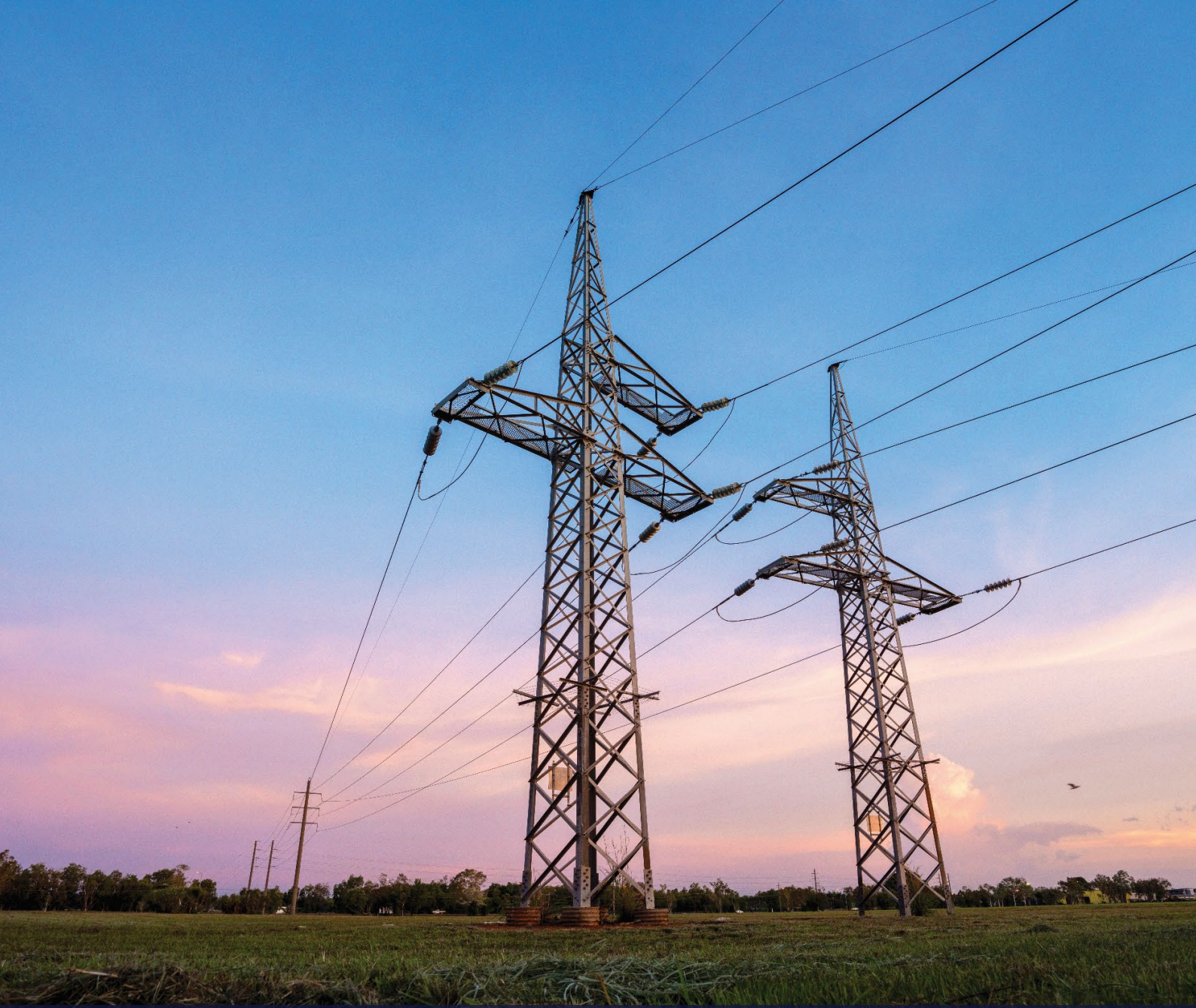

Attachment 4.1: Contingent projects

Revised Regulatory Proposal

30 November 2023

PowerWater

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1. Background

1.1 Our initial proposal

In our initial proposal we identified five large projects, each expected to cost more than $15 million, which may be required during the 2024-29 regulatory period but are uncertain in terms of timing, scope and/or funding arrangements. The regulatory framework requires that the costs associated with these projects be excluded from the forecast capital allowance, and separately identified as contingent projects.

Our proposed contingent projects were:

- Shared transmission works to transport generation from a Renewable Energy Hub in Darwin-Katherine.
- Unlocking existing large scale renewable generation in Darwin-Katherine.
- Holtze-Kowandi land development.
- Middle Arm commercial development.
- Wishart commercial development.

