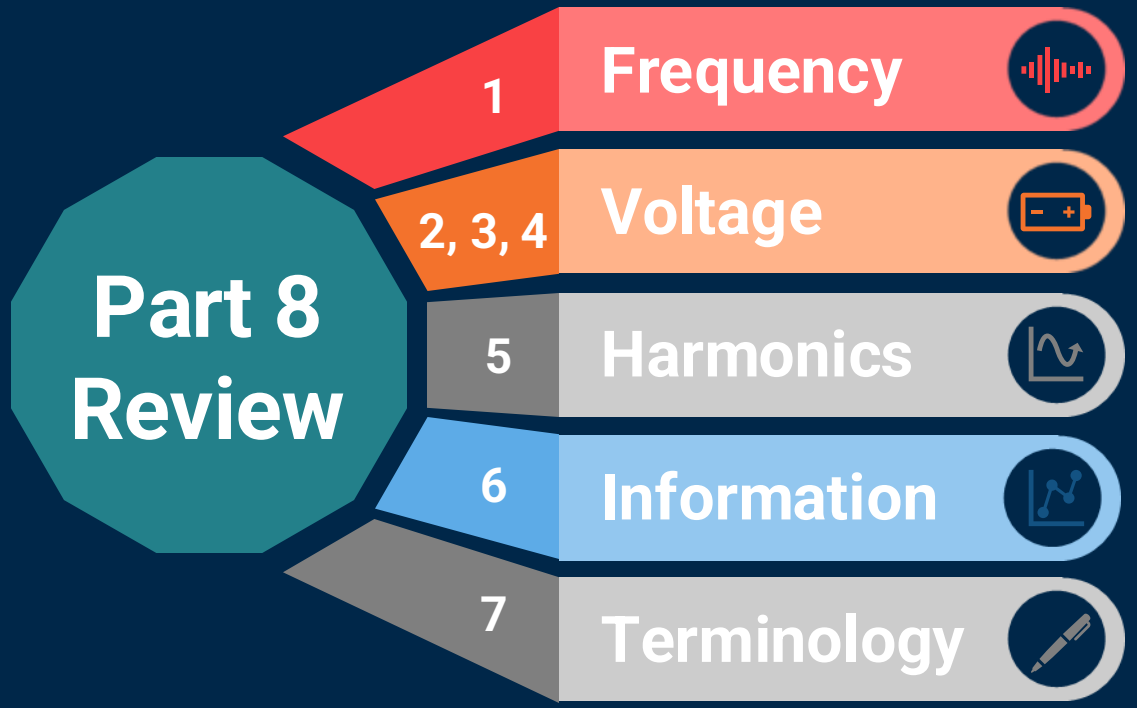
Future Security and Resilience: Common Quality Technical Group (FSR CQTG)

Meeting 13: 20 October 2025



ELECTRICITY AUTHORITY
TE MANA HIKO

Purpose

Provide feedback on the proposed approaches to:

- Frequency
- Voltage
- Information
- CACTIS

Agenda

Time	Item
9:00 am	Welcome and introductions
9:15 am	Frequency
10:15 am	Morning tea
10:30 am	Frequency - *continued*
11:00 am	Voltage
12:30 pm	Lunch
1:00 pm	Information Code amendment
2:00 pm	CACTIS SO Consultation submissions
3:00 pm	Afternoon tea
3:10 pm	CACTIS - *continued*
3:45 pm	AOB
4:00pm	End of meeting

Frequency

Promoting reliable electricity supply: Frequency-related Code amendment proposals

Consultation paper

6 May 2025

Costs of the proposals

Feedback	Preliminary thinking
There is currently no proportional compliance pathway for smaller generators	More thought is needed on alternative compliance pathways for smaller generators: - bundling tests together, event-based compliance assessment, paper compliance approach
The Authority has understated the costs. - For example, the dispensation cost to Manawa (41 stations) is estimated to be around $5m	Review cost assumptions (eg, dispensations, wear and tear).
Existing generators are unable to comply without undergoing uneconomic upgrades	Implement a grandfathering approach for existing stations that cannot comply

Grandfathering

Feedback	Preliminary thinking
Grandfathering should not be revoked if a generating station is upgraded to increase its capacity	- We consider it's necessary to ensure generators remain aligned with compliance expectations, and prevents exploitation of legacy grandfathering arrangements.
Clarity needed around what constitutes an increase in capacity (ie, new intake screens?)	Applies to an increase in capacity of more than 5MW
There is no benefit in applying grandfathering for only a finite period of time	Apply grandfathering indefinitely, rather than setting arbitrary time limits.

Uniform vs technology specific dead bands

Feedback	Preliminary thinking
A uniform dead band is not necessarily a low-cost approach if it triggers a large number of dispensations	Agreed
Certain technologies would struggle to comply with a ±0.1Hz dead band, such as: - geothermal - generators with actuator controls - older machines with mechanical governors and linkage systems - wind turbines - Kaplan turbines (higher repair costs than Francis turbines) - Huntly (Unit 5, thermal units) and hydro with hydraulic instability - BESS	Amend the proposed dead band, to be the higher of: • ±0.1Hz; or • the inherent dead band specified by the OEM Possibly include an exclusion for geothermal.

Alternative options

Feedback	Preliminary thinking
The Authority should investigate mandating grid-forming (GFM) inverters	• We are investigating GFM technology as part of our system strength project.
Some submitters repeated their support for Option 3 from the options paper	• Clearly restate the reasons that the Authority does not view Option 3 (ie, status quo) as the preferred option in the upcoming paper.
Multiple requests for the Authority to prioritise the creation of a dedicated capability market	• We acknowledge these requests and have added the development of a capability market to our work programme. However, this does not diminish the importance of the current proposals.

Other

Feedback	Preliminary thinking
Suggested amendments to our proposed definition of “maximum export power”	- To discuss in the voltage section
Demand-side response should also be considered alongside generation, because generators are not the only participants that can cause frequency issues.	Potentially revisit this in the future if needed, but we do not consider this is a high priority.
Clarification is needed on how the frequency-related AOPOs apply to hybrids, BESS and intermittent generation to avoid unintended consequences.	We will specifically address this in our Hybrid/BESS AOPO project.

