

System tools

Regulatory Business Case

FY2028–32 System Control and Market

Operator Charges Review

Contents

1. Overview	2
2. Identified need	4
3. Options analysis	7
3.1 Options assessment	7
4. Recommendation	14
4.1 Strategic alignment	15
4.2 Dependent projects	16
4.3 Delivery	16
4.4 Customer considerations	17
4.5 High-level scope	18

1. Overview

The Darwin–Katherine Power System (DKPS) is experiencing a period of significant transformation. These changes are reshaping operational requirements. Over the past five years, NTESMO has been responding to the increasingly dynamic and challenging operating environment by enhancing system tools to ensure system security and reliability.

These system tools (previously called transitional tools¹) provide critical decision-support information to control room operators, enabling them to maintain real-time operations and ensure system stability and security. By leveraging these tools, operators can monitor system performance, anticipate potential issues, and take proactive measures to manage contingencies. This integration is essential for supporting the transition to more dynamic and complex power systems, where real-time visibility and predictive capabilities are key to maintaining reliability and operational efficiency.

Three options have been considered for ensuring fit-for-purpose system tools for the next regulatory control period.

The first option is to do nothing and operate the system tools without the required ongoing funding to maintain them. This option was discounted as it would mean the existing Energy Management System (EMS) tools will progressively become outdated and incapable of supporting the system’s operational complexity. This would expose NTESMO to unacceptable system reliability and security risks.

Option 2 involves providing maintenance and basic support for the existing transitional tools, including Capacity Forecast Dispatch System (CFDS) tool, Contingency Frequency Control Ancillary Service (C-FCAS) tool, Proportional Energy Dispatch Tool (PED) tool, Real Time System Strength Monitoring Tool (RTSSMT), and Forecasting. This option ensures that the current tools remain functional and incremental improvements are made. However, this option does not invest in any new functionality in response to the increasing complexity and rapidly changing conditions of the DKPS. Relying solely on maintaining the existing tools introduces risk. The current suite of applications does not provide the enhanced visibility, automation, or analytical capability required to operate a system with high renewable penetration, declining synchronous services, and growing operational constraints. Without enhancements or new applications, system operators may face limitations such as reduced visibility of critical resources (e.g., available energy in batteries or synchronous condensers), insufficient real-time monitoring, and slower response to system disturbances.

Therefore, the third option is the preferred option to maintain and support the existing tools while also enhancing the current suite by enabling advanced functionalities available in GE EMS v3.4. This option delivers five new modules in GE EMS v3.4 which are further described within the business case. Table 1 presents the total expenditure for the preferred option.

¹ The reason for the change in nomenclature reflects the enduring nature and purpose of the system tools, particularly their integration with the Territory Dispatch Engine.

Table 1 Annual capital and operational expenditure (\$millions, real FY2025)

	FY28	FY29	FY30	FY31	FY32	Total
Capex	2.25	0.20	0.00	0.00	0.00	2.45
Opex	1.40	1.05	0.80	0.90	0.80	4.95
Total	3.65	1.25	0.80	0.90	0.80	7.40

This regulatory business case has been prepared on the basis of real \$FY2025 and all figures are in \$FY2025 unless otherwise stated. For the purposes of the FY2028–32 System Control and Market Operator Charges Review Initial Proposal, the annual capital and operational expenditure have also been escalated and presented in forecast \$FY2027 dollars and classified by NTESMO function and regulatory cost category as per the table below.

Table 2 Annual capital and operational expenditure (\$million, real FY2027)

Function	Cost Category	FY28	FY29	FY30	FY31	FY32	Total
System Control	Professional Fees	1.51	1.13	0.86	0.97	0.86	5.33
System Control	Capex	2.38	0.21	-	-	-	2.59
Total	-	3.89	1.34	0.86	0.97	0.86	7.92

Note: Numbers may not add due to rounding.

2. Identified need

The DKPS is experiencing a period of significant transformation, driven by structural and system changes in both supply and demand. These changes are reshaping operational requirements, increasing system volatility, and elevating the need for enhanced real-time situational awareness, automation, and stability assessment tools within the Energy Management System (EMS). Furthermore, the single 132 kilovolt transmission line connecting Darwin and Katherine remains a major system constraint, requiring careful operational planning and continuous real-time monitoring to maintain system security.

Given the increasing penetration of renewables, the declining synchronous generation fleet, and the more dynamic nature of system conditions, the existing toolset within EMS v2.6 is no longer sufficient. The new EMS v3.4 needs to be tailored and made fit for the DKPS by leveraging and enhancing the libraries within the EMS v3.4. The enhanced features in EMS v3.4 support:

- Advanced state estimation for systems with high inverter penetration
- Improving the enablement of renewable energy sources within the DKPS
- Enhanced contingency analysis tools tailored for low-inertia and low-fault-level environments
- Automated system strength and voltage stability monitoring
- Improved Automatic Generation Control (AGC) and renewable dispatch management, including hybrid and BESS resources.

These capabilities present a critical opportunity to equip the control room and planning teams with tools that directly address emerging system risks. The enhanced and tailored functionalities provided in GE EMS v3.4 are therefore essential to maintaining a secure, reliable, and cost-effective electricity system into the future.