1.2 The AER's draft decision

In its draft decision, the AER accepted four of our five proposed contingent projects at a total indicative cost of $296.3 million.

The AER did not accept the proposed contingent project to unlock existing large scale renewable generation in the Darwin-Katherine area, as it did not consider the project to be *reasonably required to maintain the quality, reliability and security of supply, or to meet or manage the expected demand for distribution services over the 2024-29 period.*[1] The AER considered that we had not demonstrated a sufficient need for the project, and therefore could not approve it under the NT NER.

1.3 Works undertaken since our initial proposal

We maintain that the proposed contingent project associated with allowing existing large scale renewable generation capacity connected to the Darwin-Katherine transmission line (**DKTL**)[2] to export existing and expected new renewable energy is required for the 2024-29 period, and have provided further information to better articulate and justify the need for the project.

1.3.1 NT operating context

As the Norther Territory (**NT**), along with the rest of Australia, continues its pathway towards net zero greenhouse gas emissions, new large scale renewable energy facilities will displace fossil-fuel powered,

[1] As per the requirements of clause 6.6A.1(b)(1) of the NT NER.

[2] The DKTL is a single circuit 132kV transmission line that connects from Channel Island Power Station to Katherine. It supplies the townships of Manton, Batchelor and Pine Creek.

synchronous generation. The Northern Territory Government has an objective to meet 50% of demand by renewable energy by 2030 in the Darwin-Katherine Electricity System.

The NT Government's Darwin-Katherine Electricity System Plan (**DKESP**) forecasts 50% of underlying demand will be met by renewables. The DKESP projects the expected change in generation mix by 2030 as comprising 15% small scale solar, 26% large scale solar and 9% battery energy storage.[3] During the same period, thermal generation will reduce from 88% in 2021 to 50% by 2030.

Coupled with this, Territory Generation published plans to start retiring the four Frame 6 gas-fired generators at Channel Island from 2026 and has more recently signalled its intention to retire one unit by the end of 2024. We expect these synchronous generators will largely be replaced by renewables. This will significantly decrease the proportion of synchronous generation in the system.

Synchronous generators play an important role in maintaining system security. They provide essential system services (**ESS**) such as system strength, inertia and frequency control. Asynchronous (or inverter-based) generation such as solar cannot provide these ESS alone, they have to be complemented by assets such as synchronous condensers and/or battery energy storage systems (**BESS**). Without these complementary assets, large scale inverter-based generation can have a detrimental effect on voltage stability and system strength.

1.3.2 Outcomes of system studies

Since our initial proposal, our system studies have identified that more work needs to be done to address the system strength issues posed by the transition to renewables and the changing generation mix in the Territory.

Our initial proposal was based on the premise that the proposed investment to 'unlock' the full capacity of renewables connected to the DKTL (potential installation of a synchronous condenser and/or battery storage systems) would also address future system strength issues likely to arise across the network in the near term. However, the recent studies indicate addressing the system strength issues on the DKTL would not provide an adequate solution to maintain security of supply in the broader Darwin area. Additional synchronous condensers or other network solutions at additional locations would also be required.

Therefore, the originally proposed Unlocking existing large scale renewables on the DKTL contingent project would not address system security issues in the Darwin area. Additional investment will be required.

We considered revising the initial contingent project description and investment. However, we found it easier to separately identify and discuss the two discrete components of the project. This has helped us to better articulate the different locational needs, triggers for, and investment required in each of the two areas of the network.

The two components of the proposed contingent project to accommodate a greater proportion of inverter-based generation, in accordance with the NT Government policy objectives and system plans in the Darwin-Katherine Electricity System are:

a. **Unlocking large scale renewables on the DKTL (CP2a)**: As per the initial proposal, investment in the order of ~$50 million is required to enable large scale solar to increase export from facilities connected to the DKTL without compromising system security (see section 2).

[3] DKESP, page 15 and Figure 6

b. **Managing network voltage and system strength with an increasing proportion of inverter-based generation (CP2b)**: As synchronous generation leaves the power system and the proportion of inverter-based generation increases, investment is required to maintain adequate system strength and regulate voltage across the Darwin region. This will likely include additional synchronous condensers and/or battery storage systems in the order of ~$100 million (see section 3).

Sections 2 and 3 of this attachment provide an overview of the outcome of our early planning and analysis, options considered credible in our initial assessment, and proposed trigger events that are consistent with those approved by the AER in its draft decision for other contingent projects.

1.3.3 Continued customer engagement

We have tested the focus of our revised proposal with our customers. Residential customers of our People's Panel (Panellists) have repeatedly supported the need to invest in renewables to support the future network. Customers also stated that Power and Water has an important role in facilitating and encouraging the connection of renewable technologies.