Voltage

Promoting reliable electricity supply – a voltage-related Code amendment proposal

Consultation paper

3 June 2025

When voltage support required

Feedback	Preliminary thinking
Voltage support obligation should apply only when voltage at point of connection is within a specified range (as for transmission)	Agree – propose using 11kV to 110kV voltage ranges in clause 8.23 of the Code
Voltage support obligation should apply only under normal system operation	Agree – suggest voltage support obligation *'does not apply during transient disturbances at the point of connection to the local network'*
Embedded generator should provide voltage support only when 'electrically connected' and 'synchronised'	Agree – consistent with transmission generation

±33% default reactive power requirement

Feedback	Preliminary thinking
Authority did not demonstrate ±33% optimal: - for voltage management on Dx networks - in terms of reactive capability of embedded generating station's equipment	- Most equipment comes with capability - CQTG advised ±33% quite common overseas - Powerco's modelling suggests ±33% supports maintaining voltage on its network within regulated limits - The distributor and embedded generator can agree an alternative capability
Further questions: 1. What was technical rationale for ±33%? 2. How does ±33% compare with requirements on generators that are not embedded? 3. What is the cost of this requirement to the embedded generator and the overall market supply?	1. Per above preliminary thinking 2. Requirement for transmission grid-connected generators is +50%/-33% 3. Incremental cost relatively low cf. total cost of commissioned generating station

Practical considerations

Feedback	Preliminary thinking
Voltage support governed by: • operating voltage range at generating station point of connection to Dx network • Dx network's power quality requirements	Code amendment proposal provides for this
Being in voltage control mode & providing reactive power support is incompatible with existing GXP power factor requirements	• Typically difficult to establish direct relationship between an embedded generator's reactive power export/import and the GXP power factor • Any incompatibility only during regional peak demand periods • PF requirements proposed to be amended in tandem with option to manage import/export of reactive power at a GXP • Enforcement a contractual matter
Providing voltage support will require control systems & settings coordination between stations, the distributor and Transpower, to avoid the control systems "fighting" each other – will have resourcing implications	How material is the *incremental* cost of this?

Practical considerations (cont)

Feedback	Preliminary thinking
• To ensure consistent expectations across parties, further guidance may be helpful around distributors directing embedded generation to operate in an alternative voltage control mode to the default mode • Should distributors have to document or publish default expectations for embedded generators?	This would need to involve liaison between distributors and Transpower (both as system operator and a transmission grid owner)
Is the system operator or the distributor managing and policing the default voltage support obligation?	• Distributor managing, to the extent it can instruct embedded generation to operate in an alternative voltage control mode • System operator responsible for monitoring compliance with Part 8

Lower cost approach to FRT compliance

Feedback	Preliminary thinking
Use a high-level assessment of FRT compliance Rely on supplier statement that generating station's technology complies with the Code's 'no trip zone' requirements	• System operator limits scope & no. of FRT studies – ie, high-level FRT compliance assessment rather than in-depth studies • High speed monitoring used to demonstrate compliance • Generating station subject to under-frequency event charges
	• SO accepts supplier statement that generating station technology complies with 'no trip zone' settings in Code • High speed monitoring used to demonstrate compliance • Generating station subject to UFE charges • SO recovers from generator any instantaneous reserve costs associated with station not proving FRT compliance
	• SO requests that Authority require one or more 10MW- <30MW generating stations to undertake same FRT studies as for 30MW & above generating stations, based on SO satisfying Authority there is a benefit to the public • Analogous to clause 8.38 of the Code

Legacy clause arrangements

Feedback	Preliminary thinking
1 July 2026 too soon for ‘legacy clause’ arrangements to not apply	Push out date from 1 July 2026 to 1 July 2027
Make ‘legacy’ status permanent	Disagree – a generating station upgrade should result in the station complying if the upgrade means the station can comply
Delete Code provision that revokes ‘legacy’ status if maximum export power increases	‘Legacy’ status revoked if maximum export power of the generating station increases by >5MW over the capacity at 1 July 2027

Definition of ‘maximum export power’

Feedback	Preliminary thinking
Clarify whether 10MW threshold applies to nameplate capacity, average export, or export under specific operating conditions	Export under ‘normal’ operating conditions
For generating stations with multiple generating plant maximum export power is not simply the summation of all nameplate ratings – can be material losses between the generating plant and the point of connection	• This interpretation treats generating plant as a subset of a generating station • The Code amendment proposal definition treated generating plant as being a generating station, and so addressed this submission point
The nameplate rating of intermittent generation is subjective	Noted
‘Generating plant’ used instead of ‘generating station’, which is used in voltage AOPOs	‘Generating station’ applies to local network and transmission generation only

Definition of 'maximum export power' (cont)

Feedback

Submitters' proposed definition:

maximum export power *means, in respect of a* ***generating plant****, the lesser of—*

(a) the design maximum power that can be exported at the ***point of connection****; or*

(b) the power export limit which applies to at least a full ***trading period*** *imposed by an* ***active power*** *export control device under normal system conditions*

Code amendment proposal definition:

maximum export power *means, in respect of a* ***generating plant****, the lesser of—*

(a) the ***nameplate capacity*** *of the* ***generating plant*** *minus the minimum load at its* ***point of connection****; or*

(b) the power export limit imposed by an ***active power*** *export control device*

Preliminary thinking

- Is 'design maximum power' clearly understood and enforceable?
- Is 'trading period' appropriate? What is the benefit of referring to power over time instead of instantaneous power?
- Cf. 10MW offer threshold in Part 13 of the Code – *a generating station that is 10MW or smaller* (clause 13.25)
- 'MCO' is a separate definition in the Code

- Change '*a generating plant*' to '*a distributed generator or generating station*'
- Change '*the generating plant*' to '*the distributed generation or generating station*'

Other matters (for CQTG noting)

Feedback	Preliminary thinking
• Costs & benefits insufficiently quantified • Benefits overestimated • Calculate a quantitative net benefit • Well-reasoned qualitative & quantitative assessment	• Qualitative & quantitative assessment is appropriate • Quantitative net benefit just as subjective
Mandate grid-forming inverters	To be investigated as part of the system strength investigation, planned for later in 2025-26 financial year
Inconsistency in proposed changes to clause 8.21 across the voltage and frequency Code amendment proposals	The draft Code for each Code amendment proposal was prepared based on the proposal being standalone
Potential for loopholes surrounding the voltage support obligation	Authority staff reviewing the draft Code

Information

Promoting reliable electricity supply – a Code amendment proposal on common quality-related information

Consultation paper

1 July 2025

Confidentiality & intellectual property

Feedback	Preliminary thinking
Asset owners often do not own the IP in models. Asset owners' contracts with OEMs may prohibit them from sharing models with other asset owners.	• Further conversations with OEMs confirmed all but one are comfortable sharing a generic model. • Clarify in Code amendment that asset owner's must provide a model that can be shared – can be generic model.
Some encrypted models also contain IP, specifically source code that is the actual control software.	Clarify in Code amendment that the system operator must not disclose any modelling information to third parties, except as provided for in the Code (for example, the models provided specifically to be shared).
Recommend a framework similar to Australia's AEMO model, which allows suppliers to provide modified models directly to the system operator.	• OEMs are not participants under the Code. Asset owners remain responsible for ensuring compliance with the CACTIS. • OEMs may provide information directly to the system operator on behalf of the asset owner – the confidentiality protections will apply to this information.

