LODESTONE ENERGY

25 September 2025

System Operator
By e-mail: system.operator@transpower.co.nz

Re: Connected Asset Commissioning, Testing and Information Standard

Dear System Operator,

Lodestone Energy appreciates the opportunity to provide feedback on the System Operator's consultation on the proposed **Connected Asset Commissioning, Testing and Information Standard (CACTIS)**. This letter forms the entirety of our submission and includes both our position and supporting technical commentary.

As New Zealand's first utility-scale solar developer, Lodestone Energy has a strong interest in ensuring that grid requirements are technically justified, commercially feasible, and aligned with international best practice.

Lodestone Energy was founded in 2019 with the mission to "harness the sun's energy to power Aotearoa's zero carbon future". We currently operate three solar farms in Kaitaia, Edgecumbe, and Waiotahe with two more under construction in Whitianga and Clandeboye and a pipeline to deliver another nine sites over the next few years. Our experience as an early mover gives us practical insights into the challenges of connecting inverter-based resources (IBRs) to the grid, particularly within distribution networks.

Lodestone Energy believes in being a responsible grid participant. We support paying reasonable compliance costs where these demonstrably improve system reliability and fairness. However, compliance requirements must be proportionate, evidence-based, and not impose unnecessary burdens that hinder New Zealand's uptake of new renewable generation.

Executive Summary of Lodestone Energy's Position on the Proposed CACTIS

Lodestone Energy **does not support** the proposed CACTIS in its current form. Although we support the principle of **standardising information requirements**, the proposed changes outlined in the new CACTIS introduce **significant costs, technical complexity, and uncertainty** without clearly articulated or quantified benefits. We urge the System Operator reconsider the requirements outlined within the document.

Our key concerns:

1) **Modelling Requirements are Excessive**

   The requirement for four validated power system models—especially the inclusion of TSAT—is out of step with international practice and unjustified by clear system benefits.

2) **The new Communication and High-Speed Data Monitoring Requirements are Poorly Justified**

   The proposed requirements add cost and complexity without a transparent cost-benefit case or clarity on operational integration.

3) **Lack of Clear Model Assessment Criteria**

   The CACTIS fails to specify objective benchmarks for model accuracy or acceptance, undermining predictability for developers.

4) **No Grandfathering Provisions for Existing IBRs**
   The proposal does not address how legacy IBRs will be treated, creating compliance uncertainty and commercial risk.

We recommend an **alternative risk-based, and internationally aligned approach**:

1. **Modelling:** Require a benchmarked and validated PowerFactory RMS model for all projects; require PSCAD EMT models only where the system strength is low, defined using agreed metrics.
2. **High-speed Recording:** Introduce only with clear justification; better consideration of in–flight and legacy projects should be introduced to recognise unique challenges such as limited connectivity and expensive retrofitting.
3. **Legacy IBRs:** Apply grandfathering provisions or transitional compliance pathways for existing IBRs.
4. **Governance of the CACTIS:** Ensure future CACTIS updates are subject to formal consultation and rigorous cost-benefit analysis.

In summary, in a grid that needs new renewables to be built as fast as possible, these changes represent an unwelcome new barrier that will slow the energy transition for NZ consumers and create additional risks and uncertainty.

1 Discussion of the System Operator's Proposal – Issues Addressed

The following sections contain our expanded comments on the proposed CACTIS. We have largely followed the order and title of sub-headings within the proposal document.

1.1 Validity of Information Requirements

We agree that detailed technical information requirements for connected assets should be housed in a consolidated document such as the proposed CACTIS. We also support the notion of this enabling more frequent updates to support the rapid evolution of technology, particularly inverter-based technology. We would encourage the System Operator to proactively indicate to industry how frequently updates and revisions of the CACTIS will be made. Our view is that frequent minor incremental changes is a more robust framework than infrequent substantive changes and that a reasonable cadence for such updates would be twice annually.

1.2 Changing Modelling Information

We agree that IBR generation control systems are generally more complex than synchronous machines and that there are some circumstances where it may be necessary to undertake detailed EMT studies to ascertain correct plant behaviour; although we disagree with the generalisation that this is always required. **The request for EMT modelling should be justified on a system needs basis such as low system strength or anticipated low system strength using agreed metrics**.