Stakeholder feedback relevant to these contingent projects includes comments made in the May 2023 People's Panel:

- The facilitation of renewables in the NT during the next regulatory period is important to improve the energy landscape for future generations and provide affordable, reliable and environmentally friendly electricity to current energy users.
- Power and Water should also consider progressing slower in its pace of investment to learn from other electricity networks and potentially take advantage of lower costs in the future and balance it with a need to make changes now to accommodate for a growing renewable electricity grid.

In the October 2023 People's Panels, we presented our revised suite of future network related projects, including increasing large scale renewable generation through the contingent proposed projects aimed at relieving constraints that limit dispatch. We received the following feedback:

- Customers understood that there are network challenges that need to be resolved to enable dispatch of large scale renewables in the Darwin and Katherine regions.
- Panellists supported investment to unlock renewable energy from existing solar farms to customers, forming the view that this low cost and clean form of generation should enable electricity to be supplied at a cheaper cost, as well as providing environmental benefits.

2. Unlocking large scale renewables on the DKTL

The existing large scale solar generators connected to the DKTL are facing frequent and significant constraints, severely limiting the amount of renewable energy they can export into the power system. The constraint is caused by a lack of system strength due to their distance from Darwin and the limitations of the radial DKTL.

This project is designed to allow greater dispatch from these four facilities. It will also allow more renewable electricity into the power system and push NT closer towards its net zero goals. Investment to increase system strength is justifiable based on the economic benefits of limiting the level of curtailment, as well as the contribution towards greenhouse gas targets.

This project is included as a contingent project, not due to the need for investment (which is clear), but because of uncertainty around the timing for the investment, and the need for further analysis[4] to identify the most prudent and efficient solution.

2.1 What is the challenge?

There are four large scale solar facilities with a total capacity of 55 MW[5] connected to the DKTL. These facilities are:

1. Katherine Solar Farm with capacity rating of 25 MW
2. Batchelor 1 Solar Farm with capacity rating of 10 MW
3. Batchelor 2 Solar Farm with capacity rating of 10 MW
4. Manton Solar Farm with capacity rating of 10 MW

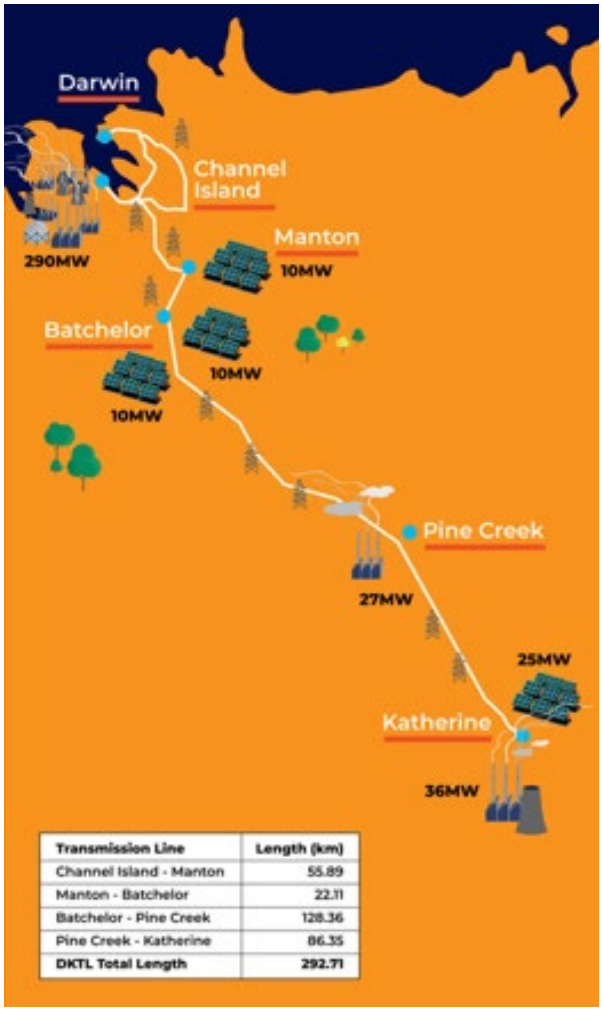
All four facilities are located south of Darwin and are a significant distance from the major load centre of Darwin itself (see Figure 2.1). The largest facility, Katherine Solar Farm, is approximately 300 km from Channel Island.

There are also two conventional thermal gas generators including Pine Creek Power Station with capacity rating of 27 MW and Katherine Power Station with capacity rating of 36.5 MW.

The total export from DKTL into the Darwin region is limited based on the level of network demand to ensure the security of the Darwin network should a contingency event occur resulting in the separation of the DKTL from the Darwin network.

