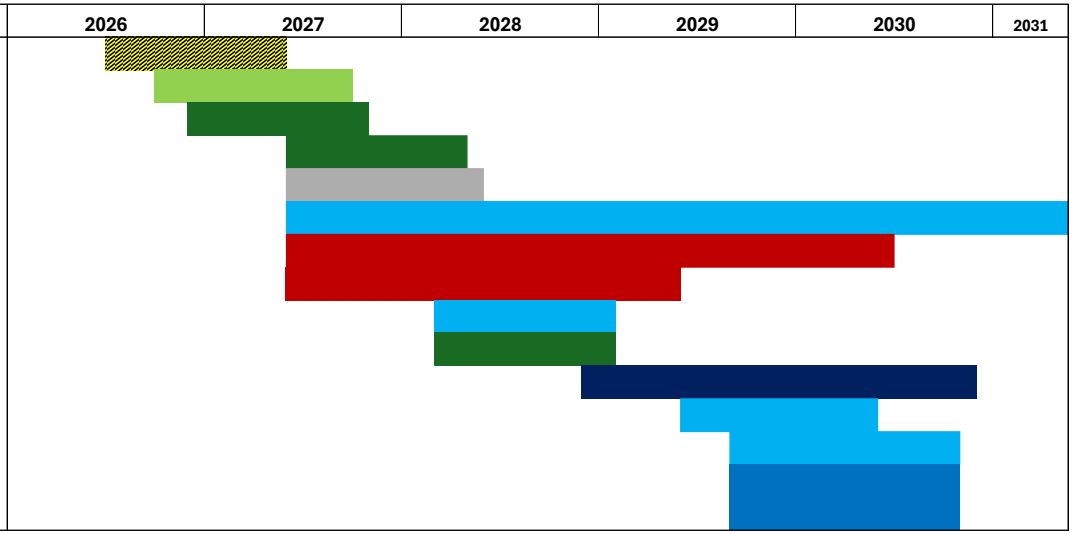

Figure 4 Timeline for Operational Technology Upgrade Project

6. Review of Capex Costs

6.1. SI Cost

DGA believe that Transgrid's market engagement approach with SIs has been extensive and provides a strong basis for the cost estimates. Transgrid's market engagement process is common and appropriate for estimating a 5 year Operational Technology program as a full Request for Proposal (RFP) would be impractical at this stage in a project lifecycle to improve the cost estimates.

The current level of interaction with the SIs has been appropriate for the market based assessment with the level of analysis and clarification similar to an RFP process. The interaction with SIs over eight months included multiple reviews, a series of questions and several workshops which resulted in multiple revisions of the SIs' estimated costs. This ensured both SIs had a consistent set of GEV costs, phased software deliveries within their schedules, consistent Opex/Capex allocations and clarity on the split between Transgrid and SI activities. This process led to a material amount of cost refinement. In DGA's view any further interaction may impact on the competitive nature of the RFP process.

The SI estimates used to prepare the CPA after the interactive process with Transgrid are generally reasonable and reflective of the scale and complexity of the projects. DGA were concerned that holistically, when assessed as an integrated project, the costs for the initiatives that formed the Base EMS[10] were above an efficient level. The Base EMS includes the SCADA/AEMS system, operational forecasts and look-ahead contingency assessment, wide area monitoring, smart transmission device management and fault level and system parameter monitoring and power system analysis capability initiatives and the costs may reflect the limited comparable experience of both SIs with the GEV solution. Transgrid acknowledged this concern and applied a reduction of $2.0m, $3.0m, $4.0m, $1.5m and $2.0m respectively to the SI costs for each of these initiatives when calculating the overall project SI cost, resulting in values that are closer to expected levels.

The final set of SI Costs incorporating the Transgrid adjustment and aligned with DGA's reviewing approach is shown in the table below:

Initiatives	SI Costs ($2024/25)m	DGA Framework Categories	SI Costs ($2024/25)m
Outage management	*$0*	Enhanced Interfaced Systems	*$0*
Alarm management enhancement[11]	*$12.9*	Foundation Projects	*$34.4*
Data management and network modelling system	$21.5		

[10] This includes the Core EMS and EMS Extended Monitoring and Analysis framework categories shown below.
[11] In DGA's assessment the CPA cost category of alarm management, visualisation and situational awareness enhancement was split between Alarm management technologies and Visualisation and situational awareness enhancement. The costs of these 2 categories ($12.9m + $10.8m) align with the CPA.