It is also the case that IBR systems, particularly those with BESS, present new control opportunities to the System Operator to improve system performance. For example, frequency responses can be

tuned to be much faster than traditional governor based synchronous machine control and could be used to arrest contingent event frequency declines more quickly than at present.

1.3 Information Quality

We support connected parties providing accurate information to the System Operator. However, access to confidential information such as unencrypted models from OEMs is always challenging. In most cases, the Asset Owner does not have access to this information, and the OEM is unwilling to provide it due to commercial sensitivity.

Additionally, the requirement to provide four models in three different formats creates a high risk of making this process unworkable. Model translation between formats is a difficult and specialised task, frequently time consuming and error prone. For example, when translating between EMT and RMS models simplifying assumptions need to be made, which can result in some degree of misalignment between model responses; such differences need to be explained. The CACTIS does not provide any guidance on what degree of model misalignment is tolerable.

Although the AEMO Dynamic Model Acceptance Test (DMAT) guidelines are far from perfect, they do provide detailed guidance on model acceptance criteria and the nature of the comparative tests (benchmarking) that must be undertaken. In Australia, lengthy connection approval processes (and in several cases, failures) have been driven largely by this model alignment and translation process. This has led to considerable delays and increased costs to the industry, for a questionable benefit. We note this is only for alignment of two models, not four as proposed by the CACTIS.

2 Comments on New or Revised Information Requirements

2.1 Time Frame Requirements

We are supportive of the CACTIS imposing clear time frame requirements on the submission of information. However, we do note some of the response timeframes for the System Operator are tight. What assurances is the System Operator able to provide around meeting these timeframes, especially given the additional proposed modelling and information requirements compared with the status quo?

As discussed in the prior section, clear objective quantitative criteria for assessment of compliance for each time bound step of the process will be critical. The current proposal does not include sufficient detail in this regard.

2.2 Commissioning Plan Requirements

Section 2.3 (b) (iii) states that a **commissioning plan must be provided in the event of a change to a control system setting or firmware**. This has the potential to be unwieldy and impractical. For example, firmware updates that provide security fixes can occur several times within a year, especially early in the lifetime of a technology product such as an inverter. We think this clause should be modified to state that a commissioning plan is required only if the control system firmware upgrade or setting change causes a known change to the EIPC performance of the plant. For example, if it affects ramp rates, FRT settings etc.

Development of a standard published commissioning plan template by the System Operator is a positive step and we support this.

2.3 Asset Capability Statement Requirements

Clause 3.4 (c) states that a generator ACS must **always be complete and up to date**, without providing timeframes for when updates must be made. Some form of reasonable endeavours

caveat would be useful here, or alternatively referencing the timeframes listed in 3.5. The two business days timeframe listed in section 3.5 is short and we would like to see this increased to at least five days.

2.4 Modelling Requirements

Our overarching view is the proposed **modelling requirements are excessive and not supported by rigorous cost-benefit analysis**.

The requirement within the CACTIS to submit **four validated models**, including TSAT, is excessive and lacks international precedent. In Australia (the NEM), considered to have among the most rigorous regimes, only **two validated models** are required. Moreover:

- **TSAT is not widely supported**; few NZ consultants have experience or access. Consequently, there will be a heavy reliance on expensive overseas resource to produce these models.
- The modelling burden scales **non-linearly** with software format diversity. Model tuning and maintenance across three platforms and four models is disproportionately complex.

The consultation document states that the System Operator needs accurate, fit-for-purpose models to assess risks and maintain power system security. This is an unqualified assertion that lacks supporting evidence. Moreover, a large step change in the modelling burden such as that proposed by the CACTIS, should be accompanied by a rigorous cost-benefit analysis.

Confidentiality Concerns

We agree with the proposal that confidentiality concerns create barriers to sharing information. We also think the proposal is understating the commercial challenges. EMT models in many cases run the exact source code of the inverter and therefore are critical intellectual property of the OEMs. It is reasonable to expect OEMs to support one or two software model formats, but unreasonable to require support for more than this.

The nature of inverter resources means that any given OEM will have tens of products each with hundreds of firmware versions. Each of these require quality control and model development meaning that the OEMs need to maintain hundreds to thousands of models even to support one software modelling format. The industry already struggles with model accuracy and errors within popular modelling formats, so requiring unrestricted models for many software formats seems like a requirement that is destined to fail.

