Addressing Queensland's System Strength Requirements

Webinar held: 29 November 2024, 1-2pm AEST

Questions and answers

Do you consider other technologies that are not listed in your portfolios?

If there's another technology that has not been considered in the portfolios yet, there is still time to provide information on that.

Can you explain in more detail 'transfer of revenue from energy' while providing the service?

The transfer of revenue from energy while providing system strength services refers to how financial flows will be managed when a system strength service is dispatched.

When a synchronous machine is providing system strength services, the associated generation or load participates in the energy market. When it is dispatched for system strength services, energy revenue associated with its operation, will be transferred to Powerlink.

For example:

- For a synchronous machine **generating** 10 megawatts (MW),
    - if the spot price is **negative**, such as -$100/MWh, the proponent would pay $1,000 per hour (10 MW x -$100). This cost would then be passed through to Powerlink.
    - if the spot price is **positive**, say $100/MWh, the proponent would receive revenue of $1,000 per hour (10 MW x $100) for 10MW generation. This revenue will similarly be passed through to Powerlink.
- Similarly, for a synchronous machine **consuming** 10MW of load
    - If the spot price is negative, proponent revenue will be passed through to Powerlink
    - If the spot price is positive, proponent costs will be passed through to Powerlink.

If the asset were to switch back to commercial operation, this pass-through arrangement would no longer apply, and the proponent would resume direct exposure to energy market dynamics.

What is the maximum contract term that will be considered to amortise capital expenditure over?

The maximum contract term for amortising capital expenditure will largely depend on the specific needs and circumstances of the project. This includes factors such as the level of uncertainty, the nature of the investment, and the need for flexibility as conditions evolve.

Generally, shorter contract terms are preferred to retain flexibility in case the need for the service changes or diminishes. However, for projects involving significant capital expenditure, longer contract terms may be considered to spread the cost over a more extended period and reduce the annual financial cost.

As a guide, a 10-year term is likely to be the maximum contract duration. If there's a compelling case—such as a substantial capital investment or unique circumstances—extending beyond 10 years could be explored, but this would require careful consideration and justification.

For assets or services with minimal or no capital investment, shorter contracts are preferred to maintain agility and avoid locking in longer-term commitments. Each case will be evaluated on its merits, balancing financial prudence with operational needs.

What does the 2 December 2025 deadline relate to? What options does Powerlink intend to commit on by then?

The date of 2 December 2025 is when AEMO is required to have its system for scheduling and enabling system strength services operational. This is the date by which Powerlink must have services available for AEMO to schedule, meaning AEMO will begin managing and dispatching these services under the new system strength framework.

By this date, Powerlink aims to have addressed all early requirements to ensure the planned levels of system strength are available. This includes having contracts in place for system strength services, as these are essential for AEMO's scheduling and dispatch processes to operate effectively. The focus is on aligning with AEMO's timeline and ensuring the necessary arrangements are finalised to support the enablement of services.

In the RIT-T you have three different services options. One is the reactive power, and then you have fault level and inertia. When you talk about overloading capability, do you mean that you would require that overloading capability for dynamic reactive support as well?

The assessment of short-term overloading capability relates specifically to the system strength requirement for stable waveforms, not to inertia or reactive power services. The focus is on ensuring a stable voltage waveform under dynamic conditions.

This capability is assessed in scenarios such as where a battery operates at its steady state limit (i.e. its designed maximum active and reactive power output), with tests conducted in PSCAD as well as through information provided by manufacturers about how overloading and battery current limitations are implemented. The aim is to evaluate whether the equipment has sufficient headroom to operate for certain dynamic network conditions lasting for short timeframes (e.g. fault recovery) without reaching its current limit.

This short-term overloading consideration is not about reactive voltage control requirements. Instead, it ensures the stability of the voltage waveform and prevents distortions that could impact the recovery of other grid-following renewable plants after a disturbance in the network. For instance, if the proposed solution is operating at its design limits, the assessment checks whether a reasonably expected network transient event could result in waveform distortion (caused by the BESS reaching its limits) and how that could affect the recovery of other renewable plants in the broader network. The BESS may provide short-term overloading (through various means) to meet these performance requirements, avoiding waveform distortion in this assessment.

In summary, this assessment is focused solely on the system strength support function and its dynamic response, rather than reactive power or inertia services.

What specific documents or additional materials should be included in submissions due by 20 December? While the PADR outlines some requirements (e.g., technical and financial appendices with tables to populate), it is unclear whether other supporting documents, such as an MS Project schedule, project plan, or delivery strategy, should or could be included.

The required information for submissions is outlined in Appendix B of the PADR, which provides a proforma detailing all the necessary details and data. Beyond the specified requirements, there are no additional mandatory documents.

However, if you have supplementary materials—such as an MS Project Schedule, Project Plan, Delivery Strategy, or any other documents you believe strengthen or clarify your submission—we encourage you to include them. While not explicitly required, additional documents are welcomed and will be reviewed as part of your submission to better understand your proposal.