The evolving generation mix is increasing operational complexity in forecasting

The rapid uptake of distributed rooftop solar photovoltaic (PV) systems across the Northern Territory is fundamentally altering the behaviour of the DKPS. Simultaneously, the generation fleet is transitioning away from conventional synchronous thermal units toward inverter-based resources such as large-scale solar PV plants and battery energy storage systems (BESS). Based on the estimated generator retirement dates provided by Territory Generation, a significant amount of large inertia units are forecast to be retired by the end of 2034². These changes are increasing operational complexities for management of the system.

Data from the Transmission Distribution Annual Planning Report 2025 indicates that the maximum system demand in the Darwin–Katherine region is forecast to increase by approximately 15% over the 10-year planning horizon. In contrast, minimum demand is expected to continue declining due to increasing rooftop and large-scale solar penetration. Figure 1 illustrates the Darwin–Katherine minimum demand forecast, showing a 50% probability of exceedance (50% POE) of approximately 50 MW by FY2034.

Additional insights from NTESMO's Quarterly Renewables Reports highlight the continued growth of solar generation in the Northern Territory (NT). By Q3 2025, total solar penetration is estimated to reach

² Draft assessment completed as part of the development of the inaugural Regulated Electricity System Investment Plan

approximately 23% of overall electricity generation in the NT. Figure 2 presents the estimated proportion of generation supplied by renewable energy sources. Collectively, these trends indicate increasing operational challenges in maintaining power system reliability and security, particularly under low-demand, high -renewable operating conditions, within the scope of existing system control and operational frameworks.

Figure 1. Darwin - Katherine minimum demand forecast.

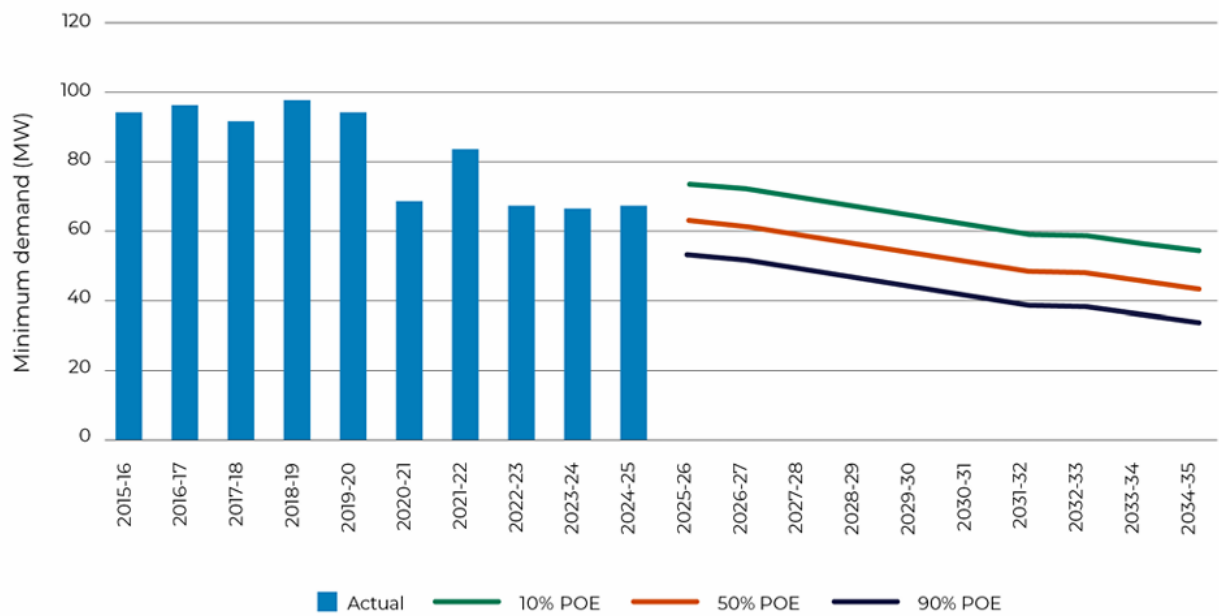
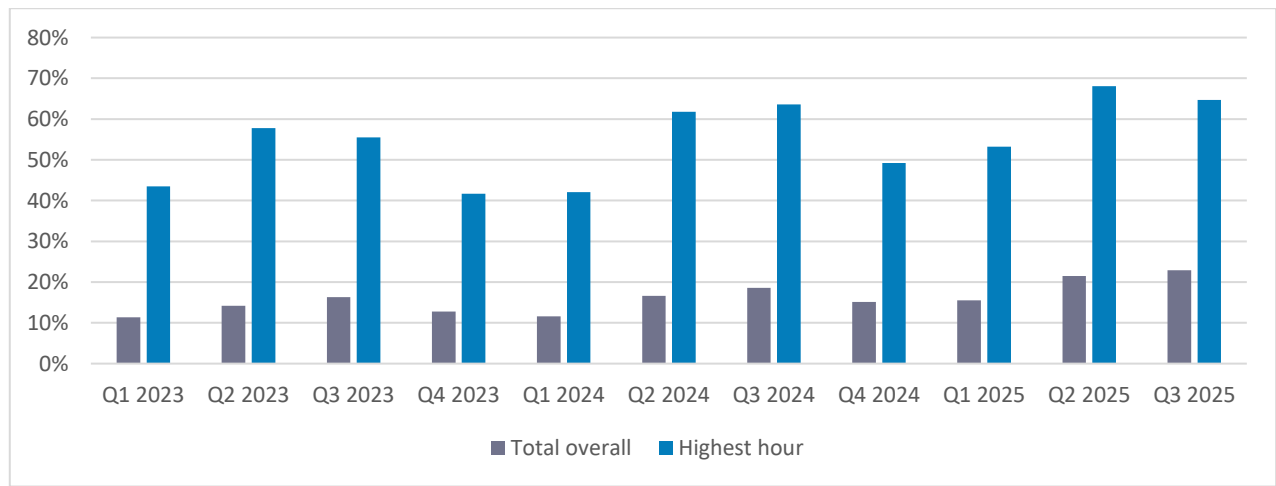