Platform Specific Expertise Lacking

Platform specific expertise is needed for model development. PowerFactory expertise is widespread within NZ and to a lesser extent PSCAD. TSAT expertise across the country is minimal, especially outside of the System Operator. Most of the major power systems consultants do not have software licenses (especially given the expense of the software), nor staff trained in the software. This will likely force the use of overseas resource, adding considerable expense, time and difficulty to the model development process.

Cost Benefits not Forthcoming

The consultation document states that information inaccuracy and incompleteness imposes costs on the System Operator. We agree. The statement goes on to say that multiple low-quality models

increase the risks. However, we don't agree that submitting four models in three different platforms resolves this risk and we believe it increases the risk of low quality unmaintained models and therefore seems more likely to exacerbate this problem rather than resolve it.

Unclear Model Requirements

4.11 of the CACTIS provides some basic criteria and model requirements. However, this section is inadequate and does not justify the basis for the criteria. A non-exhaustive list of some of the issues and inconsistencies includes:

- 4.11 (d) states that the minimum time integration time step should be 5 ms; this is out of step with requirements in overseas jurisdictions. AEMO has a requirement of 1 ms, whilst other jurisdictions are flexible on integration time steps based on the particular needs and performance of models.
- There are limited guidelines provided on model acceptance criteria or benchmarking – how do asset owners establish the validity and accuracy of their models? In comparison, AEMO in Australia produces a suite of comprehensive documents[1] to assist asset owners:
    - Connection Application Submission Review Checklist
    - Power System Model Guidelines
    - Guideline and Template for preparation of a Releasable User Guide
    - Dynamic Model Acceptance Test Guideline (DMAT), which outlines objective criteria that models will be assessed against[2] and the tests that must be undertaken. It also includes various case studies, templates and scripts to assist with the assessment process.

Need for TSAT models

We contend that the System Operator does not need TSAT models to determine and manage system security. The counter-factual is that some larger and more complex power systems elsewhere in the world manage without using such specific real-time tools; this includes some systems in North America, National Grid in the UK and AEMO in the Australian NEM.

It appears that the System Operator has a preference for using this tool and experience that has been built up over a decade of using it. However, it seems unfair to force the industry to develop models for this platform at considerable additional expense, especially when the main local experience and expertise in this platform resides within the System Operator and not elsewhere in the industry. In other words, if the System Operator wants to continue with the commercial decision to use TSAT in its real time decision making, then it is reasonable for the System Operator to bear these costs.

It is a considerable departure from international precedent to require models be submitted in the TSAT format – most transmission system operators (TSOs) internationally require the submission of RMS (PowerFactory, or PSS/E) and EMT (PSCAD) models, with develop of TSAT specific models being left to the specific TSO internally. For example, National Grid in the UK specifies the

[1] https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/network-connections/modelling-requirements
[2] https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2024/iess-rule-terminology-changes-to-national-connection-documents/dynamic-model-acceptance-test-dmat-guideline-v30.pdf?la=en

PowerFactory and PSCAD formats for RMS and EMT respectively. In the Australian NEM, AEMO specifies PSS/E for RMS and PSCAD for EMT. Neither jurisdiction requires the submission of TSAT models.

Model Maintenance and Updates

The requirement to provide updated models every time the System Operator updates its software has the potential to compound the additional modelling burden already articulated in this submission. We contend that updated models should only be required if there is a substantive change to the generating system that affects its control system performance.

Furthermore, the response timeframe of one month is not realistic – and would not allow time for the development of new models and subsequent validation.

The burden of verifying compatibility of existing models with future software product versions should fall on the System Operator when it makes a product evaluation prior to updating its modelling tool chain.

2.5 Connection Study Requirements

We are supportive of standardised system study requirements. The proposed list of required power system studies to be incorporated into the CACTIS aligns with the prior connection study requirements documentation from the System Operator.

We view the connection study requirements complementary to the model requirements; it is usually the case that models are developed and the studies done contemporaneously. As such, these studies would become overly burdensome if the requirement to develop four models flows through into study requirements.

Finally, the selection of specific fault ride through study cases should be informed based on system strength indications of the connected node. In some cases, this may mean that no EMT studies are required.

2.6 Test Plan Requirements

We are generally supportive of the requirement to provide test plans. However, similar to commissioning plans, this requirement should **not** be triggered by a control system setting change or firmware updates, unless the change or update materially affects the plant performance.

