Consultation Document

# Connected Asset Commissioning, Testing and Information Standard

**1 September-29 September 2025**

| | Position | Date |
|---|---|---|
| Prepared By: | Power Systems Group | August 2025 |
| Approved By: | Head of Power Systems | August 2025 |

## IMPORTANT

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# Executive Summary

The system operator is responsible for operating New Zealand's power system in a safe, reliable and economically efficient manner. To fulfil this role, the system operator requires timely access to certain information about assets that are connected, or intend to connect, to the power system. We need the connection requirements to be enforceable and sufficiently adaptable to align with technological evolution. This will enable the smooth integration of new technologies into the power system.

Current common quality information requirements do not accurately reflect recent industry changes and trends, such as the increasing penetration of inverter-based generation. In this environment, there are new challenges and the requirements need to adapt to help support electricity security for New Zealand and to be appropriate and fair across the different technologies connecting.

In addition, the Electricity Industry Participation Code 2010 (the Code) does not specify the timing of commissioning process activities that both asset owners and the system operator must adhere to. This lack of clarity makes it difficult to plan and coordinate these activities in an environment where demand for such activities is rising.

The Authority is proposing to incorporate by reference in the Code a document called the Connected Asset Commissioning, Testing and Information Standard (CACTIS), which clarifies technical requirements to address the above needs. The CACTIS is organised into chapters covering:

1. Time Frame Requirements
2. Commissioning Plan Requirements
3. Asset Capability Statement Requirements
4. Modelling Requirements
5. Connection Study Requirements
6. Test Plan Requirements
7. Testing Requirements
8. Operational Communication Requirements
9. High Speed Data Requirements

The CACTIS aims to support the system operator's ability to plan to comply, and comply, with its principal performance obligations (PPOs) and ultimately to maintain secure electricity for New Zealand. This includes providing further clarity on requirements that are currently set out in the Code and in system operator guideline documents, and to ensure requirements and appropriate and fair across different technologies. Moreover, because the system operator will author and maintain the CACTIS, we will be able to make more timely updates in the future. Being incorporated in the Code by reference will also mean that this initial draft and any future changes will involve formal consultation with participants.

This consultation document explains the rationale for key specifications in the proposed CACTIS and provides the means for industry participants to comment.

On 1 July 2025, the Electricity Authority (the Authority) published a consultation paper seeking feedback on common quality information requirements, which included a draft of the proposed

CACTIS and the opportunity to make submissions on matters relating to cost benefit studies, Code amendments and the incorporation of CACTIS into the Code. Submissions closed on 12 August 2025.

Feedback submitted on the draft CACTIS as part of the Authority's consultation and the technical aspects of this feedback has been summarised in Appendix B. This feedback will be considered when submissions to this consultation are received.

This consultation seeks your feedback on the technical content of CACTIS only.

## We welcome your feedback.

Part 7 of the Code provides for the system operator to consult on certain system operation documents to be incorporated by reference in the Code. We therefore welcome further feedback on the contents of the proposed CACTIS between 1 September 2025 and 29 September 2025.

## Next Steps

The system operator will carefully consider all feedback received and make final recommendations on the proposed CACTIS to the Authority. Our recommendations will be published in a Summary of Submissions and Recommendations paper, which we aim to release in October 2025. The Authority will consider this paper and industry feedback when deciding whether to incorporate the proposed CACTIS in the Code, and if so, in what form.

We expect the Authority to make its decision early 2026.

# Contents

# 1. Making a Submission

## Consultation Background

The system operator seeks feedback on a proposal to improve the timely provision and enforceability of common quality-related information for use in operating New Zealand's power system. The proposal would support the connection of new generation technologies to the power system and allow the system operator to more responsively develop requirements in line with industry and technology changes. This supports a secure and reliable power system for consumers.

The Electricity Authority (the Authority) has proposed to amend the Electricity Industry Participation Code 2010 (the Code) to incorporate by reference the CACTIS in the Code.

The CACTIS would include technical specifications relating to:

1. the time frames in which asset owners must provide the system operator with the documentation and information required by the CACTIS (Chapter 1: Time Frame Requirements)
2. the information that asset owners must include in a commissioning plan (Chapter 2: Commissioning Plan Requirements)
3. the information that asset owners must provide to the system operator in an asset capability statement (Chapter 3: Asset Capability Statement Requirements)
4. the minimum requirements for model configuration, maintenance, and documentation (Chapter 4: Modelling Requirements)
5. connection study cases and sharing of encrypted models from other asset owners (Chapter 5: Connection Study Requirements)
6. submissions and contents of test plans (Chapter 6: Test Plan Requirements)
7. standards for periodically testing an asset or configuration of assets (Chapter 7: Testing Requirements)
8. the minimum requirements for operational communications between asset owners and the system operator (Chapter 8: Operational Communication Requirements)
9. the minimum requirements for high-speed monitors that asset owners must install (Chapter 9: High Speed Data Requirements).

## How to Make a Submission

Please prepare your submissions in electronic format (Microsoft Word) as shown in Appendix A. Submissions should be emailed to system.operator@transpower.co.nz with "Connected Asset Commissioning, Testing and Information Standard" or "CACTIS Submission" in the subject line. Deliver your submission by 5pm on Monday, 29 September 2025.

We will acknowledge receipt of all submissions. These will be published on our Consultations page. If your submission contains confidential material, please ensure this is clearly identified and provide a version of your submission that can be published.

Please note that all information provided to Transpower is subject to potential disclosure under the Official Information Act 1982.

# 2. Introduction

The system operator is responsible for operating the transmission components of New Zealand's power system, which consists of all the components of New Zealand's electricity system, such as generation, transmission, distribution, and consumption (load) assets. We are observing that the power system is changing from one dominated by large synchronous power stations to one hosting a diverse mix of generation resources and technologies of various sizes. At the same time, consumers are engaging with their electricity supply in new and innovative ways.