The available generation from the solar farms is likely to exceed total demand for customers that are connected

Figure 2.1: Map of existing facilities



Transmission Line	Length (km)
Channel Island - Manton	55.89
Manton - Batchelor	22.11
Batchelor - Pine Creek	128.36
Pine Creek - Katherine	86.35
DKTL Total Length	**292.71**

[4] Via regulatory investment test – transmission (**RIT-T**)

[5] Utilities Commission of the Northern Territory, Northern Territory Electricity Outlook Report 2021, Appendix A2: Supply details, Non-Summer capacity (MW)

directly to the DKTL in Manton, Batchelor, Pine Creek and Katherine. The total maximum demand on the DKTL is approximately 20 MVA during the dry season and 35 MVA during the wet season.

Since the DKTL is a single circuit line, there is no redundancy or back up to connect these generators or the load to the network if the DKTL is out of service.

With a constraint placed on DTKL export, there is expected to be a significant amount of solar generation that would need to be curtailed. In addition, the constraint also prevents or disincentivises new renewable generators from connecting to the DKTL.

2.1.1 What is system strength?

System strength is the ability of the power system to maintain and control voltage at all locations in the network during both normal operation and following a disturbance (n-1 conditions).

System strength is measured by the available fault level (**AFL**)[6]. Positive AFL is required to maintain network security and stability under fault condition so that synchronous machines and protection devices react correctly to any disturbances. As a minimum threshold, AFL needs to be greater than zero such that the system operating state remains stable. Negative AFL, or a system strength shortfall, prevents connection of new inverter-based generation and leads to system instability, which at worst may result in cascading failure of the power system and a system black event.

Our system studies show that when all the existing solar farms are fully dispatched, the AFL will become negative in Katherine. If Katherine Solar Farm (the furthest from the synchronous generation at Channel Island) was operating with the other solar farms, and an N-1 contingency event occurred (such as the loss of a synchronous generator or transmission line) the AFL would become negative across the network.

To ensure the system remains stable, following a contingency event, all solar farms connected to the DKTL are required to be constrained off (to zero export) where network demand is below 70 MW to maintain system security, including a positive AFL. Where demand is over 70 MW, studies have determined that the connected solar generation on the DKTL is constrained to approximately 50% if all solar farms are operating.

2.1.2 Why is this a problem now?

This has not been a major challenge before now, as these four generators have not yet met the Generator Performance Standards (**GPS**) and therefore cannot be fully dispatched. However, all four facilities are expected to meet the GPS in 2025. Unless action is taken to remove or at least lessen the constraint, the potential for these facilities to contribute towards the NT's renewable energy targets would be significantly compromised.

Without investment to improve system strength, the large scale solar facilities, primarily in Katherine[7], will continue to be affected by regular and significant curtailments. The curtailment of our large scale renewable energy facilities will only get worse as the proportion of inverter-based generation in the energy mix increases, and as minimum demand decreases.

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6 AFL is a fault level-based estimation method for system strength. It estimates how much synchronous fault level may be required to allow stable operation for a given level of inverter-based resources in a certain area assuming a particular minimum short circuit ratio that an inverter-based resource can stably sustain. This method provides a proxy for the underlying power system characteristics responsible for system strength.

7 The constraint is located in Katherine primarily due to the distance from existing synchronous generation in Channel Island.

2.2 Our revised proposal

We acknowledge the need for further information on the project drivers and further analysis to demonstrate the need for investment. As discussed above, since the initial proposal we have undertaken studies to identify options that will allow us to maximise the renewable energy able to be exported from the four large scale solar facilities connected to the DKTL (and more broadly in the Darwin region – see section 3).

2.2.1 Project need

As we have highlighted, there will be significant and frequent curtailment of clean, and low cost electricity generation from existing facilities on the DKTL due to system strength limitations. This problem will only become worse with the expected increase in the proportion of inverter-based generation on the DKTL and the system overall.

We have considered the industry-wide impact of the do-nothing scenario, under which we would need to limit the export of existing solar on the DKTL, resulting in:

- The NT not meetings its renewable energy targets.
- Higher overall greenhouse gas emissions.
- Large local industries not being able to meet their required reductions under the Safeguard Mechanism, and potentially either not locating in the Territory in the first place, or relocating from the NT.
- Reliance on more expensive thermal generation resulting in higher energy bills for consumers.

Our preliminary assessment has found that the economic cost of constraining the generators to maintain system security has an NPV of $153 million over a 30 year period.