2.7 Testing Requirements

We are supportive of increased consistency in testing requirements. We note the provision of test data from events as a substitute for plant testing in plants sized between 10-30 MW. However, this is potentially inconsistent with the prior modelling requirements and would make model validation difficult in such instances. We encourage the System Operator to thoughtfully consider how the model validation requirements interact with the testing requirements and recognise that although it is potentially useful to use representative events in lieu of testing for 10-30 MW plants, in practice this may not be possible due to the model validation requirements.

2.8 Operational Communication Requirements

We note the requirement to provide solar horizontal irradiance (GHI) for forecasting purposes. However, we would note a few points on this:

1. The EA has engaged DNV to provide centralised forecasting services for solar and wind farm sites. It is unclear what benefits would be obtained from the System Operator developing its own real time forecasting with live data obtained from generation sites and duplicating this work.
2. GHI alone is not sufficient for determining solar output with high accuracy, although it may be useful for the purpose the System Operator intends.
3. In accordance with IEC61724, large scale solar farms typically have more than one weather station and a minimum of two. Would the System Operator like both measurements, just one, or the average of the on-site sensors?

2.9 High Speed Data Requirements

The proposed introduction of new communication and high-speed data recording requirements within the CACTIS framework represents a material increase in both capital and operational costs for asset owners, particularly independent generators.

Although the policy rationale gestures toward improved event response and situational awareness, the proposal lacks a detailed justification of how these new data streams will be integrated into operational practice, or how they will materially improve system reliability in a way that justifies their cost. For example, the proposal does not provide quantitative analysis or case studies demonstrating how historical grid events would have been better managed had these devices been in place. This absence of a clear benefit narrative makes it difficult for participants to assess whether the return on investment for these systems is proportionate or necessary.

In the EA's earlier consultation, the cost estimates for high-speed recording implementation appear optimistic and may significantly understate the true expense of complying with the new requirements. The indicative cost range of $20,000 to $30,000 per high-speed monitoring device fails to account for the broader system integration costs, including auxiliary equipment (such as instrument transformers, signal converters, and dedicated data links), site-specific engineering design, cybersecurity hardening, and ongoing maintenance. These costs may scale steeply for smaller or remote generating sites where retrofitting infrastructure is more complex and expensive. In some cases, especially for smaller independent generators, the cumulative burden may materially impact project viability or investor confidence.

Finally, the proposal assumes a relatively uniform baseline of existing monitoring infrastructure across the industry, which does not reflect the diversity of generator configurations. For example, many smaller or earlier-phase IBR projects were commissioned under legacy requirements and do not have the physical space or communications bandwidth to accommodate these new systems without delay, redesign, and significant additional expense. As such, we are concerned that the rollout of this requirement could inadvertently delay new projects or force costly midstream design changes to projects already in advanced stages of development. A clearer articulation of benefits, a realistic total cost assessment, and a proportionate, risk-based implementation pathway would better align the proposal with the operational realities faced by independent developers.

3 Grandfathering Provisions

A critical omission in the current CACTIS proposal is the absence of guidance regarding how existing inverter-based resources (IBRs) will be treated under the new information and modelling requirements. Although the document outlines obligations for new connections and modified assets, it remains silent on whether IBRs that are already commissioned and operational will be required to retroactively comply. Likewise, for projects that have already reached a final investment decision and are under construction – they have not incorporated the additional costs and time of the CACTIS requirements into their project budgets and planning.

This lack of clarity on treatment of existing assets and in-flight projects creates significant compliance uncertainty for independent generators, many of whom operate legacy assets commissioned under earlier, less data-intensive standards. Without explicit provisions for "grandfathering" or transitional compliance periods, asset owners are left to assume the most conservative interpretation — that all IBRs, regardless of age or configuration, may soon be required to meet the full suite of new data, testing, and model validation obligations.

This creates both practical and commercial risks. Many legacy IBRs—particularly those commissioned more than five years ago—may not have the manufacturer support, firmware compatibility, or access to detailed control system documentation necessary to build or validate the four types of models now proposed. In some cases, original equipment manufacturers (OEMs) may no longer provide technical support, or the technology may have changed sufficiently that model reconstruction would require reverse engineering at considerable cost and uncertainty. Imposing full compliance on these assets, without acknowledging their constraints or providing a pathway for partial or risk-based compliance, could result in stranded investments or force asset owners into expensive upgrade cycles that are disproportionate to the system risk those assets pose.

