Electricity Authority
Wellington

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By email: OperationsConsult@ea.govt.nz

Wholesale market arrangements for battery energy storage systems

Transpower welcomes the opportunity to submit on the Electricity Authority's (the Authority's) consultation on Wholesale market arrangement for batter energy storage systems. This submission is from Transpower in our role as System Operator.

While the Authority's consultation paper explicitly excludes consideration of hybrid arrangements (Intermittent generation and co-located BESS), hybrid installations will soon be connected to the power system.[1] It would be preferable for Code and tool development decisions made under the Wholesale market arrangements for BESS to be cognisant of potential changes which may arise from the consideration of hybrid arrangements. The Authority's Future Security and Resilience (FSR) project is working with the System Operator and Common Quality Technical Group (CQTG) to consider the common quality obligations of hybrid arrangements. The FSR programme work will inevitably, broaden to consider wider Code implications because of the inter-related nature of the Code and defined terms. It is possible interim arrangements may be a pragmatic solution to 'align' the two workstreams.

We look forward to working with the Authority and industry to deliver improved treatment of BESS in the wholesale market.

Our responses to the Authority's questions follow in the Appendix.

Yours sincerely

Rebecca Osborne

Head of Markets

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[1] Meridian have commissioned their BESS and begun construction of their solar farm at Ruakākā, Ruakākā Energy Park | Meridian Energy

Appendix A: Transpower response to consultation questions

Submitter	Transpower

Questions	Transpower response
Understanding the characteristics, benefits and future operation of BESS	
Q1. Do you agree we have sufficiently identified the unique characteristics of BESS to assist in developing appropriate arrangements?	Yes
Q2. Do you have any views on how BESSs should be defined in the Code?	If BESS have unique obligations in the Code (as is likely) then that should be unique defined assets and asset owners (analogous to "generator" and "generating unit"). _We propose introducing the term "Battery Energy Storage System (BESS) meaning an **Energy Storage System** whose method of energy storage is electrochemical potential energy."_ _We propose introducing the term "BESS Trader" meaning a **Trader** in relation to the buying and selling of electricity from the charging and discharging of a BESS._ Part 13 arrangements are typically accorded to asset owners/traders, hence unique trading obligations should be applied to BESS traders. More generally we note, while a technology agnostic Code is preferable there are pragmatic limits to that goal. Especially when the additions to the Code are for a technology which presents as both supply and demand side and the existing Code treats supply and demand as distinct non-overlapping entities. As noted in our covering letter hybrid arrangements for BESS will shortly be in operation in New Zealand. It would be preferable for Code and tool development decisions made under the Wholesale market arrangements for BESS to be cognisant of potential changes which may arise from the consideration of hybrid arrangements. Interim arrangements may be a pragmatic solution to 'align' the two workstreams if one needs to advance ahead of the other.

Questions	Transpower response
Q3. Do you agree that BESS can deliver the benefits described? Are there any other benefits that will assist us in assessing the size of benefits of different arrangements?	Incentivising BESS to connect to the power system and to participate in the markets for energy and ancillary services should be a high priority. It is likely BESS will also be able to provide system services that will become more in demand as synchronous generation is displaced by lower-cost, inverter-connected wind and solar generation. The technical capability of BESS aligns not only with current system services, but also with those the system may need in the future. We are beginning to anticipate a growing need for synthetic inertia and/or fast frequency contingency management services and normal band frequency regulation. It is also likely BESS would provide cost-effective alternatives to reactive equipment and assist with managing system strength (provided locational investment signals are developed). The development of future system needs and the system services to meet those needs is part of the Authority's FSR programme roadmap.
Q4. Do you agree with our description of how BESSs are likely to operate and how this will change over time? If not, why?	Apart from observations of trading behaviour of New Zealand's two market-participant BESS, our operational experience is limited and recommend the Authority's analysis is informed by experiences in international jurisdictions (noting the various ways in which each jurisdiction has its unique behavioural motivators). Examples include: Australia: The State of Battery Energy Storage in the NEM - Research | Modo Energy Battery Archives - Renew Economy ERCOT battery energy storage buildout: Record-breaking BESS in June - Research | Modo Energy
Q5. Do you have any other insights about potential BESS operation that will help with assessing the benefits of our options?	Care needs to be taken in attempts to extrapolate overseas experiences with expectations around what may happen in New Zealand regarding BESS rollout and operation. For instance, several overseas jurisdictions have subsidies or other 'non-market' incentives or drivers in place. These not only affect the rollout of BESS but also their operation: not all costs need to be recovered from the market. Under current market arrangements in New Zealand a BESS would need to be recover all its revenues from the 'market' (energy, ancillary services, hedging, contracts etc). One observation from overseas which is likely to port directly to New Zealand is the impacts of 'first mover advantage' whereby the first (early) BESS price and volume impacts on a market reduce revenue opportunities for subsequent BESS.