Figure 2. Estimated percentage of generation from renewables, total in quarter and highest hour in quarter (Northern Territory regulated electricity systems)



As solar PV capacity grows, the power system becomes more sensitive to short-term, highly localised weather events. Wet season cloud movements and storms introduce rapid fluctuations in both supply and demand that are difficult to forecast and manage using the existing operational tools. Without enhanced forecasting, automation, real time network condition, and visibility functionalities, operators face increased challenges maintaining balance, frequency, voltage stability, and overall system security.

Further, higher variability of the renewable energy output on the network could increase system security risk. Net load profiles are flattening during the day due to solar penetration while steep morning and evening ramps are becoming more pronounced. Legacy EMS tools were not designed to manage such dynamic profiles or the speed at which changes occur.

The reduction of synchronous generation removes essential system services that must be accounted for

Ageing synchronous generators are progressively retiring or running at significantly lower output levels due to high solar penetration and degradation of the fleet capacity due to aging. 158 MW of generation capacity at Channel Island is expected to retire by 2034. Based on data published in the NT Electricity Outlook and real-time observations during the dry season, DKPS could experience a minimum demand of around 65 MW. This minimum demand is slightly higher than the Probability of Exceedance (POE90) forecast of 60 MW for 2023. The decline of these assets removes several essential system services that have historically been inherently provided. These include:

- **Fault current contribution:** synchronous machines naturally provide high levels of fault current, which supports protection system operation. Inverter-based technologies, however, are limited by semiconductor thermal constraints, and thus can only contribute a fraction of the fault current provided by synchronous generation.
- **Inertia and frequency stability:** reduced synchronous inertia leads to higher rates of change of frequency (RoCoF), increasing the risk of under-frequency or over-frequency events after even modest contingency events. Effective real-time inertia estimation and RoCoF prediction tools become increasingly important as the system evolves.
- **Reactive power and voltage regulation:** synchronous units contribute substantial reactive power and voltage support. With reduced thermal generation online, voltage stability becomes more sensitive to network conditions, requiring more precise and automated management.

The above-mentioned services are “free byproducts” of energy production from synchronous generators. As the level of online synchronous generation decreases, the DKPS must increasingly rely on separate system services to procure reactive power support, fault current contribution, and inertia. Therefore, it is essential to enhance the automation system and improved real-time monitoring tools to maintain secure operation.

System Strength and Protection Implications

The growing penetration of inverter-based generation (such as solar) causes low fault levels (or low system strength) in electricity networks. Lower fault levels, particularly during low-demand periods with high solar output, create new risks for protection coordination, voltage stability, and the system’s overall ability to withstand and recover from disturbances. As the network transitions to new protection schemes, inverter-based resource standards, and an automated dispatch through TDE, continuous monitoring and real-time visibility of system strength become essential.

3. Options analysis

Three options were explored to meet the identified need, which are outlined in Table 3. To assess the options, an options assessment was undertaken. This analysis considered costs and risks/benefits including customer expectations, technical viability and deliverability.

Option three is the preferred option, balancing cost (affordability) and outcomes to customers.

Table 3 Summary of options analysis (\$millions, 2025)

Options	Capex	Opex	Total
Option 1: base case (do-nothing)	0	0	0
Option 2: maintain existing suite of system tools	-	2.95	2.95
Option 3: maintain existing tools plus targeted expansion	2.45	4.95	7.40

3.1 Options assessment

This section describes the various options that were analysed to address the increasing risk and identify the recommended option. The options are analysed based on the ability to address the identified need.

Option 2 covers only the maintenance costs for the existing tools that were approved under the previous regulatory submission.

Table 4 Summary of options analysis (\$millions, 2025)

Assessment metrics	Option 1	Option 2	Option 3
Capex	-	-	2.45
Opex	-	2.95	4.95
Meets customer expectations	○	◐	●
Aligns with Asset Objectives	○	◐	●
Technical Viability	○	◐	●
Deliverability	○	●	●
Preferred	✗	✗	✓



Fully addressed the issue



Adequately addressed the issue



Partially addressed the issue



Did not address the issue

3.1.1 Option 1 – do nothing

Under the base case, no expenditure is undertaken. This means that the existing tools within EMS v3.4 will not be maintained, updated, or enhanced to reflect the evolving needs of the electricity system. Table 5 below shows the tools that would not be maintained under this option.