For synchronous machines, how frequently do you anticipate calling upon the service in a 24-hr period? Is it likely that the service will be called upon for 5 min and then switched off next 5 min trading interval?

The frequency and duration of calls will depend on AEMO's scheduling system, which is currently under development. As such, this is a question best directed to AEMO, as they will determine how often and for how long the service will be required within a 24-hour period. At this stage, the specifics of how the system will manage services, such as whether it will involve short intervals (e.g., 5 minutes on, 5 minutes off), are not defined.

Will Powerlink be shortlisting projects for system strength contracts based on the PADR submissions, or is that post-PACR?

Powerlink will use the PADR submissions as the basis for shortlisting solutions for system strength contracts, but the timing of the shortlisting—before or after the PACR—will depend on the urgency of the service need:

- **Immediate Needs (e.g., by the end of 2025):** Projects required for the go-live date will need to be progressed quickly. These contracts will be prioritised and shortlisted earlier.
- **Longer-Term Needs (e.g., 2030):** For services aligned with later requirements, such as those needed by 2030, the contracting process may occur in stages and be finalised closer to the time of need.

This approach reflects a staged contracting process to accommodate both immediate and future requirements. To facilitate this strategy, it is crucial for proponents to provide as much detailed information as possible in their PADR submissions by the 20th of December. This information will enable Powerlink to address both near- and long-term needs.

Regarding dispatching units for system strength, will a new dispatch system be stood up between participants, TNSP and AEMO, or will existing systems be used?

The specifics of how units for system strength will be dispatched—whether through a new dispatch system or existing systems—are better addressed by AEMO. As the organisation responsible for scheduling and dispatching

system strength services, AEMO will determine the operational framework and system requirements. For the most accurate and detailed information, it is recommended to consult AEMO directly.

More information on AEMO's arrangements for the enablement of system strength services is available on the Improving Security Frameworks for the Energy Transition page of AEMO's website.

Is coal being considered for short-term system strength services? If so, how will dispatch between energy and system strength services be managed, particularly during negative pricing periods when coal generators might otherwise shut down?

Coal generators could potentially be considered for short-term system strength services. If a generator that would otherwise be offline needs to be brought online specifically for system strength, it would be activated under system strength requirements. The associated costs of this activation could be covered by Powerlink.

Any energy revenue during this period—whether positive or negative—will flow through to Powerlink. This includes periods of negative energy pricing, where coal generators might otherwise shut down.

Regarding contracts, the preference is to rely on generators already online for energy purposes. If there are insufficient machines online to meet system strength needs, Powerlink may pursue contracts to address these gaps. The goal is to minimise the need for such contracts by leveraging existing energy generation where possible.

Is it possible to share any technical expectation and assessment guideline document for grid forming services?

Appendix I of the PADR provides a summary of Powerlink's technical expectations and assessment guidelines for grid-forming services. These expectations supplement the standard connection requirements, which include compliance with fault ride-through and other established performance standards.

In addition to these baseline requirements, Appendix I outlines expectations specific to grid-forming services, such as:

- Fault ride-through performance under weak system conditions.
- Frequency response capabilities.
- Short-term overloading capabilities.
- Mode change expectations (e.g., transitioning between grid-following and grid-forming modes).

While the appendix provides a generic framework, we recognise that each manufacturer's implementation of grid-forming technology is unique. During the submission review process, we will engage with participants individually to delve deeper into the specifics of their proposals and address unique considerations.

Was there base inertia (h) used for the syncon assessment modelling?

A base level of inertia for synchronous condensers was assumed in the modelling. When replacing coal units with synchronous condensers, our analysis included considerations for inertia and its impact on other aspects system stability. This is representative of a typical level of inertia that is equivalent to the size of the condenser utilised in the study, although additional inertia may be procured if future inertia shortfalls are declared.

A level of inertia has been considered in the planning process, and Powerlink remains flexible in addressing both current and future needs through incremental upgrades like flywheels where appropriate.

Detailed BESS model means - are you referring to the PSCAD model we usually submit as part of GPS package?

Yes, the detailed BESS model refers to the PSCAD model typically submitted as part of the GPS (Generator Performance Standard) package. If your BESS project is at a stage where you already have a PSCAD model submitted for your connection application, that same model can be used.

The expectation is that the settings in the model should remain consistent with those used for GPS compliance. However, in this case, additional checks will be performed to verify the functionality of any extra features or services the BESS may be providing for the efficient system strength services. This will ensure alignment between the GPS model and the requirements for the specific application.

If the PSCAD model is not available, due to the stage of the battery project, Powerlink could still consider the BESS project. Although, that would depend on the intended project completion date and Powerlink's identified need for services in associated years. Therefore, Powerlink would be willing to discuss the details of these projects directly with BESS participants and receive any information available on the project that could be provided.

When does Powerlink intend to provide a draft contract? Will the contract include availability obligations?

The timeline is as follows:

- After submissions close and assessments are completed for the initial tranche (Tranche 1) contracts, Powerlink will begin drafting contracts.
- The aim is to finalise and release the draft contracts as quickly as possible, ideally within a few months after the assessments are completed.