Initiatives	SI Costs ($2024/25)m	DGA Framework Categories	SI Costs ($2024/25)m
SCADA/AEMS system	*$25.7*	Core EMS	*$37.0*
Fault level and system parameter monitoring and power system analysis capability	*$5.9*		
Operational forecasts and look-ahead contingency assessment	*$2.4*		
Training technologies (DTS element)[12]	*$3.0*		
Wide area monitoring	*$5.0*	EMS – Extended Monitoring & Analysis	*$8.5*
Smart transmission device management	*$3.5*		
Visualisation and situation awareness enhancement	$10.8	Enhanced EMS Useability	*$10.8*
Training technologies, operational document management system and operational planning systems[13]	$7.2	Operational Support Systems	*$7.2*
Facilities	*$0*	Facilities	*$0*
Total	***$98.0***		***$98.0***

Table 4 SI Costs

DGA's view is that the final level of the SI costs of $98m represents an efficient level of cost.

6.2. Internal Cost

The approach to internal cost is outlined in the document 'Internal Cost Estimation (Option B)'. This contains a bottom-up breakdown of Transgrid's scope including labour usage as well as equipment, materials and expenses that are required, but not provided by the SI. This includes external costs for facilities and allowance for custom code changes.

A risk with this form of project delivery approach is resource overlaps with the SI team as well as gaps in the project that may fall between the SI and the internal project team. DGA is satisfied that there is clarity in responsibilities between the SIs/Transgrid and the bottom-up estimates demonstrate a sound approach to avoid double counting of costs between Transgrid's and the SI's estimates.

[12] 50% of the training technologies cost were allocated to the DTS
[13] These projects are grouped in this table as they are relatively small and have a low impact on other projects. 50% of the cost of training technologies was allocated to the DTS category above and with this adjustment the total costs will align with the numbers in the CPA.

Initiatives	Transgrid Costs ($2024/25)m	DGA Framework Categories	Transgrid Costs ($2024/25)m
Outage management	*$1.5*	Enhanced Interfaced Systems	*$1.5*
Alarm management enhancement	*$5.7*	Foundation Projects	*$10.8*
Data management and network modelling system	$5.1		
SCADA/AEMS system	*$6.9*	Core EMS	*$9.2*
Fault level and system parameter monitoring and power system analysis capability	*$0.7*		
Operational forecasts and look-ahead contingency assessment	*$1.3*		
Training technologies (DTS element)	*$0.3*		
Wide area monitoring	*$1.5*	EMS – Extended Monitoring & Analysis	*$1.8*
Smart transmission device management	*$0.3*		
Visualisation and situation awareness enhancement	$2.6	Enhanced EMS Useability	*$2.6*
Training technologies, operational document management system and operational planning systems	$3.4	Operational Support Systems	*$3.4*
Facilities	*$5.3*	Facilities	*$5.3*
Program Implementation	$14.4	Included in Above	$14.4
Total	***$49.0***		***$49.0***[14]

Table 5 Internal Costs

DGA considers these internal costs reasonable for the scope of the project

[14] There is a $2.9m difference in the reviewed cost against the final CPA cost. This is primarily driven by changes in the assumed hours worked by Transgrid's provided labour along with several smaller adjustments.

6.3. Contingency (P50 Confidence Level) Estimates

Transgrid has conducted risk reviews at the individual project level and the program as a whole.

DGA reviewed the risk assessment for each initiative and as a program included the associated cost. The risks reviewed were:

Seven risks at the individual technology initiative level covering:

- Vendor cost increases following contracting
- Small adjustments to scope required following contracting
- Additional outage management design effort with generators
- More than expected testing leading to more resources and rework
- More than expected data quality issues
- Additional time for contracting switching access with generators; and
- Potential for communication links from SCADA to the field requiring upgrade; and,

Two risks at the broader Project level, including:

- System integrator contract termination; and
- System module interoperability risk.

This approach provide for suitable contingency input parameter values to represent both the likelihood and impact associated with each project. Additionally, the focus is on a small number of key external risks where Transgrid has lower ability to mitigate.

An overall contingency estimate is shown in the table below.

Risk	Cost/%
Contingency (P50 Confidence Level)	*$16.5m*
Contingency Allowance (P50)	*11.2%*

Table 6 Contingency Estimates

DGA believes this percentage contingency allowance appropriately reflects project risk, noting that compounding contingencies have been avoided by excluding contingency in the build-up of internal and SI cost estimates. This contingency allowance is significantly below the 15% recommended by one of the SIs.

6.4. Conclusions on Overall Capex Cost

DGA support the set of capex cost estimates as representing an efficient level of costs to deliver the scope of the proposed capability. This recognises the constraints of the timetable, limited availability of Transgrid internal resources and the resultant approach to utilise SI services to deliver the program outcomes.