Operating a power system is highly complex and dynamic. The system operator schedules and dispatches electricity in real-time in a manner that keeps the frequency and voltage of electricity provision within acceptable limits and avoids supply disruption. We must continuously balance the supply and demand for electricity, manage voltage and frequency, and maintain sufficient reserves to handle unexpected events while keeping the system within its operational design limits. This ensures a secure and reliable power system that continuously meets consumers' demand for electricity.

The increasing adoption of inverter-based generation has added a new layer of complexity and risk to power system operations. The variability of solar photovoltaic and wind generation, combined with the highly configurable and rapid responses of inverter-based generation, necessitates that the system operator request more detailed asset information and greater visibility during real-time operations to maintain the expected level of service.

Under the Code, the system operator must meet high-level, output-focused principal performance obligations (PPOs) in relation to common quality and electricity dispatch. In short, these PPOs require us to operate the power system to maintain frequency and voltage in real time, and to avoid a 'cascade failure' of New Zealand's power system.

It is not possible to maintain security of the power system and meet the dispatch objective without access to certain information about assets connected to the power system. Moreover, as New Zealand's economy becomes more electrified, fluctuations in electricity demand, variability and intermittency of electricity supply, along with a mix of connected technologies, will further challenge the system operator's management capabilities.

To enable the system operator to meet the PPOs, the Code places some mandatory performance obligations on the owners of assets connected to the power system. These asset owner performance obligations (AOPOs) support the system operator with modelling, monitoring and reinforcing power system reliability and security. Hence, the system operator requires information to:

- enable the connection of new assets and the upgrade of existing assets
- conduct power system studies for planning purposes
- investigate power system common quality issues
- assess compliance with AOPOs
- undertake system studies not specific to a connected asset, and
- support the real-time operation of the power system and on-going protection co-ordination.

Additionally, with the increased penetration of inverter-based resources (IBR), the system operator needs additional information specific to that type of technology. The system operator has experienced challenges so far in obtaining key asset information, such as modelling data for IBRs like wind generation and solar photovoltaic generation plants, and battery energy storage systems (BESS).

The proposed CACTIS has been designed to clarify the technical information the system operator requires from asset owners—and when it is required—to ensure we can continue fulfilling our roles and responsibilities in the context of current and projected power system changes.

Our consultation on the proposed CACTIS follows the Authority's recent consultation on a Code amendment proposal in which the draft CACTIS was first introduced. The July consultation paper sought feedback on common quality information requirements and provided the opportunity to make submissions on matters relating to cost benefit studies, Code amendments and the incorporation of CACTIS into the Code. Submissions closed on 12 August 2025.

Any feedback that the Authority has received during its consultation on the technical aspects of the CACTIS has been summarised in this document in Appendix B. When preparing our recommendations to the Authority, we will consider that feedback alongside any further feedback we receive during this consultation.

***Note regarding ancillary services****: This proposed technical standard only considers requirements related to commissioning, testing and compliance of power system assets, and does not consider technical requirements related to the provision of ancillary services. Ancillary services technical requirements are detailed in the Ancillary Services Procurement Plan and each provider's ancillary service contracts.*

*We recognise there will be some interaction between the technical requirements detailed in the proposed CACTIS and those in the Ancillary Services Procurement Plan. However, any contention among these technical requirements will be considered on a case-by-case basis with each ancillary services provider. Should the proposed CACTIS be implemented, the system operator may consider further consolidating technical requirements into a single standard.*

# 3. Issues Addressed by the Proposed CACTIS

The system operator is not currently receiving sufficient or consistent information to support effective system security planning and operation. In the absence of the required detailed information, the system operator may not have full visibility of some risks and must operate the transmission system more conservatively. This cautious approach is necessary to avoid potential economic losses for consumers and industry participants that might arise from assets causing or exacerbating power system disturbances. However, on the flip side this cautious approach may result in some foregone efficiency benefits for industry participants and electricity consumers.

Section 4 summarises the proposed changes that the CACTIS would make to address this concern. For a more detailed discussion, we encourage you to read the Authority's July 2025 consultation paper on the Code amendment proposal on common quality-related information.

At present, the Code does not prescribe in detail the specific asset-related information that asset owners must provide to the system operator. For example, while the Code requires asset owners to provide modelling data for planning studies as 'reasonably requested' by the system operator, it does not define what constitutes a reasonable request.[1] Further Code ambiguities exist, including concerning the requirements for:

- time frames for submitting information
- commissioning and test plans
- model types (for example root mean square (RMS), electromagnetic transient (EMT))
- model compatibility with software platforms (for example, PowerFactory, Transient Security Assessment Tool (TSAT), Power System Computer Aided Design (PSCAD))
- use of model encryption
- validation, documentation and maintenance of models
- connection studies
- periodic testing obligations.

These ambiguities have led to inconsistent interpretations between asset owners and the system operator. In practice, these have resulted in delays, inefficiencies, and in some cases, disputes about what must be provided. Although the system operator has published guideline documents to help clarify expectations, these are not enforceable, and thus adherence to the expectations remains variable. These guidelines, or requirements documents, have also not provided a formal process for consultation with participants on the requirements

The subsections below outline some of the other key challenges the proposed CACTIS aims to address.

[1] Clause 2(5)(b) of Technical Code A of Schedule 8.3 of the Code

## Validity of Information Requirements

Some information requirements in Part 8 are outdated. As technologies evolve, the common quality technical obligations must keep step to remain effective, and the system operator needs reliable access to that information. The Code amendment process, while transparent and robust, is not well suited for updating technical specifications at pace with the rapid technological changes we are observing in the power system. This can result in delays that leave the system operator without the information needed to manage new and evolving technologies.