Thresholds for CACTIS obligations

Feedback	Preliminary thinking
Appeared the draft Code amendment requires all generators above 1MW to comply with: • Modelling requirements • Operational communications requirements • High speed data requirements	• Clarify that the high-speed data and operational communications requirements applies only to non-excluded generating stations (>10 MW). • Clarify that asset owners' modelling obligations are determined by the asset's AOPOs and connection study requirements. • In regards to cl. 8.21, CACTIS will specify that excluded generating stations with generating units above 1 MW have to provide the system operator with an asset capability statement.

Equivalence arrangements & dispensations

Feedback	Preliminary thinking
Code amendment proposal not clear about the applicability of equivalence arrangements and dispensations to obligations specified in the CACTIS.	Amend the Code to clarify that asset owners may apply for an equivalence arrangement to be approved or dispensation to be granted if an asset owner cannot comply with a CACTIS obligation.

Legacy clause arrangements, & transitional provisions

Feedback	Preliminary thinking
New CACTIS obligations should not apply to existing assets.	• Legacy clause arrangements for new CACTIS requirements, except for the 'Connected asset owner-specific requirements' in Chapter 8. • Assets electrically connected before 1 July 2027 are deemed to comply with CACTIS requirements if they meet the requirements under the Code immediately before the CACTIS is introduced.
	Transitional provision for meeting the 'Connected asset owner-specific requirements' by 1 October 2027.
Code may unintentionally classify routine tuning or refurbishment activities as a modification, thereby removing legacy provisions.	• Clarify that an asset alteration is not considered a modification under the legacy clause if it changes the asset's performance by less than 1%? • Demonstrate through either regression analysis or a simulation study.

Governance of system operation documents

Feedback	Preliminary thinking
Clarify what constitutes a completed review.	Amend clause 7.15 so that a review is considered complete when the system operator either advises the Authority that no update is required or seeks permission to consult on proposed changes.
Clarify how participant proposals for updates to system operation documents are handled	Amend clause 7.14 to clarify the options available to the system operator when a participant proposes an update to system operation documents.
Could weaken stakeholder input and reduce the rigour of cost-benefit analysis, prompting support for transparent processes and the Authority retaining approval rights over CACTIS.	Part 7 of the Code already contains a defined process for consulting on and amending the CACTIS. Under Part 7, the Authority retains the right to approve, decline, or request further consultation on any proposed amendment.

Cost benefit analysis – general

Feedback	Preliminary thinking
Simplified quantification of the material net benefit and significantly under-estimates the compliance costs.	Provide an updated cost-benefit analysis, with quantified costs and benefits where possible and aggregated system level costs where the benefits can not be quantified.
Concerned that the cost-benefit analysis was largely qualitative.	
Estimated costs uneconomic for small-scale generation.	Clarify 10 MW threshold for operational communications and high-speed data requirements. Clarify asset owners' modelling obligations are determined by an asset's AOPOs.
Consultation paper understated the costs of retrofitting existing assets to comply with new requirements.	Clarify that the new requirements for modelling, high-speed monitors, and operational communications will apply only to new and modified assets.

Cost benefit analysis – modelling

Feedback	Preliminary thinking
Concern with requirement to provide four different types of generator models for all generators above 1 MW.	Clarify that asset owners' modelling obligations are determined by an asset's AOPOs. Not all generators above 1 MW have to provide models.
Concern of costs/practicality of requiring existing assets to meet new modelling requirements	Clarify that existing assets (and assets electrically connected before 1 July 2027) will be grandfathered in.
Requiring TSAT models creates considerable additional expense and delays for the industry.	Further conversations with OEMs clarified that all but one can provide TSAT models at no extra cost, one will require external consultants (est. $40K-$80K).
Requiring TSAT will create a reliance on TSAT supplier Powertech.	Some OEMs will rely on external consultants, however some OEMs have existing in house capability.

Cost benefit analysis – modelling

Feedback	Preliminary thinking
Paper understated the costs of compliance associated with the modelling requirements for IBRs.	Estimate of system-level costs for modelling requirements **over 10 years $2m-$5m** (still to be peer-reviewed) based on: • TSAT translation - $0-$80K • TSAT validation - $10K-$20k • PSCAD validation - $20k • Data from the system operator's commissioning pipeline (2026–2028) and the Authority's generation investment pipeline (2029–2036) on generating stations > 10MW.

Cost benefit analysis – high-speed data

Feedback	Preliminary thinking
Compliance for existing assets will require costly upgrades.	Clarify that existing assets (and assets electrically connected before 1 July 2027) will be grandfathered in.
Concern that for some stations, a high speed recorder will be required for each generating unit, not per station.	HSM equipment will not be required for each generating unit – only need to monitor HV side or station level
The estimated cost of $20K-$30K per station understated. Estimate the cost of retrofitting likely to be $100,000+ per unit.	Many of the additional costs for existing assets raised in submissions, such as power and wiring modifications to existing assets, ICT upgrades, and outage-related expenses, will not be incurred.
	Estimate of system-level costs for HSM requirements over **10 years $1.5m-$2m** (still to be peer-reviewed) based on: • Updated estimate for new stations - $30k-$40k • Data from the system operator's commissioning pipeline (2026–2028) and the Authority's generation investment pipeline (2029–2036) on generating stations > 10MW.