Table 5 Description of the System Tools

#	System tool	Project status	Description
1	CFDS	Implemented	An application integrating real-time generator forecasts for dispatch of renewable generators.
2	C-FCAS	Expected go-live mid 2026 subject to the go live of the EMS project which is yet to be confirmed	Implementation of contingency FCAS in accordance with the Secure System Guidelines replaces the current spinning reserve policy. The tool provides a quantitative assessment of system security by evaluating frequency stability and contingency response, with the objective of preventing under-frequency load shedding (UFLS) and avoiding system-wide blackouts.
3	PED	The PED project is currently in the Investment Concept phase. The business case is expected to be approved in Q1 2026. Expected go live in 2027	Revises generator tie-break procedure to incorporate proportional dispatch principles. The PED tool optimises renewable energy dispatch by evaluating network constraints, including transmission limits and operational boundaries.
4	RTSSMT	Business case is approved and implementation has commenced. Go live is expected in Q1 2027	Platform for real-time system security monitoring and constraint formulation. The RTSSMT will provide insight into, and assessment of, voltage violations, system strength, and fault levels across the network.
5	Forecasting	Continue BAU	Management of behind-the-meter (BTM) forecasting and regulation of MW requirements for generators. This process requires ongoing refinement of the prediction model and periodic updates to all inputs for the prediction and requirements of R-FCAS.

As the network continues to change, driven by increasing renewable penetration, declining synchronous generation, and more dynamic operating conditions, this option quickly becomes unviable. Without ongoing maintenance and development, the existing EMS tools will progressively become outdated and incapable of supporting the system's operational complexity.

Failure to update the tools will increase system security risks, as operators would be relying on old models, algorithms, and monitoring capabilities that no longer accurately represent the real-time behaviour of the power system. This would lead to reduced situational awareness, slower response to disturbances, and a higher likelihood of operational and compliance breaches.

In summary, the “do nothing” option exposes the DKPS to growing operational, technical, and security challenges, making it unsuitable for a system undergoing rapid transformation.

3.1.2 Option 2 – maintain existing system tools

Option two includes expenditure to maintain our existing system tools.

These tools require ongoing maintenance costs that have not been funded for. Ongoing maintenance is required to ensure the tools perform efficiently and remain aligned with evolving system requirements.

Table 6 summarises the required maintenance activities needed for the existing suite of system tools.

Table 6 Existing tools maintenance activities

#	System tool	Key maintenance activities
1	CFDS	Key maintenance activities will include: Supporting integration with other operational tools: • Code optimisation • Forecast algorithm enhancements • User interface improvements. Maintaining the custom application: • Updating EMS databases • Revising solar aggregation logic and ensuring reliability and accuracy • Ensuring compatibility with EMS system upgrades.
2	C-FCAS	• Model enhancement activities include updating EMS parameters and databases based on tuning outcomes. • Routine maintenance tasks include: • Adjusting frequency response thresholds • Revising System Frequency Response (SFR) parameters • Updating and refreshing the EMS application database • Updating alarm thresholds • Ensuring the C-FCAS application continues to accurately assess system security. • Planned improvements include: • Strengthening primary frequency response analysis • Enabling dynamic contingency sizing • Enhancing operator dashboards to improve situational awareness and operational decision-making. • Documentation will be updated as part of the maintenance process to ensure operational consistency and support training activities.
3	PED	• Refining the algorithm to accommodate changes in market rules and procedures. • Adapting the algorithm to support new renewable technologies. • Improving energy management between renewable generation and other energy sources. • Updating the EMS database and source models to reflect these changes.

		Enhancing the code during the first-year post-implementation to address defects and incorporate additional improvements based on lessons learnt.
4	RTSSMT	- Updating security thresholds based on seasonal study outcomes. - Integrating new EMS alarms into the RTSSMT tool. - Optimising the user interface to support faster operator interpretation and response. - Implementing technical improvements to reduce data refresh latency. - Enhancing failover handling to ensure system reliability during critical operations. - Conducting regular maintenance planning to sustain the accuracy and responsiveness of the RTSSMT application. - Recalibrating security limits and validating model assumptions in response to changes in network configuration, generation mix, and seasonal operating conditions. - Ensuring the tool continues to provide reliable situational awareness and timely alerts to support operators in maintaining system security and mitigating operational risks.
5	Forecasting	- Collecting and updating prediction models to improve in determining raise/lower R-FCAS requirements for a distribution demand change. - Maintaining and enhancing EMS/PI dashboards and backend calculation frameworks, including addressing user-driven feature enhancements and bug fixes. - Reviewing and updating model documentation to reflect methodological changes. - Preparing and submitting technical reports outlining model refinements and their application in real-time operations. - Publishing updated model data and associated documentation following each revision cycle

Option 2 involves providing maintenance and basic support for the existing system tools, including CFDS, C-FCAS, PED, RTSSMT, and Forecasting. This option ensures that the current tools remain functional and incremental improvements are made. However, this option does not invest in any new functionality in response to the increasing complexity and rapidly changing conditions of the DKPS.