Moreover, some of the existing information requirements in the Code no longer reflect current operational practices or technological capabilities. This contributes to information gaps, limiting the system operator's ability to plan for contingencies, assess power system behaviour, and support secure and efficient operation of the power system.

## Changing Modelling Information

As more IBRs connect to the power system, the modelling requirements for planning and operation become more complex. IBRs have different characteristics to traditional synchronous generators and necessitate more sophisticated modelling to understand how they affect power system behaviour. While RMS models were historically sufficient, EMT models are now also needed to accurately capture the fast-switching, software-driven controls of IBRs.

These models are critical for identifying risks such as voltage and frequency instability, unintended control interactions, or protection issues, particularly during system disturbances. Without access to appropriate models, the system operator may underestimate these risks, potentially compromising system security.

## Information Quality

Information currently provided to the system operator is sometimes incomplete or sub-standard. Submitted models are sometimes incomplete, inaccurate, or do not meet the required technical standards for accuracy and engineering best practice. Several factors contribute to this issue:

- IBRs require more detailed and precise modelling than traditional generators, and their dynamic behaviour is not always accurately captured
- Some asset owners dispute what qualifies as a 'reasonable request' by the system operator and manufacturers may withhold model details due to intellectual property concerns
- Each equipment manufacturer uses different tools, making the model conversion between software packages (e.g. PowerFactory, TSAT, PSCAD) difficult and error prone. Translating models can also result in data loss.

Due to the unpredictable, confidential and complex nature of IBR models in particular, the system operator does not have the resources to translate these models. Incomplete information then requires us to request resubmissions from asset owners. While one poor-quality model may have limited impact, multiple low-quality models increase the risk of unforeseen power system behaviours during disturbances or high-stress events. This can undermine the system operator's ability to carry out reliable planning, compliance assessments, and real-time operations.

# 4. New or Revised Information Requirements

Much of the content of the proposed CACTIS has been transferred from Technical Codes A and C of the Code. This section of the document captures the rationale for the requirements that are either being introduced or altered in the draft proposed CACTIS. Refer to Appendix C for a summary of the clauses of the draft CACTIS that have not been modified from what is currently in the Code.

## Chapter 1: Time Frame Requirements

The key deliverables of the process for commissioning assets do not currently have a delivery time frame associated with them. This has resulted in critical information, such as the confirmation of protection coordination, delaying the date when a generating asset is scheduled to first electrically connect to the power system. Other sources of delay include late delivery of information and the consequent inability to update market tools in a timely manner.

The proposed CACTIS specifies the time frames that asset owners and the system operator must adhere to in order to ensure commissioning (including upgrades to connected assets) and decommissioning activities occur in a timely manner.

Asset owners must provide the required final documentation and information to the system operator according to the specified timings so that we can achieve the dispatch objective and plan to comply, and to comply, with the PPOs. In turn, there is a specified time frame for the system operator to review final documentation, and the completed information provided to us.

If all activities are not completed within the mandated time frames, then commissioning of generating assets will be delayed until the activities are completed.

Mandating information delivery time frames allows asset owners to confirm requirements to contractors and consultants. Where asset owners employ consultants and contractors to provide final documentation and information, the firm time frames facilitate the contractual setting of delivery times. Asset owners can then review final versions of documentation and information prior to submission to the system operator.

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?

Q2. Do you agree with the proposal to mandate minimum time frames for the activities in Chapter 1 of the proposed CACTIS?

Please explain your answers.

## Chapter 2: Commissioning Plan Requirements

The proposed CACTIS mandates that commissioning plans must follow the format that the system operator publishes. To assist asset owners, the template to be used is available on the system operator website. This template has been designed to help asset owners collect the required information. We expect the use of this standard template will reduce the time required for asset owners to prepare a draft commissioning plan for system operator review.

Currently, Part 8 of the Code requires asset owners connecting at the transmission network interface to provide commissioning plans for their assets. At present, the Code does not require asset owners that connect to a local network to provide commissioning plans to the system operator. However, we do request them, and asset owners have provided them. The draft CACTIS proposes to formalise this requirement.

This needs to be read in conjunction with clause 8.21(2) of the Code, which sets a minimum threshold for information requirements of 1 MW for generating units (or 10 MW for generating stations, as proposed by the Authority in its recent consultation).

Generating stations connecting to a network can pose additional security risk to the power system during commissioning. Requiring a commissioning plan in every case would enable us to identify and mitigate that risk when it exists. The commissioning plan would also include the timing of all related actions, thereby enabling the system operator to coordinate commissioning activities to minimise effects on the wholesale electricity market.

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?

Q4. Do you agree that requiring asset owners to use a standard commissioning plan template would help streamline the preparation and review process?

Please explain your answers.

## Chapter 3: Asset Capability Statement Requirements

We propose to require asset owners to provide us with asset capability statement (ACS) information at three points during the asset commissioning process: planning, pre-commissioning and final commissioning. The *Time Frame Requirements* chapter formalises the time frames for these three stages to ensure timely delivery of information to the system operator. In the *Asset Capability Statement Requirements* chapter, we outline the information required at each stage, as well as the obligations for both asset owners and the system operator regarding the timing and provision of feedback of ACS assessments.

The system operator relies on the information in the ACS being accurate and up-to-date. It is understandable that, if asset capability suddenly changes, updating ACS information at short notice may not be possible under certain circumstances. For these scenarios, the proposed CACTIS specifies how asset owners must address urgent or temporary changes to asset capability.

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?

Q6. Do you agree that formalising the asset capability statement assessment requirements will provide clarity for asset owners?

Q7. Do you agree with the proposal to formalise requirements for asset owners to provide urgent or temporary changes to asset capability statements?

Please explain your answers.