7. Review of On-going Costs

7.1. Opex Costs

The opex costs are derived from a bottom-up calculation of the cost of additional personnel, system licensing and support. The cost for each element is transparent with a link between when individual elements of the enhanced solution are available and operating and therefore when there is a need for increased resources or system licence/support costs.

DGA have reviewed each of the opex costs to confirm that the activity is required, the timing of the opex cost and that there is no double counting of costs between opex/capex budgets. The review also checked for any missing operational activities needed to run the enhanced systems.

The opex costs breakdown into:

- Software licence/support costs (SCADA/EMS, Plexos, AVEVA PowerRunner, AVEVA Pi)
- Additional resources for Operational Planning
- Additional resources to maintain SCADA/EMS system (including Evergreen Software support)
- Additional resources in the control room (for new forecasting capabilities)
- Inclusion of hardware maintenance
- Other small temporary training costs.

The licence costs are all individually specified by product with the major costs being incremental software licensing costs from GEV. These licence/support cost are an essential part of the expansion of the OT systems. This cost has been confirmed in the material provided by GEV. Review and validation have also been undertaken for the additional licence costs for other vendor's products.

Transgrid provided supporting material to justify the increased control room and operational planning resources, which were incremental to current resourcing. This included supporting information from GEV for additional resources for the EMS and a report from GHD on future planning needs[15] covering the Operational Planners.

The expected Opex costs until 2031/32 are shown in the table below.

Opex Review $m	26/27	27/28	28/29	29/30	30/31	31/32
Total Project ongoing costs	$0.00	$0.8	$2.9	$6.5	$7.4	$8.1

Table 7 Opex Cost

DGA has reviewed the Opex estimates and endorse the scope and confirm these costs as reasonable. They represent an efficient estimate for operating with improved capability and an Evergreen solution model for the EMS components.

[15] GHD Advisory – Review of Future Planning Needs – Report to support Contingent Project Application 20th August 2024

7.2. Refresh Costs

The refresh costs have been reviewed over a 15 year period. This is based on the following key assumptions:

- Evergreen support for all SCADA/AEMS software components: GEV is adopting Evergreen support for SCADA/AEMS software, whereby customers will be able to update the software in small low impact modules as part of their routine support capabilities. This enables customers to take advantage of new functionality quicker with lower operational risks and keeps software in vendor support windows for longer, thus extending the life of the software from 7 years to 10 years.
- SCADA/AEMS platform hardware (i.e. servers, storage, PCs, network) will be refreshed in line with typical IT lifecycles of 4 years to maintain continuity of support and maintenance.
- Refresh costs for software solutions (excluding hardware) are assumed to be 20% less than the initial capital costs (as referenced in section 6 above). This is to acknowledge that there will be less effort in a refresh than the initial setup of new capabilities.
- Asset life adjustments: Data Management, Outage Management, EMS Hardware and operational support systems have a 4-year asset life, Facilities 8 years and all other solutions are at 10 years, mainly reflecting EMS's transition to Evergreen support.

The impact of these assumptions on refresh costs is shown in the table below.

Initiatives	Refresh Costs ($2024/25)m	DGA Framework Categories	Refresh Costs ($2024/25)m
Outage management	$2.4	Enhanced Interfaced Systems	*$2.4*
Alarm management enhancement	$0	Foundation Projects	*$45.5*
Data management and network modelling system	$45.5		
SCADA/AEMS system	*$22.2*	Core EMS	*$22.2*
Fault level and system parameter monitoring and power system analysis capability	*$0*		
Operational forecasts and look-ahead contingency assessment	*$0*		
Training technologies (DTS element)	*$0*		
Wide area monitoring	*$0*	EMS – Extended Monitoring & Analysis	*$0*
Smart transmission device management	$0		
Visualisation and situation awareness enhancement	$0	Enhanced EMS Useability	*$0*

Initiatives	Refresh Costs ($2024/25)m	DGA Framework Categories	Refresh Costs ($2024/25)m
Training technologies, operational document management system and operational planning systems	$11.7	Operational Support Systems	*$11.7*
Facilities	$5.3	Facilities	*$5.3*
Program Implementation	$11.1	Included in Above	$11.1
Total	***$98.4***		***$98.4***

Table 8 Refresh Costs (total may vary due to rounding)

The major element impacting the overall refresh cost is the assumption of zero EMS software refresh costs over the 15 year assessment period, which is dependent on a 10 year life with the Evergreen support model. DGA notes that this approach is not currently deployed on GEV's EMS. However, it is an approach currently being delivered on other GEV products (i.e. Distribution Management System) and is part of GEV's strategy within the timeframe of Transgrid's proposed EMS delivery.