TRANSPOWER

Connected Asset Commissioning & Testing Information Standards (CACTIS)
CACTIS SO Consultation submissions

Presentation to CQTG

20 October 2025

CACTIS High Level Expected Timeline

Based on options consultation submissions, the EA has asked the SO to develop a draft CQ Information Requirements with further endorsement from CQTG at Febr 2025 CQTG meeting

Draft CQ Information Requirements document intended to be consulted on as part of the Information Requirements (Issue 6) Code Amendment Consultation scheduled for June 2025
SO also to consult separately

Code provisions that would be migrated to the CQ information requirements document:

- Technical Code A – Assets
  - Some of clause 2 (relating to ACS information, commissioning of assets, and testing of assets)
  - Appendix B: Routine testing of assets and automatic under-frequency load shedding systems
- Technical Code C – Operational communications

In Scope for CACTIS

Schedule 8.3 - Technical codes

Technical Code A – Assets

Appendix A – Main protection system requirements

Appendix B – Routine testing of assets and automatic under-frequency load shedding systems

Technical Code B – Emergencies

Technical Code C – Operational communications

Technical Code D - Co-ordination of outages affecting common quality

CACTIS – Overview Key Areas

Chapter 1 – Timeline for Commissioning and Connecting Assets

Chapter 2 – Commissioning Plan

Chapter 3 – Asset Capability Statement

Chapter 4 – Modelling

Chapter 5 – Connection Study

Chapter 6 – Operational Test Plan

Chapter 7 – Testing

Chapter 8 – Operational Communication

Chapter 9 – High Speed Monitoring

Submission Summary

Number received:

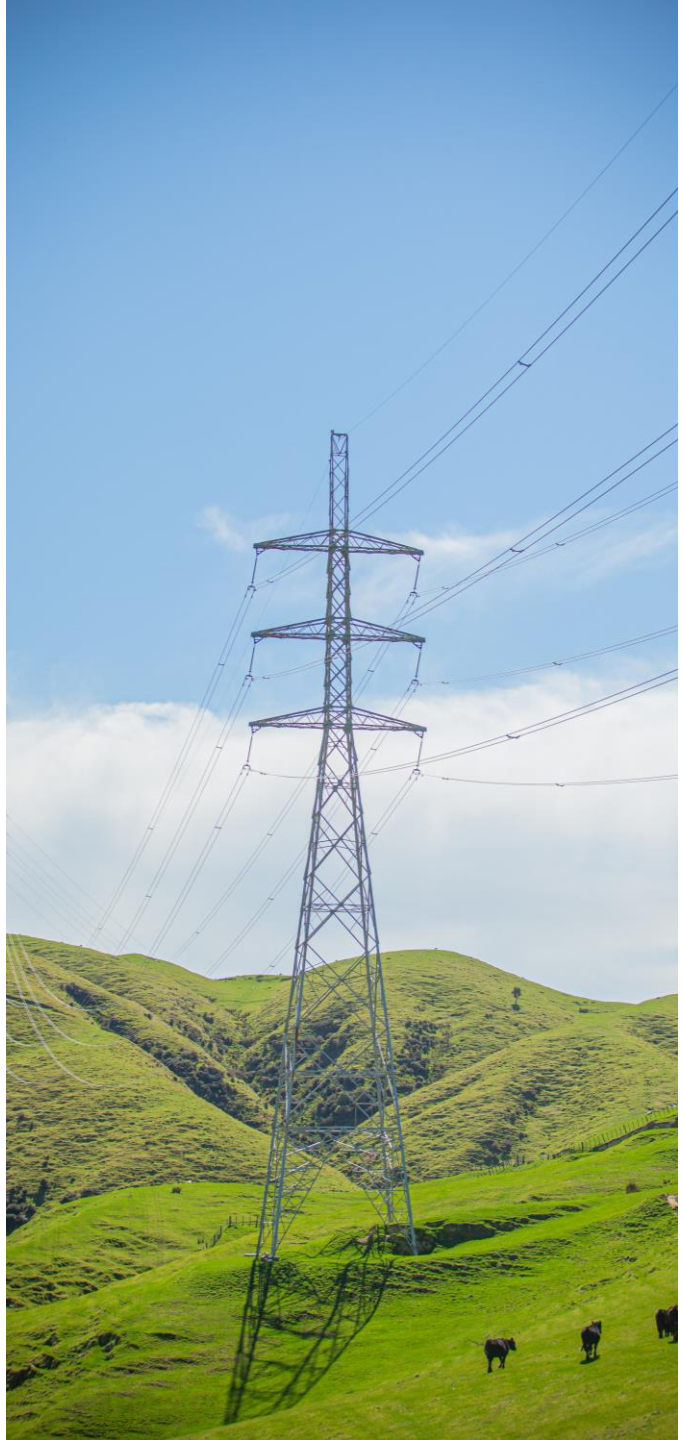
- 15 from the Authority's Part 8 consultation
- 14 from the system operator's consultation

Breakdown:

- 11 submitters replied to both consultations.
- 7 from generation companies
- 5 from distributors
- 2 from industry groups
- 1 from a direct connect customer
- 1 from a wind turbine vendor
- 1 from a modelling consultant

Common themes

- Lack of clarity on who needs to meet obligations in the proposed CACTIS
- Application of all the requirements to every generating unit of 1 MW or larger is excessive
- Provision of 4 models for every generating station is a burden to Asset Owners
- A timeline starting 12 months before commissioning is unrealistic



Working Principles

Part 8 and the Technical Codes:

- set out the Asset Owner Performance Obligations and who they apply to,
- are going through an amendment process along with the proposed CACTIS,
- have assessed all proposed changes to obligations complete with cost-benefit analyses, and
- laid the groundwork for the proposed CACTIS to become an Incorporated Document in the Code by reference.

The proposed CACTIS:

- sets requirements relating to:
  - information, including modelling, that asset owners must provide the system operator, and
  - the commissioning and testing of assets, and
  - other operational matters
- is not intended to provide a mechanism to change aspects of Technical Codes that have not gone through the regulatory change process.