Relying solely on maintaining the existing tools introduces risk. The current suite of applications was developed to meet previous system needs and does not provide the enhanced visibility, automation, or analytical capability required to operate a system with high renewable penetration, declining synchronous services, and growing operational constraints. Without enhancements or new applications, system operators may face limitations such as reduced visibility of critical resources (e.g., available energy in batteries or synchronous condensers), insufficient real-time monitoring, and slower response to system disturbances.

As the DKPS continues to evolve, the gap between operational needs and tool capability will widen, increasing the likelihood of inefficiencies, manual workarounds, and system security challenges. Therefore, while maintaining the existing tools is necessary, it is not adequate on its own.

3.1.3 Option 3 – Maintain existing system tools with a targeted expansion

Option 3 includes expenditure to maintain the existing system tools as well as to complete a targeted expansion. The additional tools are summarised in Table 7.

Table 7 Summary of new tools

#	System tool	Functionality
1	SFURM	A third-party firming service to address solar capacity shortfalls during cloud incursions that are not forecasted. Due to the size of the solar generators compared to the typical demand these shortfalls pose operational risk of inadequate supply which could trigger frequency events. To address this, strict forecasting accuracy requirements (for all generators) were adopted. However, solar participants have not been able to meet the Automatic Access Standard requirements for Capacity Forecasting (per network technical code) without the use of collocated batteries (flagged during early consultation as well) or Temporary Derogations using a third party firming service. SFURM is a proposed alternative to the forecast accuracy requirements in the existing Generator Performance Standard while still ensuring the solar capacity shortfalls are appropriately addressed to ensure system security is not compromised. This tool is being trialled in the current period with the plan to build the application on EMS v3.4 and implement in the real-time BAU in the next period.
2	Enablement of general reserve monitoring	Reserve monitoring is a critical capability that tracks the reserve capacity of online generating units to maintain operational system security and meet NTESMO's obligations under the Secure System Guidelines. Reserve monitoring provides real-time visibility into operating reserves (spinning reserve), non-spinning, and regulating (up/down) across the network. It is a critical capability that supports NTESMO to respond to unexpected events such as generator outages, sudden load changes, and cloud cover affecting solar generation. The objective of this project is to replace the existing collection of calculations and tools with the GE Generalised Reserve Monitoring (GRM) module to provide a capability that better aligns with regulatory changes while reducing maintenance costs and risks. The current reserve monitoring methodology is out-dated and does not align with recent updates to the System Strength Guidelines. Additionally, a lack of integration between the current data sets limits situational awareness during high-demand periods and contingency events, exposing NTESMO to compliance risks associated with grid codes that require minimum reserve levels for N-1 security criteria and system frequency response performance. Existing manual and resource dependant methods to monitor reserves are likely to lead to increased delivered energy costs and costly emergency actions, such as procuring reserves at premium prices or implementing load shedding.

3	Digital life cycle management tool	Digital life cycle management provides a structured approach to planning, operating, maintaining, and retiring digital systems. It supports consistency, compliance, and efficient governance by giving system owners the tools to assess risks, track changes, system operational, system maintenance, manage vendor arrangements, and understand total cost of ownership. The proposed application will enhance planning and operational coordination by ensuring asset information is current, risks are visible, and changes are well-managed. This strengthens overall system governance while reducing operational burden on small teams.
4	Battery information capacity tool	The Battery Information Capacity Tool provides system operators with critical visibility into the real-time capability of energy storage resources. By converting existing dispatch data (MW) into an energy-based forecast (MWh), the tool offers a clear and intuitive view of available storage capacity, helping operators understand not just instantaneous output, but how long storage assets can sustain that output during system events. This tool embeds the essential functions of energy storage systems directly within the Automatic Generation Control (AGC) environment, ensuring that batteries and other fast-response resources are fully integrated into real-time system operations. By leveraging renewable energy source models, the tool delivers key information such as state of charge (SoC), remaining energy capacity, discharge/charge availability, and the percentage of energy remaining in each storage device. Importantly, the tool supports a range of storage technologies—including batteries and flywheels—and consolidates all relevant data into the generator summary page. This integrated view strengthens operational decision-making by enabling controllers to: • assess the true availability of storage resources during contingencies, • understand the duration and depth of energy that storage can provide, • optimise dispatch decisions involving inverter-based resources, and • improve reserve management and system security under rapidly changing conditions. Since essential services will be increasingly required to be dispatched from batteries or other renewable sources, it is important to have a tool that can monitor and provide real-time insights. Without such a tool, real-time operations will not have adequate visibility of battery capacities. Overall, the tool provides a vital enhancement to situational awareness and operational reliability, ensuring energy storage systems are used effectively to support frequency control, reserve adequacy, and system stability.
5	Renewable energy module	The GE EMS v3.4 Renewable Energy Module introduces a robust framework to enable grid operators to group renewable energy sources and distribute