DGA considers that an 80% refresh cost for the other projects and 4-year asset life is conservative for some of the OT Projects and hardware. However, DGA accept that deriving a precise number for refresh costs is not feasible and that the current approach would avoid inflating the NPV outcomes.

Overall DGA believe that the revised refresh costs are reasonable for the purposes of calculating the Net Present Value (NPV) for the Project.

Appendix A – Example DGA Project Assignments

Project	Client	Date	Description of DGA Consulting Project Roles
SCADA/EMS Upgrade Acceptance Testing	Power and Water Corporation	2024-26	PWC commissioned DGA to review the upgrade project scope and to carry out a detailed review of their acceptance testing regime and test procedures, followed by managing the conduct of, and participating in, both Factory Acceptance and Site Acceptance Tests.
Outage and Switch Order Management Review	CLPP	2023-24	CLPP commissioned DGA to undertake an extensive study into the industry practices performed by world-leading TNSPs, as well as research the product functional capabilities available from leading EMS solution providers. DGA's role included reviewing the current systems and process with CLPP before conducting interviews with TNSPs from NZ, Singapore, Australia and NZ as well as the four major global EMS Vendors. DGA's report was used as an input into CLPP's decision making on their EMS Upgrade Strategy.
EMS Project	Confidential	2023	DGA was engaged as EMS Subject Matter Expert to advise a potential Owner/Operator for a new Renewable Energy Zone (REZ) on the specification and procurement of an EMS. The EMS Solution needed to allow the client to fulfil the obligations of a TNSP as well as maximise the potential applications of the EMS for its existing assets.
Consultancy Services for SCADA/GCS Platform Replacement Project	Meridian Energy	2023-2024 and 2025-26	A first project focused on reviewing the RFI/RFP process for Meridian Energy's SCADA/GCS replacement and the proposed solution of the pre-selected vendor. Focus areas were migration of custom applications, architecture, support and proposed project schedule. DGA was later engaged to review the outcomes of Meridian's response to addressing the recommendations of the first report. Meridian had adjusted the scope of the solution, adopted a more standard product approach (as compared to the initial bespoke Generation Control application) and focused on a delivery in stages to validate solution feasibility.
OT Architecture Review	Acciona	2022-23	DGA reviewed strategic opportunities to improve the current-state OT architecture. This included operational and physical architecture, data and security architecture and a converged reference architecture to create a prioritised list of recommendations. DGA then

Project	Client	Date	Description of DGA Consulting Project Roles
			undertook a Cyber Security Uplift Program as a critical priority.
Market Assessment of Future OT Options	APA	2021-22	DGA was commissioned to investigate APA's options for the replacement of its SCADA solution. To assist with this assessment, DGA developed an RFI for future OT solutions covering power and gas assets. DGA reviewed the vendor responses and performed customer interviews to assess the appropriate OT solutions, which were collated in a market assessment report for APA.
ADMS Project	Ausgrid	2017-Present	DGA were engaged as ADMS Subject Matter Expert to advise and assist Ausgrid in their ADMS project. The scope of this assignment has included guiding Ausgrid's ADMS procurement strategy, then transitioning to a role of expert advisor throughout the phased implementation project – including business case updates, detailed design review, PM advice, acceptance testing and commissioning.
SCADA/ EMS/ Upgrade Project	Sabah Electricity Sdn Bhd	2015-2025	Worked as SCADA/EMS Subject Matter Expert with SESB to define and then implement the strategy for Operational Systems (SCADA/EMS & DTS) to help drive modernization and to transition to a market framework for power system operations for the Malaysian State of Sabah. DGA led the development of procurement documents, the selection of SCADA/EMS Supplier and then management of the implementation project from design review through to system commissioning and acceptance. DGA continued to support SESB after go-live.
ADMS 2.0 Project	Meralco (Philippines)	2021	DGA assisted Meralco in their strategy and procurement of ADMS 2.0. This included visioning workshops, business requirement workshops and development of a detailed RFP for the ADMS/EMS. DGA also developed the SCADA business case and ADMS Roadmap to ensure that a robust strategy and design informed the RFP
Strategy and Roadmap for Future OT Environment	APA	2020-21	DGA provided a review of the Technology & Transformation Group's current state and formulated a strategy and roadmap for their future OT environment. This strategy was followed by an assessment of the business and functional requirements for APA's core OT platforms with assessment of the vendor's solution against business requirements, and a recommendation on the future solutions.

Project	Client	Date	Description of DGA Consulting Project Roles
ADMS Upgrade Review	Evoenergy	2017-18	Evoenergy required an external organisation to provide independent oversight of the ADMS Upgrade design process. DGA's role included review of design documents and traceability to technical requirements.

Table 9 Overview of Recent Projects Delivered by DGA's Consultants