## Chapter 4: Modelling Requirements

The growing integration of IBRs into the power system introduces new dynamics and complexities. To maintain system stability, reliability, and efficient planning, it is essential that we hold accurate modelling information at the appropriate stages of commissioning and throughout a generating asset's operational period. The proposed CACTIS requires asset owners to provide certain models at different points during an asset's lifecycle. We refer to these models as m1 and m2 models:

- The m1 model would serve as a preliminary representation of a generating asset and would be submitted as part of connection studies before commissioning. This m1 model would capture the control system architecture, parameter settings, and expected behaviour of the asset. The model would support early-stage system impact assessments and planning decisions.
- The m2 model would be required post-commissioning. This model would reflect the final as-left settings and would need to be validated against site test results. This would ensure that the model accurately represents the commissioned asset and supports integration into operational and real-time system analysis.

The system operator has periodically published a guideline document[2] to assist asset owners with modelling requirements, including specifying type, structure and quality expectations for various asset types. With the draft CACTIS, we propose to formalise these modelling requirements to ensure consistency and transparency.

We need accurate, fit-for-purpose models to assess risks and maintain power system security. They enable comprehensive studies to define safe operational boundaries and are critical to meeting our PPOs for secure and reliable system operation.

As previously explained, IBRs differ significantly from traditional synchronous generators and require more advanced modelling due to their complex and variable control system architectures. This variability, combined with confidentiality concerns and model encryption, creates challenges in accessing accurate data and translating models across platforms. The Authority's consultation paper provides further details on this.

The draft CACTIS addresses this by requiring owners of IBR assets to provide models in the following formats:

- DIgSILENT PowerFactory
- Power System Computer Aided Design (PSCAD)
- Powertech Transient Security Assessment Tool (TSAT)
- Western Electricity Coordinating Council (WECC) generic model.

These form part of the system operator's suite of tools that ensure robust analysis and real-time monitoring of the power system:

- PowerFactory is widely used in the industry to support general power system analysis, including load flow, fault analysis, event investigations and other connection studies. Its

[2] GL-EA-716 Power Plant Dynamic Model Validation and Submission Prerequisites

flexibility and ability to handle complex network models make it a preferred tool for offline analysis and planning studies.

- PSCAD is used for detailed EMT studies, particularly focusing on fault ride through (FRT) performance, inverter stability and control interactions.
- TSAT is utilised for both offline and real-time applications. Offline uses include event investigation and frequency studies which require accurate modelling of frequency reserves. In real-time, TSAT performs frequency stability analysis and transient rotor angle stability analysis. The system operator runs voltage stability analysis in real-time every 2-4 minutes, and frequency analysis every 7-9 minutes to evaluate power system security.

    (a) WECC generic models are widely used in power system studies due to their standardisation, compatibility across platforms, and simplified representation of system components. However, this simplification can lead to reduced accuracy, making them less suitable for detailed or site-specific studies. The system operator aims to publish WECC models in the Authority's Electricity Market Information (EMI) case and use them in real-time studies only when detailed TSAT and PowerFactory models cannot be shared due to confidentiality constraints.

The Authority's consultation paper provides further details on the studies and their associated models.

Additionally, the proposed CACTIS formalises the model maintenance and update process to ensure models remain accurate and fit-for-purpose throughout the asset lifecycle. This includes clarifying asset owner responsibilities, defining update triggers (e.g. equipment or control system changes), and setting requirements for model review frequency and quality. A structured process would support model integrity and reliable system studies.

Q8. Do you agree with the proposed time frames for asset owners to submit m1 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?

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?

Please explain your answers.

# Chapter 5: Connection Study Requirements

## Fault Ride Through Studies

The proposed CACTIS changes the FRT study requirements for IBRs, which behave differently from conventional synchronous generators during fault conditions. These differences primarily stem from power electronic interfaces and the advanced control systems that govern IBR operation. IBRs exhibit fast, nonlinear, and often complex, control and protection responses that cannot be adequately captured through RMS studies alone; EMT studies are necessary for this.

With the increasing integration of IBRs into the power system, it is essential that the FRT study requirements reflect this complexity. Under the proposed CACTIS, IBR asset owners would be required to perform both RMS and EMT FRT studies. RMS simulations continue to be valuable for broad system-level screenings and initial assessments of FRT performance. However, EMT studies of the scenarios identified by the RMS studies provide the detailed insight needed to accurately analyse system behaviour and support power system security.

## Repetition of Fault Ride Through Study

The proposed CACTIS requires asset owners to repeat FRT connection studies whenever control system parameters are changed. These parameters, such as voltage control settings, frequency response characteristics, or protection schemes, play a critical role in determining the dynamic performance of a generating asset, particularly its ability to ride through faults and maintain stability under abnormal system conditions.

Changes to these parameters can affect the asset's FRT capability. In these cases, the draft CACTIS proposes that asset owners must repeat FRT studies to verify continued compliance with the Code's FRT requirements. This includes performing both RMS and EMT simulations, as appropriate, using the updated control system parameters.

## Sharing of Models for Fault Ride Through Studies

The proposed CACTIS requires asset owners to share *encrypted* control system models with other asset owners when they are needed to support FRT analysis. If an asset owner is required to assess the impact of other assets on the FRT capability of a generating asset, the relevant encrypted models must be made available to the asset owner

Asset owners will be able to obtain these models either directly from the respective asset owners or by asking the system operator to facilitate access. In cases where the system operator is involved, we may act as an intermediary to obtain consent and provide access to encrypted models held within our repository.

The shared models must be used exclusively for the purpose of conducting FRT studies for the specified asset, thereby ensuring that the scope of access remains strictly technical and project specific. This approach aims to balance the need for technical transparency and system reliability with the protection of commercially sensitive data.

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?

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?

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?

Q14. Do you support the proposed process for accessing encrypted models from other asset owners when needed for fault ride through studies?

Please explain your answers.