Furthermore, the absence of a transitional timeline — even one with staged obligations — could create an enforcement bottleneck and reduce the willingness of owners to voluntarily collaborate with the system operator. A more effective approach would involve clearly defined grandfathering provisions for legacy assets, coupled with a flexible compliance framework that allows owners to demonstrate functional equivalency through representative testing or simplified modelling for older equipment. This would support system reliability goals without placing undue burden on operators of otherwise well-performing assets. Clarifying this aspect in the next phase of consultation is critical to maintaining investor confidence and ensuring regulatory fairness across the generation fleet.

4 Response to Consultation Questions

Question	Comments
Q1. Do you agree that failing to provide key information will have an impact on the commissioning of an asset, power system security and the system operator's ability to meet the PPOs and dispatch objective?	Yes
Q2. Do you agree with the proposal to mandate minimum time frames for the activities in Chapter 1 of the proposed CACTIS?	Yes
Q3. Do you agree with the proposed time frames for asset owners to submit a commissioning plan and for the system operator to review them?	Yes, with caveats. See our detailed response for comments.
Q4. Do you agree that requiring asset owners to use a standard commissioning plan template would help streamline the preparation and review process?	Yes
Q5. Do you agree with the proposed time frames for asset owners to submit asset capability statements at the planning, pre-commissioning, and final stages of the commissioning process, and for the system operator to review them?	Yes, with caveats. See our detailed response for comments.
Q6. Do you agree that formalising the asset capability statement assessment requirements will provide clarity for asset owners?	Yes
Q7. Do you agree with the proposal to formalise requirements for asset owners to provide urgent or temporary changes to asset capability statements?	Yes, although we would like the response timeframes to be increased slightly.
Q8. Do you agree with the proposed time frames for asset owners to submit m1	No. Three months to provide final m2 models is too short given the increased modelling requirement of providing four power system models for IBR generation.

and m2 models, and for the system operator to review them?	
Q9. Do you agree that the updated modelling requirements are necessary to reflect the increasing complexity and changing generation mix within the New Zealand power system?	No, we strongly disagree. See our detailed response for further commentary.
Q10. Do you agree that the system operator needs TSAT and PSCAD software models to conduct the studies needed to maintain power system security and meet the PPOs?	No, we strongly disagree. See our detailed response for commentary.
Q11. Do you agree with the proposed time frames for asset owners to submit a final connection study report, and for the system operator to review it?	Yes.
Q12. Do you agree with the proposed approach of using RMS studies for scenario screening and EMT studies for detailed fault ride through analysis of IBRs?	No. EMT studies should only be required in cases of low strength, or anticipated low system strength using agreed metrics. See our detailed response for commentary.
Q13. Do you agree with the proposal to require asset owners to repeat fault ride through studies when control system parameters are modified during or after commissioning?	No. See our detailed response for commentary.
Q14. Do you support the proposed process for accessing encrypted models from other asset owners when needed for fault ride through studies?	No, this is likely to be unworkable practically. See our detailed response for our commentary.
Q15. Do you agree with the proposed time frames for asset owners to submit a commissioning plan and for the system operator to review it?	Yes
Q16. Do you agree with the proposed time frames for asset owners to submit a final engineering methodology, and for the system operator to review it?	Yes

Q17. Do you agree with the proposed testing requirements for wind, solar photovoltaic and BESS technologies?	Yes
Q18. Do you agree that the system operator needs the additional data identified in this section to maintain power system security and meet the PPOs?	Yes, with some caveats. See our detailed response for commentary.
Q19. Do you agree with the proposal to use high-speed monitoring data to verify asset performance and reduce the need for routine testing of generating stations between 10 MW and 30 MW?	Yes, with some caveats. See our detailed response for commentary.
Q20. Do you agree with the data quality requirements as described in Chapter 9 of the proposed CACTIS for high-speed monitoring and operational reporting?	Yes, with some caveats. See our detailed response for commentary.
Q21. Do you currently have the ability to provide the additional information proposed in the draft CACTIS? If not, when do you expect to be able to meet these requirements?	No. See our detailed response for commentary.

Kind regards

[redacted]

Peter Apperley
General Manager, Engineering
T: [redacted]
E: [redacted]