	generation setpoints equitably among resources. This functionality is critical for optimising renewable generation while maintaining system reliability and operational efficiency. The module supports dynamic, real-time dispatch of solar, battery, and hybrid resources. It integrates seamlessly with SCADA and Automatic Generation Control (AGC) systems to ensure proportional adjustments across all resources, respecting network constraints and reserve requirements. This approach reduces curtailment, improves resource utilisation, and supports compliance with grid codes and renewable integration targets.
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Option 3 involves enhancing the current suite of system tools by fully enabling the advanced functionalities available in GE EMS v3.4, while continuing to maintain and support the existing applications. In addition, this option includes investment in several new tools that are essential for future system operations, including the Solar Forecast Uncertainty Reserve Margin (SFURM), general reserve monitoring, a digital life cycle management tool, a battery information capacity tool, and the renewable energy module.

This option represents a proactive and future-focused approach to managing the increasing complexity of the DKPS. As renewable penetration grows, synchronous machines decline, and system conditions become more dynamic and weather dependent, operators require tools that provide deeper visibility, better automation, and faster and more accurate decision-support capabilities.

Option 3 directly addresses these emerging requirements by delivering improved situational awareness, reducing operational risks such as the likelihood of under-frequency events through enhanced reserve monitoring and improved forecasting, strengthening planning and operational coordination through digital life cycle management, and ensuring better alignment with the ongoing evolution of the power system.

Overall, Option 3 provides a comprehensive enhancement of operational capability, enabling system controllers to make more informed and timely decisions, reducing the likelihood of system security breaches, and improving the reliability and resilience of the DKPS. This option delivers the greatest long-term value by ensuring the EMS platform evolves in step with the changing power system, enabling a safe, efficient, and secure transition to a high-renewable future.

4. Recommendation

The options analysis presented in the previous section has identified Option 3 – Maintain existing system tools, with a targeted expansion at an estimated cost of \$7.40 million, to be the most prudent and cost-effective option to meet the identified needs.

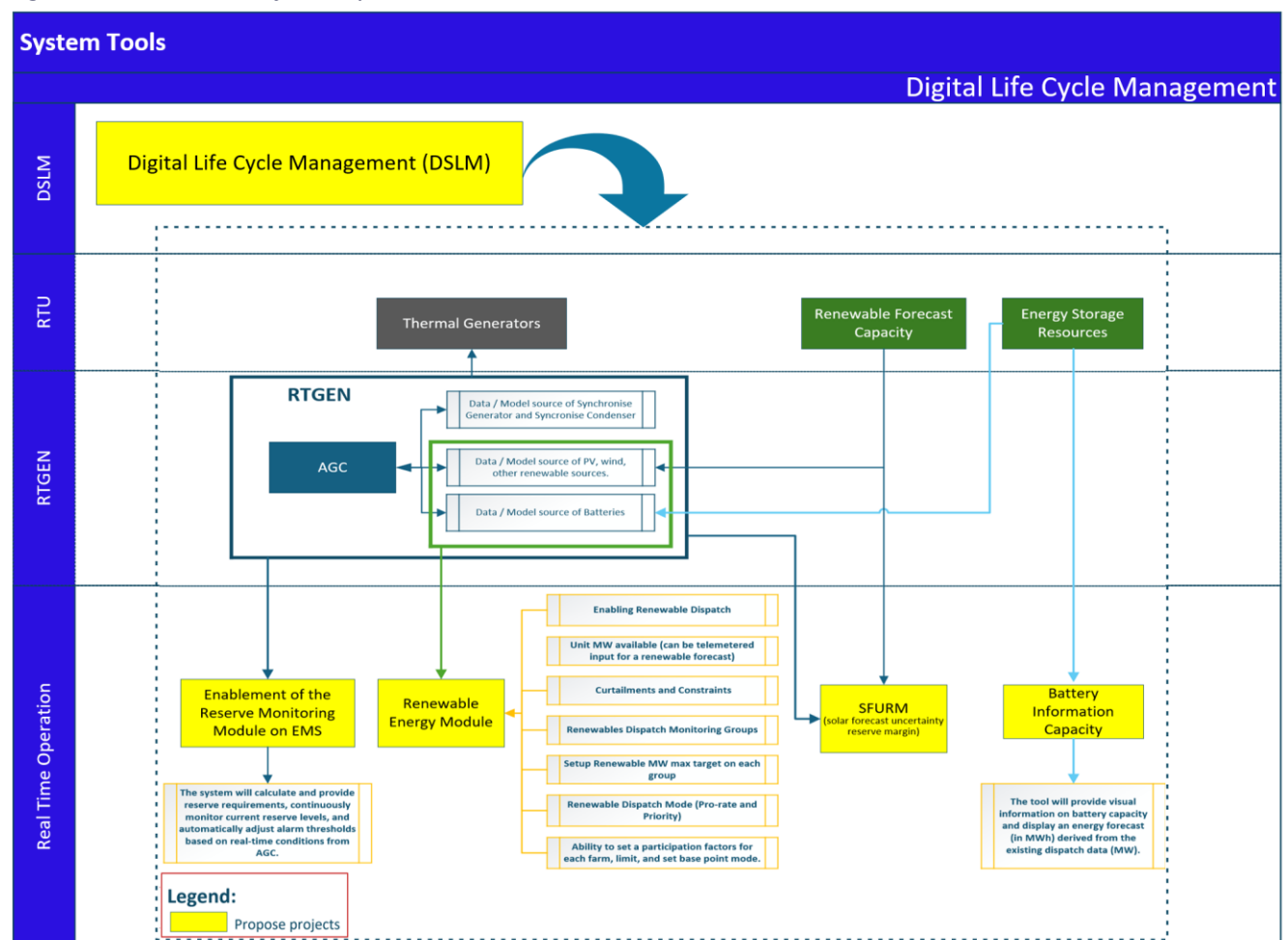
Option 3 expenditure is outlined in the table below.