## Chapter 6: Test Plan Requirements

Part 8 of the Code currently requires asset owners connecting at the transmission network interface to provide test plans for their assets. At present, the Code does not require asset owners that connect to a local network to provide test plans to the system operator. However, we do request them and asset owners have provided them. The draft CACTIS proposes to formalise this requirement.

This needs to be read in conjunction with clause 8.21(2) of the Code, which sets a minimum threshold for information requirements of 1 MW for generating units (or 10 MW for generating stations, as proposed by the Authority in its recent consultation).

Providing test plans ensures the system operator has sufficient information to maintain power system security during asset testing activities.

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?

Please explain your answers.

## Chapter 7: Testing Requirements[3]

The proposed CACTIS requires asset owners to submit an engineering methodology for all asset testing. To reduce the burden on smaller generating stations, the proposed CACTIS introduces a provision for generating stations that export less than 30 MW to use event data instead of carrying out testing.

Furthermore, the draft CACTIS specifies that certain asset owners must test:

- shunt capacitors and reactive control systems
- dynamic reactive power compensation device transient response and control.

This applies to asset owners, other than transmission network owners, who have installed or are installing reactive power devices large enough to affect the management of the transmission system (both in steady state and in response to power system changes).

Finally, the proposed CACTIS includes specifications for the testing of wind and solar photovoltaic generating assets, as well as BESS. The methods to test these technologies differ from those used for synchronous machines. These specifications include:

- generating unit frequency response
- generating station frequency response
- generating station frequency control
- generating station transformer voltage control
- generating station voltage response and control.

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?

Q17. Do you agree with the proposed testing requirements for wind, solar photovoltaic and BESS technologies?

Please explain your answers.

[3] For the purposes of this consultation and the proposed CACTIS, the terms 'periodic testing' (used in the Authority's consultation) and 'routine testing' (used in the CACTIS draft) have the same meaning.

## Chapter 8: Operational Communication Requirements

We rely on data provided by asset owners to make critical decisions regarding the operation of the power system. This information ensures we have adequate visibility of assets and supports the efficient and secure management of new and evolving generation technologies such as solar photovoltaic, wind, and BESS. This is particularly important given the layout of these generating plant and the nature of these generation sources.

The proposed CACTIS clarifies the specific requirements for asset owners to provide indications and measurements for generating systems. While existing requirements are suitable for traditional generation technologies like machine-based synchronous generators, emerging technologies present distinct challenges. These generating stations often consist of numerous small generating units connected in series to form a generating system. The generating system is then linked to the station collector system and connected to the power system through a transmission grid-tie transformer. The system operator requires detailed information at the generating system level to monitor the operational status of each generating system and accurately model the power system, thereby determining the asset's capability.

The proposed CACTIS also introduces requirements for owners of wind and solar photovoltaic generating stations to provide information on wind speed and solar irradiance. This information will help us to manage system voltage and frequency and will also help predict the rapid changes in solar photovoltaic and wind generation output caused by changes to weather conditions.

Furthermore, distribution networks are playing an increasingly active role in contributing to power system behaviour. This is driven by the rising number of generation assets connecting to distribution networks and the growing participation of electricity demand in the wholesale electricity market, offering products ranging from instantaneous reserve to flexible demand response. The system operator requires more visibility of distribution networks to ensure that assets are dispatched as scheduled by the system operator. The proposed CACTIS requires connected asset owners to provide information on the status of electrical loads classified as controllable loads.

Finally, we are proposing new minimum technical requirements for operational communication between asset owners and the system operator. These are outlined in Table 1 below and are essential for real-time system monitoring, co-ordination of network responses, and the efficient dispatch of generation and load. Note that these are baseline specifications. As is standard practice, the system operator can request additional information on a case-by-case basis if we reasonably consider it necessary to help us to comply with the PPOs.

### Table 1: New minimum technical requirements for operational communications

| Indication or measurement | Purpose of collecting information |
|---|---|
| Specific Requirements for Generators | |
| Frequency Control Operation Mode | Configuration of online speed/frequency control model<br>Compliance check |

| Indication or measurement | Purpose of collecting information |
|---|---|
| Voltage Control Operation Mode | Configuration of online voltage control model<br>Compliance check |
| Power System Stabiliser or Power Oscillation Damper Status | Configuration of online power system stabiliser model<br>Compliance check |
| Station high voltage (HV) Bus Voltage (if HV bus is not owned by a transmission network owner) | Real-time operations - management of voltage |
| **Specific Requirements for synchronous Generating Units** | |
| Generating unit Terminal Voltage kV | Configuration of online voltage control model<br>Compliance check |
| **Specific Requirements for Battery Energy Storage Systems** | |
| Station state of charge (SOC) (%) | Configuration of BESS frequency control model<br>Compliance check<br>Real-time operations |
| **Specific Requirements for PV assets** | |
| Solar irradiance horizontal (W/m$^2$) | Real-time operations<br>Post-event investigation |
| **Specific Requirements for Wind Turbine Assets** | |
| Wind speed at nacelle height (km/h) | Real-time operations<br>Post-event investigation |
| **Specific Requirements for Hybrid Plants** | |
| Station intermittent generation MW | Real-time operations |
| Station BESS Injection / Load MW | Real-time operations<br>Configuration of online BESS and Photovoltaic/Wind plant model |
| **Transmission Network-Owner Specific Requirements** | |
| Reactive Power Controller status | Real-time operations - management of voltage |

| Indication or measurement | Purpose of collecting information |
|---|---|
| Reactive Power Controller Setpoint kV or Mvar | Real-time operations - management of voltage |
| **Connected Asset Owner specific requirements** | |
| Controllable load available MW | Any controllable load that is not currently off or armed for interruptible load<br>Actual or calculated (±5% accuracy)<br>Per grid exit point (GXP) unless agreed otherwise |
| Controllable load currently off MW | Actual or calculated (±5% accuracy)<br>Per GXP unless agreed otherwise |
| Controllable load armed for interruptible load MW | Actual (±2% accuracy)<br>Per GXP unless agreed otherwise |

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?