There is benefit to addressing the system strength shortfall to the point that the limiting factor becomes the export constraint on the total generation of the DKTL of up to 40 MW[8]. The residual cost of energy curtailed by addressing the system strength shortfall is approximately $70 million, resulting in a benefit of $83 million that is attributable to any project that resolves the constraint.

On this basis, we consider a contingent project is warranted to formally assess the costs and benefits of unlocking the existing large scale solar generation on the DKTL. We will therefore continue to progress the necessary studies, planning, business case development and necessary approvals to determine which potential solution is the most prudent and efficient option.

2.2.2 Preliminary options analysis

Consistent with the economic analysis procedure in the RIT-T guidelines, we have conducted an initial assessment to identify credible options that will improve system security to allow facilities connected to the DKTL to increase their output (subject to each first meeting the GPS).

A summary of our preliminary assessment of the credible options is provided in Table 2.2.

[8] This constraint is due to NTESMO's need to manage system security by curtailing the energy supplied from the DKTL as the single largest contingency. There is likely to be value in removing or increasing the 40 MW constraint on DKTL when generation increases. However, we have not done any sensitivity analysis to determine when, or at what install capacity, this may occur.

Table 2.1 Summary of credible options to improve system security to allow increased export from the DKTL

Option	Project	Description	Estimated totex [9]
1	Base Case – apply export limits to solar on the DKTL for system strength	Renewable generation would be constrained on the DKTL to ensure system strength adequacy.	-
2	Install a synchronous condenser in Katherine	Install a 40 MW synchronous conductor at Katherine to improve system strength.	~$40 million capex ~$0.4 million p.a. opex
3	Install a synchronous condenser and BESS in Katherine	Install a 40 MW synchronous condenser at Katherine to address the system strength limitation. In addition, install a 20 MW / 40 MWh BESS at Katherine to enable additional solar generation to be captured during the day and discharged at night.	~$70 million capex ~$0.55 million p.a. opex
4	Install a BESS in Katherine	Install a 100 MW/ 200 MWh BESS at Katherine to improve system strength.	~$150 million capex ~$0.75 million p.a. opex

Our preliminary economic analysis[10] considers the constraint of the facilities on the DKTL related to system strength limitations[11] and the cost benefits of solar power compared to thermal generation. We found options two and three both return a positive net present value (**NPV**) and positive benefit cost ratio across three scenarios[12]. Under all scenarios, option 2 (the installation of a synchronous condenser in Katherine) is found to be the preferred option.

The preferred option results in a net benefit of $46.6 million over the 30-year period relative to the base case due to lower generation costs and lower emissions. We also undertook sensitivity analysis to ensure that the option was preferred under different sensitivities.

The preferred option under the initial analysis would be to procure, transport and install a 40MVA synchronous condenser at Katherine. The optimal timing analysis suggests the preferred option should be implemented in 2024-25, as soon as the renewable generation meets the GPS or otherwise receives approval to be dispatched.

9 We estimated the opex as 1% of the capex cost for synchronous condensers and 0.5% of capex for BESS. These values will be reviewed further as part of the further analysis.

10 We undertook cost benefit analysis of the above options, consistent with the economic assessment process in the AER's RIT-T guidelines, noting that similar analysis will be required when we undertake a RIT for this project.

11 Note, this assessment also factors in the overall limitation imposed by System Control for the purposes of managing voltage to ensure we do not over-estimate the benefits associated with the increase in system strength.

12 The three options were an 'expected case', 'low demand growth, low generation growth' and 'high demand growth, high generation growth'. Further scenarios will be assessed as part of the RIT-T.

We consider it is not practicable to deliver the solution by 2024-25. This is because:

1. There is a significant lead time on the procurement, manufacture, delivery and installation of a synchronous condenser.
2. The project has not been subject to a (RIT-T) where alternative options may be canvassed by interested parties which will take time.

We consider that the practical timing of the project would be in 2025-26.

Two further options have been considered, however, our preliminary analysis suggests these would be less efficient than the preferred option:

1. **Duplicating the 292.7 km DKTL** – The estimated cost of this option is $0.75 million to $1.0 million per kilometre so it would cost between approximately $219 million and $292 million. This is expected to outweigh the benefits of removing the constraint on the existing DKTL.
2. **Paying a network support payment for the out of merit dispatch of the Katherine Power Station** – This option would only marginally reduce the constraint and would only be able to resolve the issue in periods of high demand. Although the cost is low ($4.6 million), it would only result in benefits of around $2.9 million per year.

These and any other options would be explored further and in more detail via a RIT-T process.

2.2.3 Trigger events

Consistent with the AER's draft decision on other contingent projects, we have revised the proposed trigger events for this project to be more specific.