Table 8 Total expenditure (\$millions, 2025)

	FY28	FY29	FY30	FY31	FY32	Total
Capex	2.25	0.20	0.00	0.00	0.00	2.45
Opex	1.40	1.05	0.80	0.90	0.80	4.95

Figure 3 provides a high-level illustration of the architecture of the new system tools within EMS.

Figure 3. Architecture of new system tools



4.1 Strategic alignment

The “Power and Water Corporation Strategic Direction” is to meet the changing needs of the business, our customers and is aligned with the market and future economic conditions of the Northern Territory projected out to 2030.

This proposal aligns with Asset Management System Policies, Strategies and Plans that contributes to the D2021/260606 “PWC Strategic Framework” as indicated in Table 9.

Table 9 Power and Water Strategic Framework

Goal	Objective	Impact
Modernising our business	Delivering sustainable value safely and reliably for our customers and community	The project aligns with the organisation's commitment to sustainability by supporting secure power system operation under higher shares of renewable energy and preventing power disruptions that could impact customers.
	An empowered and high-performing workforce	The project will provide comprehensive support to controllers in their day-to-day operations by delivering additional information to assist with critical decision-making in the control room. In addition, the proposed tools will modernise the system by offering comprehensive systems visibility and automated functionality that can adapt to network changes.
	Successful investments in core systems and the capability to improve efficiency and value of service	The project represents a strategic investment in enhancing EMS v3.4, a core system that directly influences operational efficiency. The proposed enhancements will be tailored to meet DKPS requirements and support the needs of real-time operations and system controllers.
Embracing a sustainable future with innovation	Structuring, facilitating, and enabling infrastructure and innovations to support the renewable energy transition and achievement of economic growth targets	The modernisation of EMS v3.4 will deliver a more flexible and adaptive platform capable of supporting the increasing penetration of renewable energy resources. By enabling enhanced functionalities—including reserve monitoring, renewable integration tools, SFURM forecasting, and battery information capabilities. The upgraded EMS will significantly improve operators’ ability to make timely and informed decisions in real-time conditions. These enhancements will provide fit-for-purpose tools that directly address the system’s emerging operational challenges, such as greater weather dependency due to high solar PV penetration,

		declining synchronous generation services, and an increasing number of system constraints. Strengthening the EMS in this way will support the broader objective of enabling the renewable energy transition while maintaining grid stability and system security—both of which are essential to sustaining economic growth in a cleaner energy future.
	Proactively adopting government policy for a clean and secure future	The project aligns with government initiatives aimed at securing a cleaner and more reliable energy future. By proactively addressing these policy goals, the organisation positions itself as a leader in supporting the transition to a low-carbon economy.
	Partner with customers and stakeholders to create innovative solutions	The project comprehensively supports stakeholders in operating the power system under higher penetrations of renewable energy. By actively engaging stakeholders throughout the project, the organisation demonstrates its commitment to collaborative, innovative problem-solving, driving mutual benefits for all parties involved.

4.2 Dependent projects

There are no dependencies for this project, which means it can proceed independently without waiting for other initiatives. The EMS upgrade project is expected to be completed by the end of 2026, providing the foundation for enhanced system monitoring and control capabilities.

The proposed tools will be built on the new EMS v3.4 platform, which introduces improved functionality, advanced system monitoring, and enhanced support for real-time operations. Leveraging EMS v3.4 ensures that these tools can fully utilise features such as updated renewable models, AGC enhancements, and real-time data exchange.

As the EMS serves as the real-time monitoring and control platform, it provides the operational backbone for system stability and security. This foundation is critical to ensure that the Territory Dispatch Engine (TDE) receives accurate, real-time inputs for optimisation, enabling cost-efficient and secure dispatch strategies.

4.3 Delivery

A delivery plan for the recommended option has been developed and presented in the figure below. Our delivery plan is a sequenced approach to tool implementation to balance timeliness of benefit realisation and deliverability. Our plan has broken up implementation into project planning, investment development, implementation and go-live.