Please explain your answer.

## Chapter 9: High-Speed Data Requirements

The proposed CACTIS introduces requirements for asset owners to install high-speed monitors that meet certain specifications. High-speed monitoring is essential to oversee equipment performance for compliance purposes and to optimise asset performance. It enables the detection of fast changes in voltage, current and frequency, which provides vital information for calibrating power system models and understanding asset performance.

High-speed monitoring can also be used to identify imminent problems that can impact the stability and efficiency of the power system. Early detection of problems can prevent widespread power outages and damage to assets, potentially reducing lengthy downtimes and maintenance costs.

Moreover, high-speed monitoring can be utilised to assess an asset's response to voltage or frequency changes for generating stations that export between 10 MW and 30 MW to a network. The data collected can be used to verify asset performance and validate mathematical models, which may reduce the need for routine testing.

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?

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?

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?

Please explain your answers.

# Appendix A Format for Submissions

| Submitter: | |
|---|---|

| 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? | |
| Q2. Do you agree with the proposal to mandate minimum time frames for the activities in Chapter 1 of the proposed CACTIS? | |
| 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? | |
| Q4. Do you agree that requiring asset owners to use a standard commissioning plan template would help streamline the preparation and review process? | |
| 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? | |
| Q6. Do you agree that formalising the asset capability statement assessment requirements will provide clarity for asset owners? | |
| Q7. Do you agree with the proposal to formalise requirements for asset owners to provide urgent or temporary changes to asset capability statements? | |

| | |
|---|---|
| Q8. Do you agree with the proposed time frames for asset owners to submit m1 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? | |
| 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? | |
| 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? | |
| 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? | |
| 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? | |
| Q14. Do you support the proposed process for accessing encrypted models from other asset owners when needed for fault ride through studies? | |
| 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? | |
| 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? | |
| Q17. Do you agree with the proposed testing requirements for wind, solar photovoltaic and BESS technologies? | |
| 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? | |
| 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? | |
| 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? | |
| 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? | |

# Appendix B Summary of Prior Submissions

Comments on the technical requirements proposed in the draft CACTIS from the Authority's recent consultation have been summarised by theme and are captured below. These will be considered when submissions to this consultation are received.

Comments on matters relating to cost benefit studies, Code amendments and the incorporation of CACTIS into the Code are not included in this summary which is limited to technical details of CACTIS only.

### Table 2: List of submitters

| Submitter | Abbreviation |
|---|---|
| **Buller Electricity Limited** | BUL |
| **Contact Energy Limited** | CTCT |
| **Electrical Engineers' Association** | EEA |
| **Genesis Energy Limited** | GENE |
| **Independent Electricity Generators Association** | IEGA |
| **Lodestone Energy** | LODE |
| **Manawa Energy** | CNIR |
| **Mercury** | MRPL |
| **Meridian** | MERI |
| **NewPower Energy Services Limited** | NPEL |
| **Orion New Zealand Limited** | ORN |
| **Powerco** | PCO |
| **Vestas – New Zealand** | VES |
| **WEL Networks** | WEN |
| **Transpower NZ Limited** | TP |

## General

i. Submissions will be reserved until the System Operator consultation of CACTIS (GENE; ORN; PCO)

ii. CACTIS should align with:

   a. EEA National Technical Connection Guidelines (EEA)

   b. other SO initiatives like digitalisation efforts (PCO)

iii. No provisions have been made for asynchronous generation (CNIR)

iv. Provisions allowing the System Operator to reasonably request information additional to CACTIS requirements should be removed (MERI) or further defined (WEN) as it goes against the stated purpose of providing clear and defined information requirements

v. "Maximum capacity" and "scaling factor" needs to be defined (WEN)

vi. Requirements should be fit-for-purpose and not be a shopping list of 'nice-to-haves' (ORN; MERI)

vii. Synchronous generating station boundaries should be standardised to the Low Voltage side to be consistent with Clauses 8.23 (a) and 8.23 (b) (MRPL)

viii. Requirements for asynchronous generation are not considered (CNIR)

ix. Feedback across multiple sections included:

   a) application of CACTIS to generators 1 MW and above could be onerous or excessive particularly on smaller stations (EEA; IEGA; NPEL; LODE)

   b) there was ambiguity and concern whether the requirements apply to only new assets or new and existing assets (GENE; BUL; MERI; IEGA; LODE; CNIR; MRPL)

x. Concerns were raised around industry consultation and transparency around CACTIS development and review cycles (CTCT; EEA; IEGA; CNIR)

## Time frame requirements

i. Too much discretion is given to the System Operator on information to be provided. The quantum of information should be either determined by negotiation or a mechanism created to allow challenge of information being requested (MERI)

ii. A lead time of 3 months to establish data communication paths and datasets is too long, 1 month is realistic (MERI)

iii. System Operator review periods of 20 days are too long (MRPL)

iv. A final ACS is required within 1 month of test completion, yet a final M2 report and validated model can be supplied after 3 months. Should a draft ACS be supplied at 1 Month and a final one at 3 months? (GEN)

v. 4 months for a Final Assessment of compliance is too long, an earlier check of sufficiency of test results should be carried out (MERI)

vi. Provision to agree a mechanism to modify timeframes by mutual agreement should be included (MERI)

vii. Updating models after a software upgrade in 1 month is unrealistic (VES)

### Commissioning Plan requirements

i. Reference to a change in a control system change is too broad (MERI)

ii. Protection and control settings are not typically specified in the Commissioning Plan, they are currently specified in the Engineering Methodology Document (MERI)

### Asset Capability requirements

i. Asset Owner should notify the System Operator immediately about a change in capability of an asset and must then update the ACS within 3 weeks (MERI)

ii. Temporary changes should be defined as up to 3 months rather than 20 days or less (MERI)