Our revised trigger events are:

1. Confirmation by NTESMO of a projected shortfall in system strength on the DKTL, or in the Katherine region.
2. The AER is satisfied that Power and Water has successfully completed a RIT-T that:
    a. Identifies a need to relieve limitations that would otherwise have constrained the dispatch of generation connected to the DKTL.
    b. Identifies a preferred option consistent with the RIT-T guidelines that maximises the net economic benefit to all those who produce, consume and transport electricity.
3. Power and Water Board provides a commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the NER.

2.2.4 Meeting the NT NER requirements for inclusion as a contingent project

Table 2.2 provides a summary of how this project satisfies the criteria under clause 6.6A.1(b) of the NT NER to be accepted as a contingent project for the 2024-29 regulatory period.

Table 2.2: Application of the contingent project criteria

Criteria	How this project meets the relevant criteria
Reasonably required	The four large scale solar facilities connected to the DKTL are expected to be available for full dispatch in 2024-25[13], at which time they will be curtailed frequently and significantly due to a lack of system strength. This lack of system strength is due to the location of these facilities close to the end of the radial single 132 kV DKTL, and a significant distance from the synchronous generation at Channel Island. There is an overall net benefit of unlocking this capacity in the short term. It will become more important to help meet expected demand with the retirement of the Channel Island generators which will also commence in the next regulatory period. We consider this project is therefore reasonably required to be undertaken in the 2024-29 period.
Not included in the forecast capex	There is no expenditure included in our proposal that would increase system strength to reduce or remove the export limits of these facilities.
Reflects the capex criteria	Our preliminary assessment of the project is based on: • Assessment of the costs and benefits of continuing to curtail 55 MW of renewable generation on the DKTL which demonstrates a need for / prudence of investment in the next regulatory period (see section 2.2.1). • Options analysis of five options designed to improve system strength on the DKTL, and comparison to the status quo (see section 2.2.2). • Forecast costs based on the best information available to us at this point, and are reflect an efficient cost as they are sourced from third parties and have been tested with industry peers.
Exceeds $15 million or 5% of the annual revenue requirement in 2024-25	The estimated cost of each of the options considered in our preliminary assessment is above the materiality threshold for a contingent project.
Complies with relevant requirements of any relevant regulatory information instruments	N/A

[13] Following compliance with the GPS (expected in 2024-25)

Criteria	How this project meets the relevant criteria
Trigger events are appropriate	Our revised proposed trigger events for this project are aligned to those approved in the AER's draft decision for other contingent projects. They: • Are reasonably specific and capable of verification. • Reflect an event (NTESMO confirmation of a shortfall in system strength), which if it occurs makes the project reasonably necessary to continue to meet expected demand. • Reflect an event that relates to a specific location (the DKTL and Katherine region). • Is described such that the occurrence of the relevant events is all that is required to amend the determination. • The event is probable, given we expect the solar facilities will meet the GPS from 2024-25, and export limits have already been developed for these facilities due to the known network constraint. However, the inclusion of forecast capex is not appropriate because: – The timing of the project is uncertain due to long lead times and competition for the required assets, and need to complete a full assessment and RIT-T. – The costs are uncertain as the choice of technology and potential reduction in costs of these technologies is moving at a fast pace.

3. Managing network voltage and system strength with an increasing proportion of inverter-based generation

Territory Generation has published plans to start retiring the Frame 6 gas-fired generators at Channel Island from 2026, and has recently signalled its intention to retire one of the four Channel Island generation units sooner, likely by the end of 2024. As flagged in the DKESP, the expectation is that they will be replaced by renewable energy sources.

The existing synchronous gas-fired generators play an important role in maintaining system security. Synchronous generators are used to provide essential system services (**ESS**) such as inertia, frequency control and system strength. Asynchronous (or inverter-based) generation such as solar cannot provide these ESS alone, they have to be complemented by assets such as synchronous condensers or BESSs. Indeed, without these complementary assets, large scale inverter-based generation can actually have a detrimental effect on network voltage stability and system strength.

This contingent project is necessary to enable us to develop a solution to manage voltage stability and system strength as the Channel Island generators retire and the proportion of asynchronous generation connected to the Darwin-Katherine network increases.

This project is included as a contingent project because of uncertainty around the timing for the investment. Further analysis is required to identify the most prudent and efficient solution, which will be identified via a RIT-T process once the contingent project triggers have occurred.

Note this contingent project is related to the unlocking large scale renewables on the DKTL project (see section 2), in that this solution will address voltage and system strength issues which are likely to be exacerbated as the four large scale solar farms (and any other future inverter-based generation) export more electricity into the network. However, the triggers for, location of the issue, and potential solutions differ.