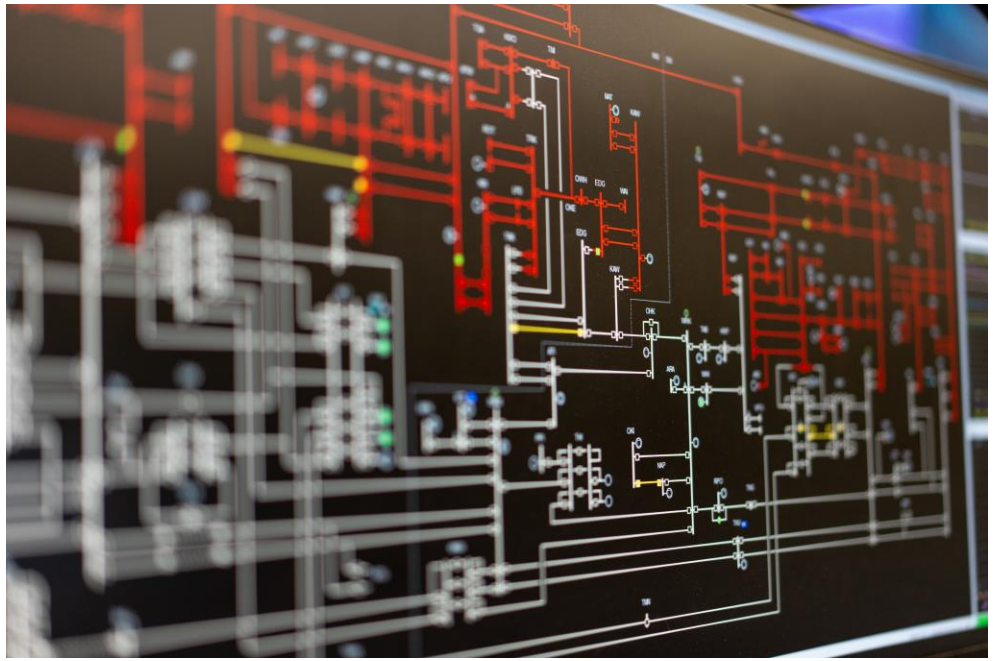
Proposed CACTIS Timeline

Timing
T = start of commissioning
E = end of commissioning
m = month
w = week

	T-3m	T-2m	T-6w	T-3w	T-2w	T	E	E+1m	E+3m	E+4m
						Commissioning				
Commissioning Plan (Chapter 2)		Commissioning Plan*								
Asset Capability Statement (Chapter 3)		Pre-commissioning ACS						Final ACS		
Modelling (Chapter 4)		M1 Model*							M2 Model*	
Connection Study (Chapter 5)		Connection Study Report*								
Testing (Chapter 7)		Engineering Methodology*		Operational Test Plans				Final Test Results		
Operational Communications (Chapter 8)	Signals finalised in Dataset + Dispatch (Part 13)									
Other Compliance Milestones					Protection Coordination*					Final Compliance Assessment

* Indicates a final copy for sign-off

Time Frames – Key points



Planning ACS

Submissions:

- The planning ACS requirement set at 12 months before commissioning is much too early. Some smaller projects can be built in a much shorter timeframe.

System operator response:

- We recommend to remove reference to the Planning ACS timeline from CACTIS.
- The Planning ACS will still appear in our guideline documents as a pre-requisite to secure System Operator engagement.
- This allows a project to be completed in 3 months if the asset owner has all the required information available 3 months prior to commissioning.

Flexibility

Submissions:

- A facility needs to be made to expedite breakdown maintenance of existing assets.

System operator response:

- We recommend to introduce the ability for Asset Owners to agree timescales for reinstatement of a previously commissioned asset that has failed.
- This enables much quicker like-for-like replacements, yet still ensures information requirements are considered.

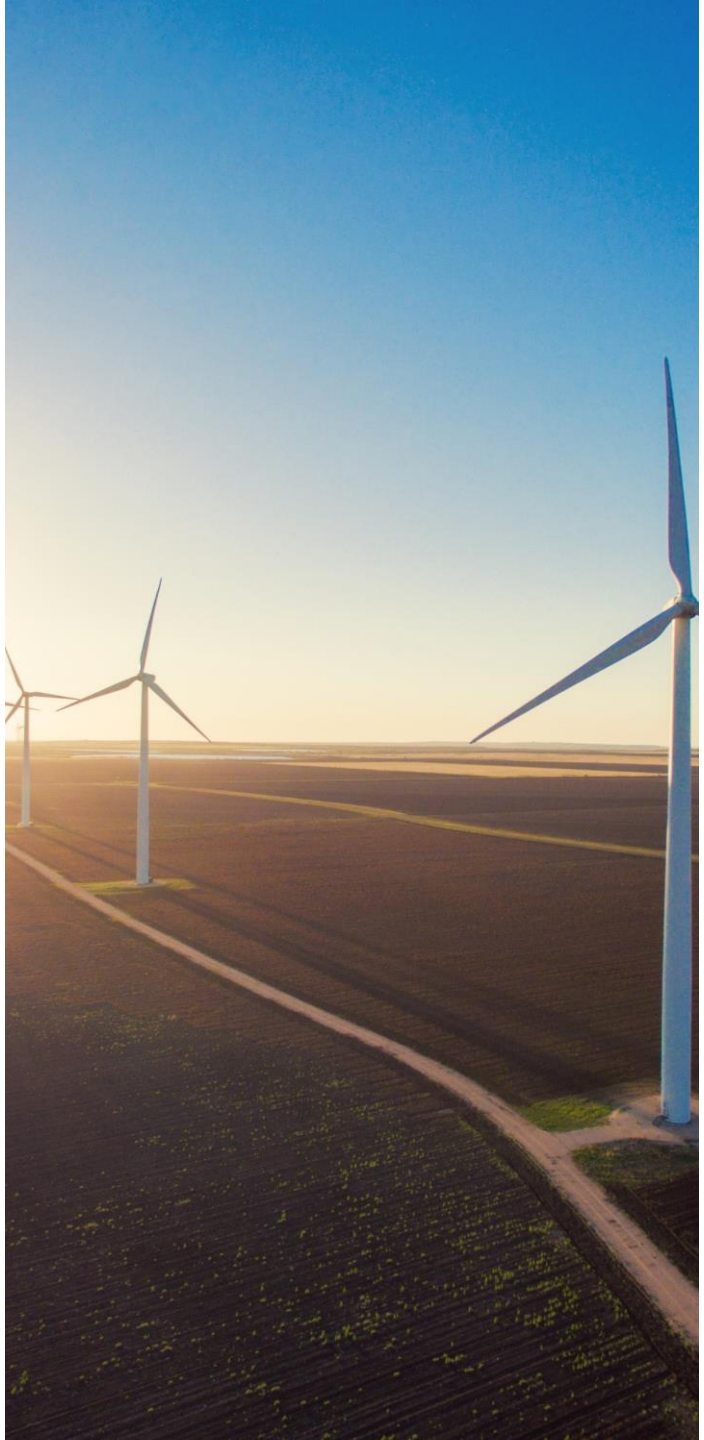
Utilisation of existing information sharing arrangements

Submissions:

- Current industry processes already manage commissioning of static components and the exchange of large volumes of data between grid owner and system operator; CACTIS will secure such information from other participants.