### Modelling requirements

i. Support for the distinction between synchronous and IBR requirements or IBR's considered more complex (CTCT; GEN; LODE)

ii. Provision of validated models in 4 software packages is excessive (IEGA; LODE; NPEL;)System Operator is under-resourced

iii. In the interests of fairness and transparency as a minimum the system operator should be seeking cost-recovery of synchronous machine model conversion services (LODE)

iv. Provision of PSCAD only when system strength is low (LODE)

v. The System Operator should be responsible for undertaking grid scale PSCAD studies (MERI)

vi. The System Operator should maintain a publicly accessible power system case that includes encrypted models from other asset owners (CTCT)

vii. M1 and M2 model definitions are helpful (LODE)

viii. TSAT is not commonly used internationally and there is limited expertise available in NZ to build and maintain models (MERI; LODE)

ix. Model acceptance and validation guidelines should be included (LODE; VES)

x. Bringing the modelling provision requirements into the Code in CACTIS will reduce the flexibility of suppliers being able to enter confidentiality arrangements directly with the System Operator (MRPL)

xi. Providing updates to models when software changes expose asset owners to potential costs which are difficult to predict (MRPL; IEGA)

xii. Recompiling model files for new software versions may not always be possible. (VES) and may not be achievable in one month (MERI)

xiii. Documentation requirements after testing wind, solar and BESS are excessive (MRPL)

xiv. Clarity is needed on what software versions are applicable (VES)

xv. No grandfathering or transition timeframe to meet the new requirements (MRPL; LODE)

xvi. OEMs are unlikely to provide unencrypted model. A framework similar to AEMO should be considered that allows equipment manufacturers to protect their IP by supplying modified information that still meets usability requirements and modelling obligations. (MRPL; VES)

xvii. Is it a good use of resource to require submission of an updated validation report when the performance of the asset has not (MERI)

## Connection Study requirements

i. Relationship between short circuit studies and frequency support; voltage support; and FRT obligations is unclear (VES)

ii. Clarification of how some studies should be carried out and the distinction between study types was requested (VES)

iii. Sharing encrypted models from other asset owners raises issues around how this information will be managed. (CNIR; MRPL; CTCT)

iv. Sharing encrypted models should be based on mutual discussion and agreement between relevant asset owners (MERI)

v. To study an asset's voltage control system settings in conjunction with assets such as STATCOM's and SVC's requires Transpower to provide sufficiently detailed models (MERI)

## Test Plan requirements

i. Reference to a change in a control system change is too broad (MERI)

ii. Asset owners should be given more discretion around when testing is required (MERI)

## Testing requirements

i. It Is not clear what exactly is covered by "modify and existing asset" (MERI)

ii. It may be helpful to further elaborate on transient response, steady state response and alternating current disturbance response

iii. It is difficult to define “self-monitoring” when frequency protection is part of inverter controls (MERI)

## Operational Communication requirements

i. Clarification of terminology used is required (Generating Station and Generating Unit boundaries; Frequency Modes, Net verses Gross readings (EEA; GENE; CNIR; MRPL)

ii. Need to consider conflicting requirements such as DER visibility by other parties (EEA)

iii. Some measurements are not currently available, particularly on the HV (GENE)

iv. System Operator developing its own forecasting of solar and wind duplicates the Authority’s work with DNV (LODE)

v. Do these requirements mandate us to use ICCP? Can an API type of data transmission service be utilised (NPEL)

vi. Controllable load accuracy to ± 5% is not achievable for assets that do not have metering class CT/VT (MERI; PCO)

vii. Distributors to be allowed to continue to provide difference bids until equipment is operational and able to provide real-time indications of controllable load (BUL)

viii. It Is not clear whether provision of controllable load SCADA replaces the Code obligation for Distributors to do difference bids (BUL)

## High Speed Data requirements

i. Unsure equipment is available to meet the specification or that there is sufficient space available on sites (CTCT; MRPL)

ii. Ancillary Service provisions have been implemented, tighter CACTIS requirements would result in need for equipment installed in 2024 to be replaced (GENE)

iii. Clarification sought on whether high speed data provision replace the need for routine testing (CNIR)

iv. Can use of event data in lieu of testing be extended to stations 30MW and larger (CNIR)

v. Should only be required for generation 10MW or larger (NPEL)

vi. Monitoring HV side may incur additional costs (GENE; IEGA)

vii. Limiting provision of data to csv, ascii, or COMTRADE format may unnecessarily create extra work (MERI)

viii. Table K specifies requirements at a station level. Is aggregation of unit data sufficient to meet station level requirements (MERI)

# Appendix C Unchanged Information Requirements

The following information provision requirements in Part 8 of the Code have not materially changed with the proposed CACTIS.

## Chapter 2: Commissioning Plan Requirements

The Code places obligations on asset owners in relation to commissioning plans for:

- assets to be connected to the transmission network or which form part of the transmission network
- changes made to assets (e.g. certain changes to protection or control systems)
- ascertaining or confirming asset capabilities.[4]

The Code also places obligations on owners of embedded generation to provide information to the system operator regarding the intended output of each embedded generating station greater than 10MW.[5] This applies if the system operator reasonably considers it necessary to assist in planning to comply, and complying, with the PPOs and achieving the dispatch objective.

## Chapter 3: Asset Capability Requirements

The Code requires asset owners to provide the system operator with an asset capability statement for each asset connected to or forming part of the transmission network, or for assets that are proposed to be connected to the transmission network.