3.1 What is the challenge?

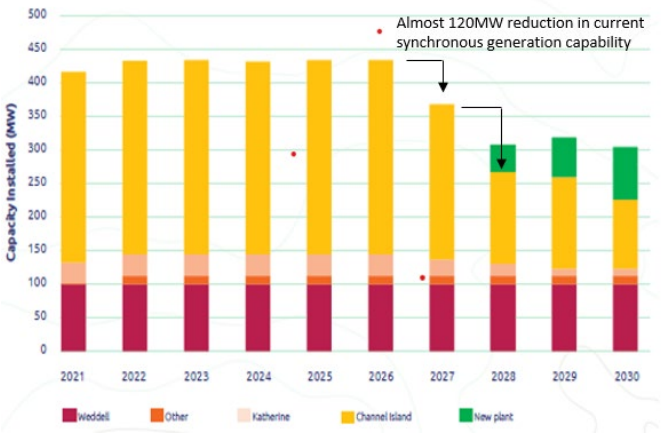
As the proportion of inverter-based generation in the NT's energy mix increases, and/or the number of synchronous generators decreases, the availability of ESS will decline and the risk of voltage and system strength issues will increase.

Why is this a problem now?

The DKESP shows the planned reduction in capacity at Channel Island Power Station due to the retirement of the existing Frame 6 gas-fired generators. These synchronous generators are relied upon for system strength (fault level), are used to manage reactive power and to provide the required system inertia.

The DKESP states that almost 200MW of installed thermal generation capacity is expected to retire by 2030, to be replaced by only 80MW of new thermal generation capacity.

Figure 3.1: Impact of retirements



Source: DKESP, Figure 25

What are the implications for the network?

Without any investment in the network to accommodate this change in the balance between synchronous and asynchronous generation will result in:

- A reduction in available fault levels, resulting in low system strength and protection schemes not operating as designed.
- High network voltages caused by an increase in reactive power[14], particularly on the 132 kV and 66 kV networks in periods of low demand.[15]
- Insufficient ESS available to be dispatched to maintain system security.[16]

The NT Network Technical Code places an obligation on system participants, including Power and Water as the network service provider, to provide facilities for ESS to address these needs. The System Control Technical Code provides the NTESMO with the authority to issue directions to system participants.

Critical to this, is that while it is a new connecting generator's responsibility to ensure it does not affect the security and reliability of network and system operations (largely through compliance with the GPS), there is no ability to impose such an obligation on an existing generator. We therefore reasonably expect, we will need to invest to address the network issues including voltage and system strength caused as synchronous generators retire. This is consistent with the proposed new ESS framework[17] that we expect will be in place in the 2024-29 regulatory period.

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[14] It should be highlighted that generators are being used to provide the reactive power compensation. This is not the preferred method for reactive power management. It is not the intended role of generators and can impact their ability to ride through a system disturbance/fault. Moreover, the generation mix towards smaller, and more inverter-based technologies provides less opportunity to use generators for reactive power management.

[15] Due to the expected frequency of the occurrence, it is not likely that the issue can be managed through curtailment of renewable energy to increase demand to manage voltage.

[16] This is already an issue in periods of low demand, with fewer facilities able to provide ESS running when System Control needs to dispatch them. This becomes more problematic as those existing ESS facilities retire and are replaced with renewable generators.

[17] This will clearly define and prescribe the ESS for the network service provider in Darwin-Katherine. The draft position paper places the procurement obligation on the network service provider in relation to the procurement of system strength, voltage management and network support. See NTEM Priority Reform Program: Review of Essential System Services, Draft Position Paper, Northern Territory Government, January 2021.

3.2 Our revised proposal

3.2.1 Project need

Since our initial proposal, we have undertaken studies to understand the options that can fill the ESS void left behind by the Channel Island generator retirements. Our initial proposal assumed investment in synchronous condensers and/or BESS on the DKTL to unlock the large scale solar would be sufficient to also maintain network voltage and system stability as the Channel Island generators retired, in the next regulatory period. However, our recent technical studies indicate addressing the system strength issues on the DKTL would not provide an adequate solution to maintain security of supply in the broader transmission and sub transmission network in the Darwin region in the near term. Additional investment is required.

We must plan and design our transmission system and equipment for the control of voltage and system strength to ensure we comply with the Network Technical Code and Planning Criteria. Our analysis has identified that the retirement of thermal generators and change in generation mix are likely to result in areas of non-compliance with our network standards and require investment in the network to ensure the system remains secure.

The timing and full impact of the Channel Island retirements, while understood at a high level, has not been fully analysed. This analysis will not be available prior to the conclusion of this regulatory process, however, the likelihood that a network (or non-network) solution to address ESS provision once the Frame 6 generator ceasing operation is high. As such, we have proposed this project as a contingent project, which will enable detailed studies and efficient solution to be developed and executed during the regulatory period.