A realistic timeline for providing the draft contracts for Tranche 1 would be by **end of April 2025.**

The contract will include availability obligations.

Are BESSs able to change between grid-forming and grid-following modes?

No, if being used for system strength, they cannot go into grid-following mode. For the system strength service, Powerlink requires a consistent grid-forming operation without mode changes. This will ensure reliability of the service, and avoid potential risks associated with unintended or unexpected transitions between modes, during power system disturbances or when there is a need to provide system strength during normal power system operation.

How is the required system strength amount for grid-forming BESS quantified from dynamic studies, and how is this reflected in the pricing structure?

The required system strength amount is determined through detailed dynamic studies based on forecasted renewable generation (wind and solar) provided by AEMO. The process is as follows:

1. **Forecast Integration:** The studies incorporate AEMO's MW forecasts for wind and solar generation in specific years and locations.

2. **Assessment of BESS Needs:** The studies assess how much battery energy storage is needed to support the additional renewable generation. Assumptions were made about battery sizes, generally optimising them between 200 and 300 MW.
3. **Geographic Allocation:** Batteries are allocated to areas with forecasted increases in renewables to meet the system strength needs. The quantity of grid-forming BESS required is mapped to these forecasted needs (gradually increasing the number of BESS' in the study as the forecasts grew), recognising that changes in forecasts may adjust these quantities.

While this approach provides a framework for determining BESS requirements, specific details on pricing structures depend on technical studies and competitive processes. Powerlink is open to further detailed discussions on these aspects and encourages reaching out via email for a one-on-one session to explore this topic in greater depth.

What is the approximate minimum h value (inertia) used in the studies?

In the studies, the assumed H value (inertia) was typical for the size of the synchronous condensers used, which were around 200 MVA. While the exact H value was not a primary focus, the equivalent inertia was incorporated as part of the modelling assumptions.

Key points:

- While inertia wasn't the primary design parameter considered in system strength studies, it was included as a by-product of the chosen synchronous condenser sizes.
- Additional assessments, using RMS based software tools, explored the impacts of assumed H values on other power system stability factors, such as transient stability.
- Inertia requirements may be addressed separately if needed, taking into account the inertia contribution provided by the selected system strength solutions.

The inclusion of inertia is part of broader considerations on system stability and is not expected to significantly alter the system strength study outcomes.

How is system strength being assessed for grid-forming technologies compared to synchronous machines, given the current methodology?

For efficient system strength services, if a grid-forming BESS is shortlisted, then the assessments described in Appendix I, supplemental to information/assessment in the standard connection process, would be needed. Powerlink will also evaluate the specific solution in our PSCAD wide area network to ensure it is fit for purpose for the efficient need. For synchronous machines proposed for efficient services, Appendix I does not apply. However, the proposals will still need to be assessed through wide area network simulations, which will require modelling and detailed information of the machine.

For minimum system strength services, currently Powerlink has assumed synchronous machines would primarily meet this requirement. To incorporate grid-forming BESS as part of minimum fault level requirements, Powerlink considers that several key activities are needed in the near future to assess the performance of grid-forming BESS and build confidence in the technology to assist with minimum requirements. Synchronous generators also provide a range of essential stability services beyond system strength. To replace synchronous machines with

grid-forming BESS for minimum requirements, we need to take a broad and balanced approach that considers the overall stability and operation of the power system.

If you have a large BESS (500MW plus), but split into two equal halves behind the POC (multiple transformers, multiple PPCS etc.), can you bid in a portion of the asset given it looks like 500MW + would be more than is being called for here?

Powerlink would be open to various grid-forming BESS options, including the scenario in the question, where half of a 500MW grid forming BESS can operate independently of the other (behind the POC). However, the need and size of a grid forming BESS is also dependent on the location of the installation as discussed in Appendix H and displayed in Figure 5 in Appendix H of the PADR.

The details of the connection arrangement in this case and BESS/PPC capabilities would also need to be discussed with Powerlink to further understand the specifics of the project and its offering for system strength.

Assessing the oscillation damping capability for system strength services, are you looking for small signal model?

To assess BESS oscillation damping for efficient system strength services, the study will need to be conducted in the PSCAD tool, using a similar approach to the oscillation rejection test described in AEMO's Dynamic Model Acceptance Test (DMAT) guideline. However, the conditions of the oscillation rejection tests to assess provision of the efficient service will need to be conducted as per Appendix I in the PADR. Regarding a small signal model, provision of this type of model and/or relevant small signal model information would be managed through the connection application process.

Will providers be penalised for not meeting availability obligation/s? What is the expected financial impact of not meeting the availability obligation?

Availability will be included in the contract as a performance guarantee and penalties will apply for not meeting this level.

Specific penalties are still to be determined but expect to at least include a reduced availability payment.

If you have further questions, or need clarification on any aspect of the PADR, please contact Powerlink's Network Assessments team at networkassessments@powerlink.com.au.