Questions	Transpower response
	As noted in our covering letter hybrid arrangements for BESS will shortly be in operation in New Zealand. Hybrid arrangements may have different drivers to their owners than stand-alone schemes and those drivers may themselves be influenced by policy decisions (e.g. should frequency keeping costs be allocated on a causer pays basis) which may be made in the future.
Dispatch requirements for BESS when charging	
Q6. Do you agree with the way we have framed the issues?	Yes
Q7. Do you agree with the Authority's preferred option? If not, what are alternative options that would better address the issues? Are there any particular risks with our preferred option that you would like to identify?	Yes. Particularly, BESS should not be permitted to bid 'non-dispatchable' (currently permitted for dispatchable load purchasers). As it stands BESS are entitled to ignore the economic outcomes of their bids and sometimes choose to charge even when their bids have failed to clear. This causes operational issues in real-time. This issue is likely to increase in severity as more BESS are commissioned, and the currently ambiguous obligations remain unclear. We consider the best way to effect these constraints is through implementation of the bi-directional offer form described as a solution to Issue 2. However, until modifications can be made to the market systems to enable that enhancement, we recommend Authority defines bidding obligations for BESS as distinct from other dispatchable load purchasers and define those obligations to mirror the requirements for generator offers. Both of these points could be effected by consideration of BESS as generating units (and BESS traders as generators). However, we believe the better solution ultimately would be to define unique obligations for BESS on the understanding they have unique operating characteristics. This view is reinforced when considering common quality requirements (for example, what are the obligations on BESS for supporting frequency and voltage when connected but idle) and settlement (for example, what constrained-off and constrained-on situations are appropriate – this is partially considered later in the Authority's paper).
Bids and offers forms for BESS	
Q8. Do you agree with how we have framed the issues?	Yes, we note the issues described exist both in the Code and the market systems – with the latter reflecting the former. We have already experienced several issues of the kind described in paragraphs 5.11-13, where low energy and reserve prices have combined to create conditions where IL is scheduled, requiring the BESS to charge, while the BESS is also scheduled to discharge energy. This is

Questions	Transpower response
	a non-physical outcome which happens to be the most economically efficient (lowest system cost) within the modelled constraints. Non-physical outcomes are currently managed through system co-ordinator and BESS operator intervention to manually adjust the set of offers and bids for the BESS, which may result in less economically efficient outcomes. This issue is likely to persist and become more impactful as more BESS are commissioned.
Q9. Do you agree with our preferred option? If not what other options would better address the issues identified?	Yes. The System Operator has indicated the impacts to our tools and process in the TAS 113 report "Improving offer arrangements for battery energy storage systems' provided to the Authority (Appendix E of the Authority's consultation paper). A bi-directional offer would most intuitively describe the physical capability of BESS and significantly simplify operations for both BESS traders and system coordinators. We agree a bi-directional offer would resolve the current issues of non-physical dispatch using appropriate co-optimisation constraints for energy and instantaneous reserve. We also expect bi-directional offers will help to enable MFK offers for BESS through 'zero', the point at which the BESS transitions from charging to discharging and vice-versa, (i.e. easing implementation of MFK during charging) and will likely complement co-optimisation of MFK with energy and instantaneous reserve, if that choice is made in the future. MFK is required to be procured on a least cost basis, where those costs are the MFK offer and an estimate of constrained-on costs which will be incurred if that provider is selected. If constrained-on costs are not paid in relation to MFK provision tool, changes to enable BESS participation in MFK may be simplified. If constrained-on payments are removed for the provision of MFK, providers would internalise the expected lost revenue in their MFK offer. Further, should this be considered it would also simplify tool changes needed to enable demand side provision of MFK. The Authority has noted the possibility of removing constrained payments from MFK providers previously and refers to this in paragraph #7.22. Lastly, we note the Authority has a separate MFK redesign workstream in progress. [2]
Q10. Do you think further restrictions to BESS participation in MFK under	We recommend the Authority move to quickly enable BESS to be able to provide frequency keeping services across their full operational capability.