3.2.2 Preliminary options analysis

Consistent with the economic analysis procedure in the RIT-T guidelines, we have conducted an initial assessment to identify credible options that will allow us to operate the network in a safe, reliable and secure state.

Given we are in the early planning stages of this project, our review of credible options has been high-level and focused on options that would address the need and are technically feasible and can be implemented within the required timeframe. The following options have been identified:

1. Installation of 2 synchronous condensers.
2. Installation of 2 synchronous condenser packages including fly wheel and a BESS.
3. Installation of reactors at zone substations across the network.
4. Installation of new synchronous generation.
5. Installation of a BESS with grid-forming inverters.
6. Conversion of retiring synchronous generators into synchronous condensers.

We highlight that:

- In this case, we consider that the status quo or 'do nothing' option is untenable as it would result in the network operating in a non-secure state.
- These options require further analysis and do not necessarily make up a full suite of potential credible options. Additional options will be assessed as part of further technical studies and the RIT-T.
- The economic analysis of the options has not yet been completed, but will be completed as part of the RIT-T.

We expect that the investment will result in positive market benefits.

3.2.3 Trigger events

Consistent with the AER's draft decision on other contingent projects, we have revised the proposed trigger events for this project to be more specific.

Our proposed trigger events are:

1. One or more of the following occurring:
    a. Confirmation by NTESMO of a projected shortfall in system strength and/or voltage support services in the Darwin region; and/or
    b. A regulatory obligation or requirement within the meaning of section 2D of the *National Electricity Law,* such as a Ministerial Direction under the *Government Owned Corporations Act 2001 (NT)*, or some other legislative or regulatory measure implemented by the Northern Territory Government, that requires the Power and Water Corporation to provide ESS including voltage, network support and/or voltage support services.
2. The AER is satisfied that Power and Water has successfully completed a RIT-T that:
    a. Identifies the need consistent with the RIT-T guidelines to manage the issues caused by a shortfall in ESS, or direction by the Norther Territory Government.
    b. Identifies a preferred option consistent with the RIT-T guidelines that maximises the net economic benefit to all those who produce, consume and transport electricity and/or implements a reliability corrective action.
3. Power and Water Board provides a commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the NER.

3.2.4 Meeting the NT NER requirements for inclusion as a contingent project

The following table provides a summary of how this project satisfies the criteria under clause 6.6A.1(b) of the NT NER to be accepted as a contingent project for the 2024-29 regulatory period.

Table 2.1: Application of the contingent project criteria

Criteria	How this project meets the relevant criteria
Reasonably required	The initial analysis demonstrates that the project is probable due to the expected timing of the generator retirements and introduction of additional inverter-based generation in the Darwin region. We consider this project is therefore reasonably required to be undertaken in the 2024-29 period.
Not included in the forecast capex	There is no expenditure included in our proposal that would ensure we are able to operate the network, in particular in the Darwin region, in a safe, reliable and secure way given the change in generation mix that would arise from the retirement of the Channel Island generators.
Reflects the capex criteria	Our preliminary assessment of the project is based on: • Identification of the estimated costs and benefits of addressing a projected shortfall in system strength in the Darwin region which demonstrates a need for / prudence of investment in the next regulatory period (see section 3.2.1). • Identification of six options designed to improve system strength in the Darwin region, and comparison to the status quo (see section 3.2.2). • Forecast costs based on the best information available to us at this point.
Exceeds $15 million or 5% of the annual revenue requirement in 2024-25	The estimated cost of each of the options considered in our preliminary assessment is above the materiality threshold for a contingent project.
Complies with relevant requirements of any relevant regulatory information instruments	N/A

Criteria	How this project meets the relevant criteria
Trigger events are appropriate	Our revised proposed trigger events for this project are aligned to those approved in the AER's draft decision for other contingent projects. They: • Are reasonably specific and capable of verification. • Reflect an event (NTESMO confirmation of a shortfall in system strength), which if it occurs makes the project reasonably necessary to continue to meet expected demand. • Reflect an event that relates to a specific location (the DKTL and Katherine network). • Is described such that the occurrence of the relevant events is all that is required to amend the determination. • The event is probable, given we expect the solar facilities will meet the GPS from 2024-25, and export limits have already been developed for these facilities due to the known network constraint. However, the inclusion of forecast capex is not appropriate because: – The timing of the project is uncertain due to long lead times and competition for the required assets, and need to complete a full assessment and RIT-T. – The costs are uncertain as the choice of technology and potential reduction in costs of these technologies is moving at a fast pace.

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