The asset capability statement must, amongst other things, include:

- all information reasonably requested by the system operator to allow the system operator to determine the limitations in the operation of the asset that the system operator needs to know for the safe and efficient operation of the transmission network
- any modelling data for the planning studies, as reasonably requested by the system operator.[6]

Supporting these Code obligations are the system operator's companion guides for the commissioning of generation. For example, the system operator's *Asset Capability Information Guideline* is intended to assist asset owners that need to submit an ACS to the system operator. It provides an overview of the ACS, the three ACS stages, and data requirements.[7]

[4] See clause 2(6)-(7) of Technical Code A of Schedule 8.3 of the Code

[5] See clause 8.25(5)(a) of the Code

[6] See clause 2(5A) of Technical Code A of Schedule 8.3 of the Code

[7] GL-EA-959 Asset Capability Information Guideline, January 2025

## Chapter 4: Modelling Requirements

The Code requires asset owners to submit mathematical models of their connected assets to the system operator, without being specific about these requirements.[8]

To address this information gap, the system operator has periodically published guidelines like the *Power plant Dynamic Model Validation and Submission Prerequisites* guideline.[9] This guideline outlines various modelling requirements to help asset owners prepare models for submission. This document was initially developed for machine-based synchronous generation, and the RMS modelling requirements for these assets are still considered sufficient for the types of studies the system operator conducts. The proposed CACTIS incorporates some of the key elements from these guidelines, with most of the requirements for machine-based synchronous generation remaining unchanged.

As the uptake of IBRs has increased over the last few years, the system operator has updated the guidelines to include IBR modelling requirements. The proposed CACTIS incorporates some of these requirements, though there are several important changes to enable the system operator to obtain the necessary models and information to assist in our power system studies. For more detail, refer to the Chapter 4: Modelling Requirements in section 4 of this document.

## Chapter 5: Connection Study Requirements

The Code requires asset owners to submit information so the system operator can fully understand the impact of any proposed connections on the power system. To assist asset owners in demonstrating compliance with these obligations, we have periodically published a *Connection Study Requirements for New Generating Assets* guideline.[10] This document outlines the scope, methodology, and modelling expectations for various asset types.

The proposed CACTIS formalises the connection study requirements, though the underlying requirements have not materially changed for the following studies:

- Power flow
- Reactive power capability
- Frequency regulation and tuning
- Voltage regulation and tuning
- Short circuit
- Transient stability.

For machine-based synchronous generation, the FRT study requirements remain unchanged. We consider RMS studies conducted using PowerFactory are sufficient for assessing FRT performance for these asset types.

[8] See clauses 2(5A) and 2(5B) of Technical Code A of Schedule 8.3 of the Code

[9] GL-EA-716 Power Plant Dynamic Model Validation and Submission Prerequisites, May 2025

[10] GL-EA-953 Connection Study Requirements for New Generating Assets, July 2025

## Chapter 6: Test Plan Requirements

Asset owners are still required to provide test plans in the following situations:

- When assets are to be connected to, or are to form part of, the transmission network.
- When changes made to assets, such as certain changes to protection or control systems.
- When asset capabilities need to be determined or confirmed.[11]

The system operator can require embedded generating stations greater than 10 MW to provide information regarding their intended output if we reasonably consider that the information is necessary to assist in planning to comply, and complying, with the PPOs, and achieving the dispatch objective.[12]

## Chapter 7: Testing Requirements

The Code requires asset owners to carry out routine testing of their assets in accordance with Appendix B of Technical Code A of Schedule 8.3.[13]

Following the relevant tests, asset owners must submit information to the system operator. This information enables the system operator to evaluate power system performance, identify potential risks, and implement necessary adjustments to maintain power system security and reliability.

The proposed CACTIS does not change the existing testing requirements for:

- machine-based synchronous generating units,
- automatic under-frequency load shedding (AUFLS) systems,
- transmission network owner synchronous compensators,
- high voltage direct current (HVDC) link frequency control and protection, and
- asset owner alternating current (AC) protection systems.

## Chapter 8: Operational Communications

The Code sets minimum requirements for communications between asset owners, except owners of excluded generating stations, and the system operator.[14] It allows the system operator to request additional information from asset owners to assist to plan to comply, and to comply, with the PPOs. This is important because some generating station layouts require a case-by-case assessment, especially when they differ from atypical configurations.

[11] See clauses 2(6) and 2(8) of Technical Code A of Schedule 8.3 of the Code

[12] See clause 8.25(5)(a) of the Code

[13] See clause 8(2) of Technical Code A of Schedule 8.3 of the Code

[14] Technical Code C of Schedule 8.3 of the Code

As more IBRs and distributed energy resources are commissioned, power system behaviour is changing. To keep pace with these developments, the operational communication requirements must be updated to enable the system operator to operate the transmission system efficiently and reliably.

All of Technical Code C of Schedule 8.3 of the Code is proposed to be incorporated into the proposed CACTIS. This will enable the system operator to consult and make changes to the operational communication requirements in a timely and efficient manner. While most of the existing Code requirements would remain unchanged, the draft CACTIS updates the requirements for asset owners to provide indications and measurements through supervisory control and data acquisition (SCADA). These updated requirements replace the current specifications found in Appendix A of Technical Code C. These changes are discussed in the Chapter 8: Operational Communication Requirements part of section 4 of this consultation document.

# Appendix D Glossary of Abbreviations and Terms

| Abbreviation/Term | Full Form |
|---|---|
| ACS | Asset Capability Statement |
| AOPO | Asset Owner Performance Obligations |
| Authority | Electricity Authority |
| BESS | Battery Energy Storage System |
| CACTIS | Connected Asset Commissioning, Testing and Information Standard (proposed draft) |
| Code | Electricity Industry Participation Code 2010 |
| EMI | Electricity Market Information |
| EMT | Electromagnetic Transient |
| FRT | Fault Ride Through |
| IBR | Inverter-based Resource |
| MW | Megawatt |
| PPO | Principal Performance Obligation |
| PSCAD | Power Systems Computer Aided Design |
| RMS | Root Mean Square |
| TSAT | Transient Stability Assessment Tool |
| WECC | Western Electricity Coordinating Council |