Table 10 Delivery plan

Task Name	2028				2029			
Solar Forecast Uncertainty Reserve Margin (SFURM)	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Planning								
Investment Development								
Implementation								
Go Live								
Enablement of Generalised Reserve Monitoring								
Project Planning								
Investment Development								
Implementation								
Go Live								
Battery Information Capacity Tool								
Project Planning								
Investment Development								
Implementation								
Go Live								
Renewable energy model upgrade								
Project Planning								
Investment Development								
Implementation								
Go Live								
Digital Life Cycle Mangement Tool								
Project Planning								
Investment Development								
Implementation								
Go Live								

4.4 Customer considerations

To support the development of NTESMO’s FY2028–32 Initial Regulatory Proposal, NTESMO released a Consultation Paper outlining preliminary positions across several key focus areas and inviting stakeholder feedback. A stakeholder workshop was held on 11 December 2025, during which the System Tools Business Case was presented and discussed.

Territory Generation (TGen) provided a written submission where they outlined their support for system tools, provided governance ensures interoperability, auditability and measurable operational benefits. NTESMO agrees with TGen’s comments and in Section 4.5, it outlines the high-level scope and highlights the importance of integrating the system tools with the EMS v3.4 and SCADA. While there are many operational benefits that have been described in the business case, NTESMO can conduct further work to better articulate the measurable benefits across the specific tools to provide more confidence to stakeholders of the value proposition.

Jacana’s submission outlined its concern that the system tools expenditure is not backed through a proposed productivity factor. Jacana note that the exclusion of a productivity factor suggests the investment in the system tools does not result in value returned to end customers through a reduced operating cost.

It is important to emphasis that while the investment in system tools is not expected to materially increase productivity in the short term, it is essential to enable NTESMO to continue managing the power system securely, safely and efficiently amid significant energy transformation. The proposed tools will ensure that there is no deterioration in critical functions as the complexity and operational demands of power system operations continue to increase.

4.5 High-level scope

This proposal will deliver the implementation of the new system tools and maintaining the existing tools. System tools will enhance the GE EMS v3.4 by adding and enabling functionality of the EMS v3.4 for improved monitoring of the system and greater visibility of the real time system performance. The project aims to establish an integrated, automated, and compliant system tools capability that meets the current Secure System Guidelines, supports future ancillary service market developments, and prepares the EMS for future optimisation with the TDE project.

Building on the implementation plan, the below section details the high-level activities required for this program of work.

Design and Build System Tools

- Build and configure the tools within the EMS v3.4 environment
- Provide unit test on each component of the calculations
- Set up calculation parameters and assess the system performances:
 - Operating (spinning) reserves and non-spinning reserves
 - Assess the firming over and the forecast error from solar sites
 - Regulating reserves (up and down)
 - Monitor and assess telemetered data from generators participants

Integration with EMS Systems

- Integrate the system tools with the EMS v3.4 database and system model to enable real-time system monitoring, dynamic reserve calculations aligned with dispatch, regulating reserve capacity
- Integrate the tools with SCADA to provide continuous data updates, status changes, and reserve tracking aligned with real-time system conditions
- Configure system tools to interface with relevant historian or reporting systems for audit and compliance visibility

Configuration and Modelling

- Configure reserve criteria and thresholds consistent with Secure System Guidelines, N-1 security requirements, and frequency response obligations
- Set up SFURM firming capacity requirement for system wide, region, solar sites, and availability
- Implement alerting for reserve shortfalls, threshold breaches, and contingency conditions
- Align generalised reserve monitor settings to support emerging ancillary service frameworks, including:
 - Raise and Lower FCAS (R-FCAS)
 - Contingency FCAS (C-FCAS)
 - SFURM
 - Battery information capacity
- Configure database and notification of the digital life cycle of the system tools.

Testing and Validation

- Conduct functional testing to confirm correct reserve calculations, battery capacity, firming requirement, and alarms threshold
- Perform integrated system testing with AGC, SCADA, and dispatch systems
- Validate the system tools performance under various operational and contingency scenarios
- Complete user acceptance testing and control room readiness checks

Operational Enablement

- Develop operational procedures for system tools
- Train NTESMO real time operation team on system tools interface, alarms, and reporting capabilities
- Establish processes for ongoing maintenance and configuration updates of methodologies, additional generations, or market frameworks evolve

Documentation and Compliance

- Document all system tools configurations, detailed design, operational logic, and manuals

Appendix A. Cost estimation

Table 11 provides a breakdown of the costs for the recommended option. The costs have been developed based on the similarly complex projects (historical and ongoing projects) such as CFDS, and C-FCAS projects.

Table 11 System tools cost breakdown (\$millions, real FY2025)

System tool	FY28	FY29	FY30	FY31	FY32
CFDS	■	■	■	■	■
C-FCAS Project	■	■	■	■	■
RTSSMT Project	■	■	■	■	■
Forecasting	■	■	■	■	■
PED Project	■	■	■	■	■
SFURM	■	■	■	■	■
Enablement of General Reserve Monitoring	■	■	■	■	■
Digital Life Cycle Management Tool	■	■	■	■	■
Battery Information capacity tool	■	■	■	■	■
Renewable energy module	■	■	■	■	■
<u>TOTAL</u>	3.65	1.25	0.8	0.90	0.8

Appendix B. Assumptions

Project schedules and delivery timeline is based on the assumption that EMS v3.4 project will be completed by end of year 2026.

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