System operator response:

- We recommend CACTIS allows continued use of current commissioning processes and timelines for grid owner “static” assets as a legacy provision.



Applicability of CACTIS requirements

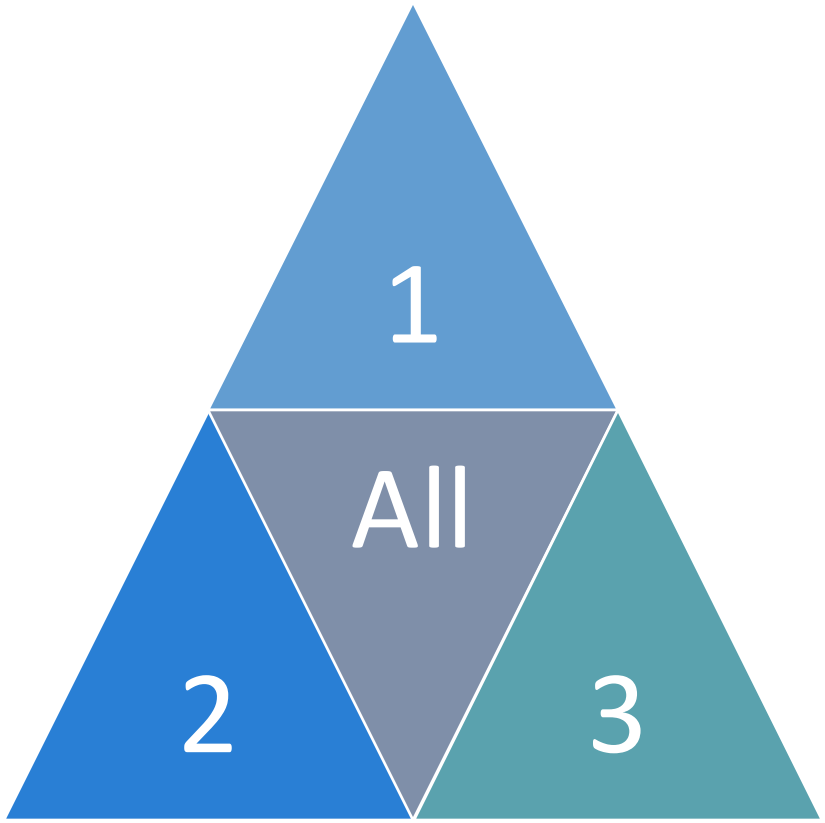
Submissions:

- It is very unclear whose assets get captured by the proposed CACTIS.
- It would be helpful for the proposed CACTIS to be better specified and proportionate in its application by identifying information requirements on an asset-type or participant-type basis to avoid any unintended "over-application"

System operator response:

- We recommend being clearer about the information required and propose to identify in each chapter of the proposed CACTIS to whom that chapter applies complete with any thresholds that can be applied .
- We propose to introduce groups of assets in the proposed CACTIS to help simplify applicability of requirements by chapter.
- There can be exceptions to these groups; they are identified in their respective chapters.

Asset Groupings



Group 1 – Provide an ACS (Chapter 3)

- Generating Units with rated net capacity of equal to, or greater than 1 MW into the grid or a local network, and
- Reactive power devices with rated net capacity of equal to, or greater than 5 MVAr

  (There is provision in the proposed CACTIS for this group to provide some additional information if required, this is discussed in more detail in a later slide)
- Distributors
- Grid owners

Group 2 – Commissioning and modelling (Chapters 2-6, 9)

- Generating Stations that export equal to, or greater than 10 MW into the grid or a local network, and
- Dynamic Reactive power compensation devices with rated net capacity of equal to, or greater than 10 MVAr

Group 3 – Testing and operational communications (Chapters 7, 8)

- All Asset Owners, as specified in the Chapters after application of Group 1 and Group 2 thresholds, unless requested otherwise
- Examples of these requests could be additional indications and measurements to be provided by distributors or from excluded generating stations

Requirements for each Asset Group

Requirements Chapter of Proposed CACTIS	Asset Group 1	Asset Group 2	Asset Group 3
2. Commissioning Plan		☑	
3. Asset Capability Statement	☑	☑	
4. Modelling		☑	
5. Connection Study		☑	
6. Test Plan		☑	
7. Testing		☑	☑
8. Operational Communications		☑	☑
9. High Speed Data		☑	

Reasonableness of information requests

Submissions:

- Some submitters held that the proposed CACTIS grants the system operator too much discretion to determine what constitutes ‘common quality’ information and to amend these requirements over time.
- Another submission requested clarity on what constitutes a ‘reasonable’ information request.

System operator responses:

- Current provisions in the Code allow reasonable information requests in each of the following situations:
    - to assist the system operator in planning to comply, and complying, with its principal performance obligations and achieving the dispatch objective; and
    - to assist during planning studies; and
    - to assess compliance of assets and configurations of assets; and
    - to include modelling data for planning studies; and
    - to demonstrate the compliance of the asset owner’s assets; and
    - to assess grid interface modelling data for planning studies;
    - to request operational communications from excluded generating stations.

The proposed CACTIS allows information requests so the system operator can complete its review obligations and to carry out its role as system operator. To be more specific, the same information request clause would need to be repeated 10 times in Chapter 1.

We recommend retaining the single information request clause in the proposed CACTIS.