[2] See Recommendation 6 (new reserve product) - Strengthening the wholesale market: quarterly update | Electricity Authority

Questions	Transpower response
the current arrangements would have any effect on their participation?	

Balancing flexible trading with security needs

Questions	Transpower response
Q11. Do you agree the issues identified by the Authority are worthy of attention? If so, do you agree with our framing?	Largely yes. As we have advised the Authority in our paper, we rely on gate closure to secure the system prior to real-time, permitting the current level of resourcing to manage real-time variations from the modelled system state. Our ability to secure the system is negatively impacted by reducing gate closure period or increasing deviations from modelled generation and demand. As the instantaneous penetration of intermittent generation increases so does our workload for securing the system, as more contingencies and potential system states must be considered and preparations made to manage those eventualities. The prospect of also allowing BESS, which by nature are controllable and not intermittent, to not be constrained by gate closure* presents a security risk when the MW capacity of installed BESS on the system is expected to increase rapidly in the short-term. It exacerbates the existing problem of the system becoming less predictable. As the Authority has identified, we have initiatives underway which are addressing the problem of increasing unpredictability, but these initiatives are in the early stages of investigation. It is currently unclear whether there would be sufficient benefits to consumers from allowing reduced gate closure for BESS to justify the increased risk to the power system that would follow. *Noting that gate closure restrictions are lifted during grid emergencies, when additional BESS capacity is most likely to be both beneficial to the power system and lucrative to the BESS Trader. We also note industry's desire for accurate price forecasts is eroded, in the main, by a reduction in gate-closure arrangements. For every negative impact on maintenance of system security there is likely to be an equivalent impact on market predictability and the accuracy of forecast prices.
Q12. Do you agree that BESS should have the same arrangements when charging and discharging, and that embedded BESS	Yes. Separately, we recommend updating gate closure requirements for offered embedded generators to align with grid connected generating units. We note the existing gate closure arrangements for offered embedded generators are effectively unchanged since the market began. Since then, the number of offered embedded generation sites and their average capacity has grown and looks set to continue increasing.

Questions	Transpower response
should have the same arrangements as grid connected BESS?	
Q13. Do you agree with our preferred new arrangements for BESS?	Yes. We note the Authority's statement the System Operator is "permitted under the current rules" to constrain BESS to charge when anticipating capacity shortfalls needs careful consideration of the constrained-on provisions within the existing Code and the proposals made in this consultation paper.
Q14. Do you see any issues with how we have defined state of charge constraints?	No.
Q15. Do you agree that the benefits of state of charge constraints likely outweigh the costs?	Yes.
Q16. Do you agree with how we have characterised the differences between various options?	Yes.
Q17. Are there any other options that you think would better achieve the gate closure objectives?	Several options could address gate-closure objectives, however none of these have been sufficiently investigated or scoped yet to enable a full consideration: The System Operator included discussion of intertemporal solves within our Evolving market resource co-ordination in Aotearoa New Zealand white paper (section 4.2.1). Intertemporal solves would optimise a BESS's charge and discharge cycles over an extended period (e.g. 12 hours) based on the trader's offers and the system's needs over the period being solved. Consequently, it would internalise many of the issues the Authority is considering concerning BESS and gate-closure. Intertemporal solves would not address gate closure issues arising from changes to scheduling which occurred after the solve completed. A summary of industry feedback on intertemporal constraints and our response to those is in Section 3.3 Intertemporal constraints (Q4) of our Market Resource Coordination Consultation Responses paper.

Questions	Transpower response
	BESS owners would be able to trade better if they were aware of intra-period peaks rather than just the average load over a half-hour. To give visibility to this a higher resolution short forward schedule could be instigated e.g. 5-minute intervals covering the next 2-4 hours solved and published every 5 minutes. Moving market settlement to 5-minute intervals would incentivise BESS traders to improve their offers to enable value maximisation based on the increased granularity of price and volume 5-minute settlement delivers.
Q18. Do you consider an interim solution is necessary? If so, do you agree with the potential solution we suggested?	This is a difficult question to answer because it depends on many unknown variables; the quantity of BESS on the system prior to the preferred solution being implemented, the situations in which BESS use is impacted the existing Code obligations concerning bids and offers, and the impact to security of the power system for enabling a carve out within those obligations for BESS to change their trades after gate-closure. The interim solution suggested by the Authority appears workable to the System Operator subject to the finer details of exactly which situations gate-closure obligations would not apply to BESS. Interim solutions need careful consideration of the impacts on the System Operator control rooms to ensure operational complexity is avoided. A solution which added operational complexity would add risk to the safe and secure operation of the power system, including in situations when capacity is tight on the system. NB in such situations existing processes would signal the need for more generation to be made available and the declaration of a grid emergency 'voids' gate-closure restrictions concerning increasing offered quantities. Should the Authority decide to proceed with an interim solution the System Operator requests to be involved in the design of the interim solution. Identifying situations which are a 'genuine surprise' from those which reflect 'lazy trading' is the key concern the System Operator has with the interim solution proposed. The interim solution should enable the former while seeking to preclude the latter. Due to the unquantifiable impacts of an interim solution the System Operator may need to engage with the Authority post-implementation, should one be progressed, to mitigate operational concerns (should any arise).
Q19. Do you have any information that can help us better understand the	Gate closure exists to provide certainty to both the System Operator and to market participants. Reducing gate closure introduces increased uncertainty to operational and market outcomes. In this way it can be thought of as analogous to uncertainty in these processes arising from forecast errors

Questions	Transpower response
benefits and costs of different options? This includes, for example, substantiating the system risks, and how to improve our modelling of benefits.	(Wind, solar, and demand forecasts all contain an inherent uncertainty). We note the Authority has spent considerable effort attempting to improve the accuracy of forecast inputs to the scheduling process. The Authorities consultation paper notes the expected large volumes of BESS expected to be operational soon, an installed MW quantity which exceeds historic forecast error quantities the Authority has sought to eradicate. While we cannot provide quantified estimates moving to a reduced gate closure in this submission it would require significant changes to System Operator tools and process. Several processes critical to the provision of system security are designed around the existing gate closure construct: for example, the calculation of reserve requirements and the automated building of transmission security constraints. While the tools and processes delivering these functions can run in real-time this is the exception and not the rule. To enable these to be able to run in real-time as the default setting would likely require a significant investigation and fulsome consideration of the operational impacts of reducing gate closure. As noted earlier, reduced gate closure also impacts market participants. Participants would face increased uncertainty around prices, transmission security constraints, instantaneous reserve requirements, and expectations around how their own assets will be scheduled. One option to reduce the quantum of impacts of reduced gate closure is to restrict the instances in which changes to bids and offers can be made close to real-time and the manner of those changes. We observe, if highly restrictive arrangements are placed on bid and offer updates close to real-time to manage the impacts of reduced gate-closure it would in effect, beg the question of why gate-closure provisions were removed?

Constrained off payments

Questions	Transpower response
Q20. Do you agree the issues identified by the Authority are worthy of attention?	We think the issues presented require more consideration. The current constrained costs regime anticipating uni-directional injection or consumption of energy and what consequences there are to the participant of being unable to realise their offered/bid price. As the Authority details earlier in its paper, BESS traders are unique in their trading incentives – BESS traders choose to consume electricity anticipating a later benefit through injecting. If BESS were to be constrained off while charging to NOT charge, they would be exposed to later opportunity costs by being unable to inject in a period which would have realised their internal benefits. Conversely, even if a BESS is constrained off

Questions	Transpower response
	and unable to charge before a later anticipated injection period, it is likely that a sufficiently high-priced period would eventuate at some point, so the opportunity cost is simply a delay to realising income. Regardless, we expect BESS traders are sufficiently unique in their trading motivations that a separate constrained-costs regime could be appropriate.
Q21. Do you agree with our framing of the issue?	See response to Q20.
Q22. Do you consider having constrained off payments would affect bidding and offering behaviour from BESS?	See response to Q20.
Q23. Do you agree with our preferred solution?	See response to Q20.