COMMISSIONING PLAN OVERVIEW

PHASES OF COMMISSIONING

Delivery

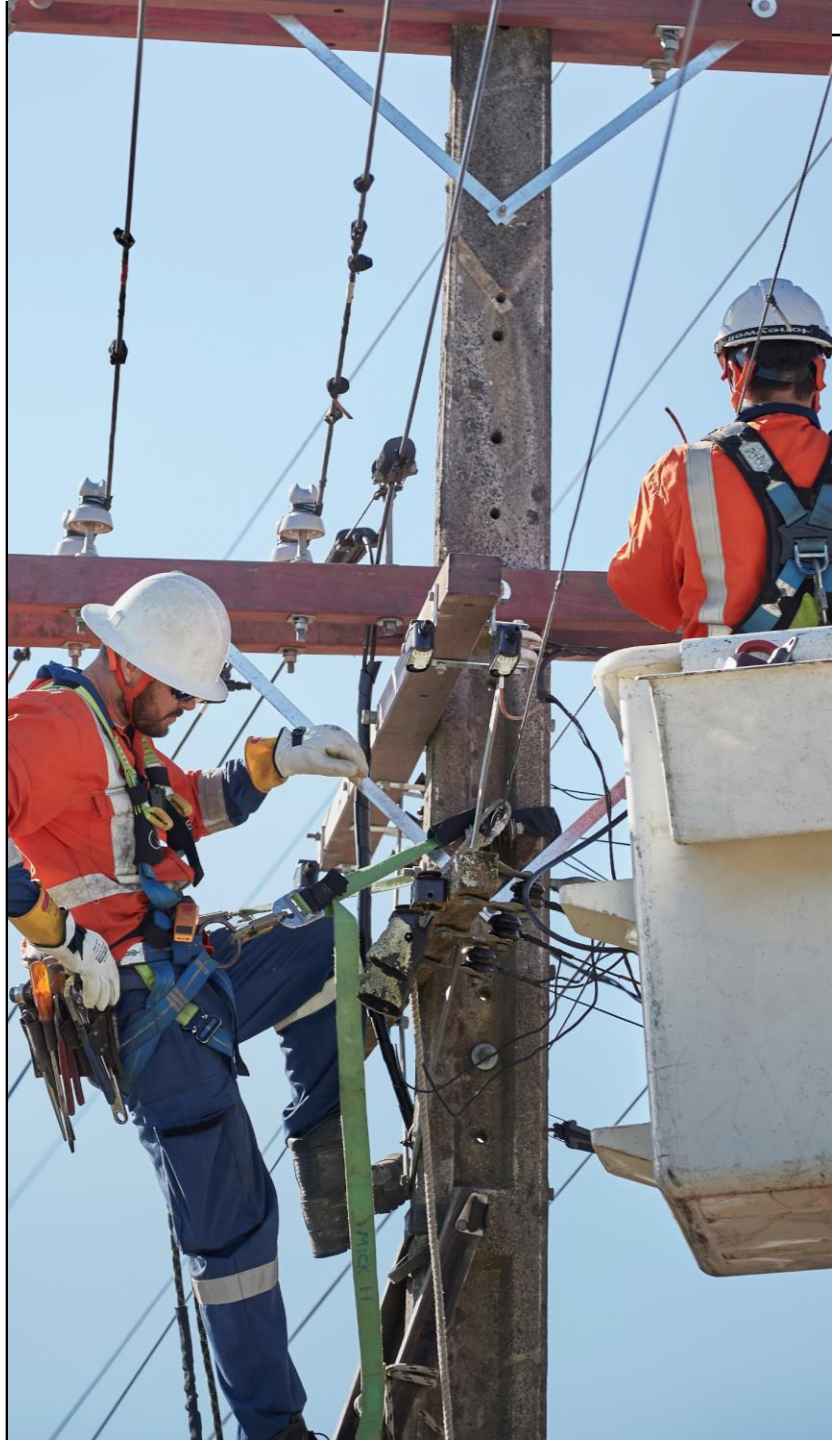
The Asset Owner develops and agrees key documents including the Code Commissioning Plan, Engineering Methodology, Connection Study, often during asset construction

Commissioning

Connection of the asset to the power system and testing to demonstrate compliance and capability

Closeout

Validation of test results to ensure compliance, and operationalising the asset for commercial operation



Commissioning Plan Requirements

The proposed CACTIS requested Commissioning Plans be submitted in the following circumstances.

- When an **asset** is electrically connected to a **network,** and
- When changes to an asset changes specific characteristics at a **grid interface.**

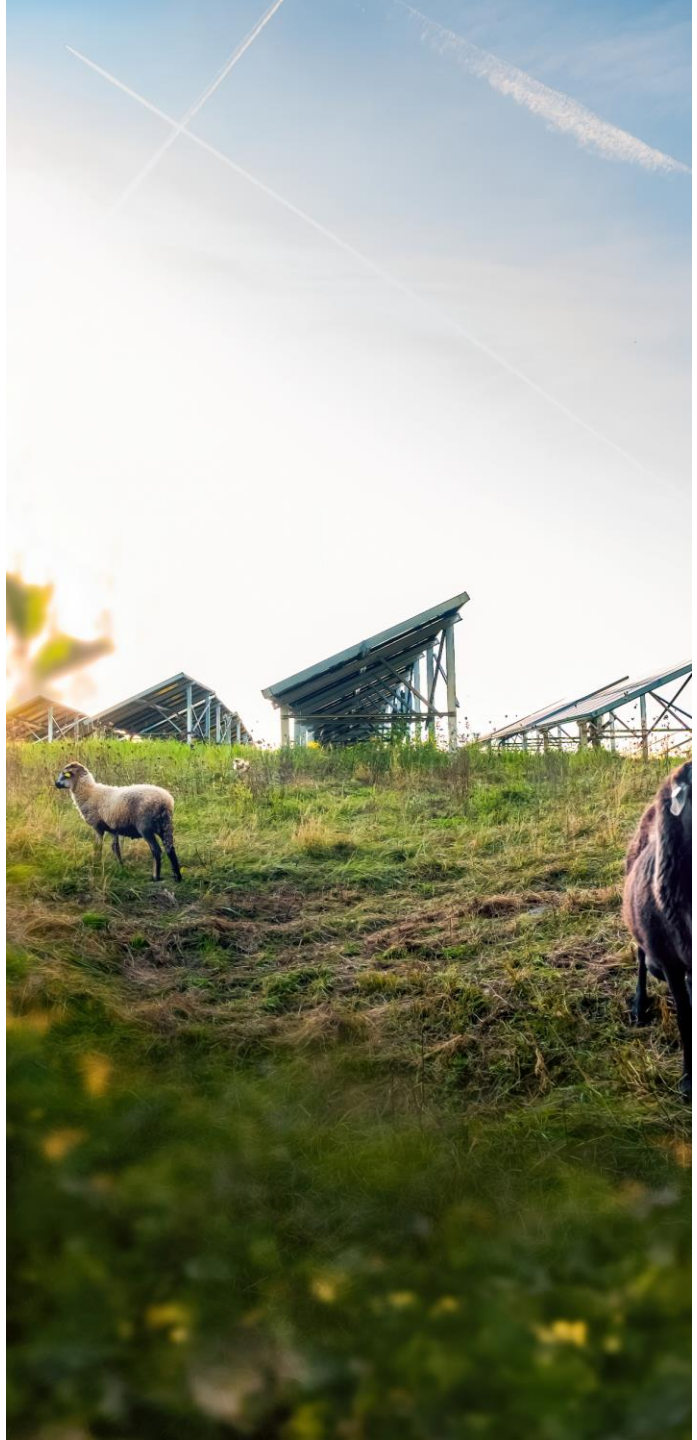
Submissions:

- The term ‘asset’ is very wide; it is unclear how far into a local network or a direct consumers equipment the proposed CACTIS applies.
- It is unclear which assets are described in the term Network.
- A control system setting or firmware change may not always change performance of the asset.

System operator responses:

- Our proposed grouping of generating stations ≥ 10MW and dynamic reactive power control devices ≥ 10MW clarifies which assets are of interest.
- The list of possible changes in those assets that could alter characteristics at the grid interface remain unchanged from the Part 8 of the Code.
- Control setting and firmware changes must be notified within the required timeframes, with supporting evidence (e.g. modelling studies), even if no grid impact is expected—so the system operator can assess them.
- **We recommend to retain this wording in this chapter of the proposed CACTIS.**

ASSET CAPABILITY STATEMENTS



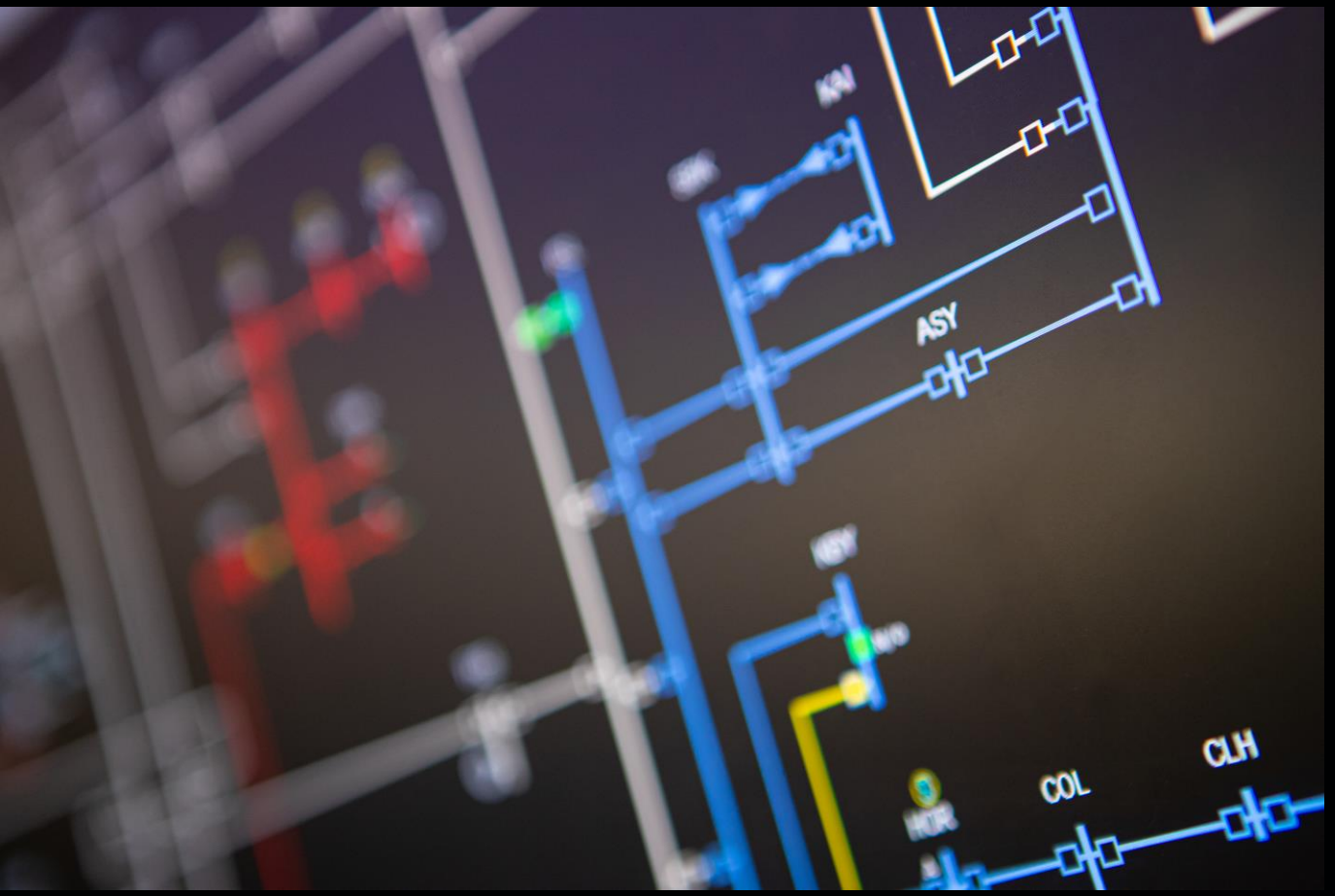
Asset Capability Statements

Submissions:

- Submissions suggested lodging an ACS 12 months prior to commissioning is impractical particularly for smaller projects.
- Updating a planned change to asset capability in an ACS in 2 business days leaves insufficient time to assess changes.
- Various submitters commented on the process for notification of urgent and temporary changes to asset capability.

System operator responses:

- We recommend removal of the time frame for a planning ACS from the proposed CACTIS. A planning ACS would still be required to kick off the system operator commissioning process, however reference to it and its timing should be removed from CACTIS. It would remain in our guideline documents.
- We recommend extending the time to submit planned changes into an ACS to 5 days.
- Urgent and temporary changes to asset performance continue to be notified separate to the ACS.



MODELLING REQUIREMENTS OVERVIEW

SIMULATION CAPABILITIES

Simulation Tools

- DigSILENT PowerFactory,
- Manitoba Hydro Hydro International PSCAD
- Powertech Lab DSATools (PSAT, VSAT, TSAT, SSAT) and DSAManager

Study Types

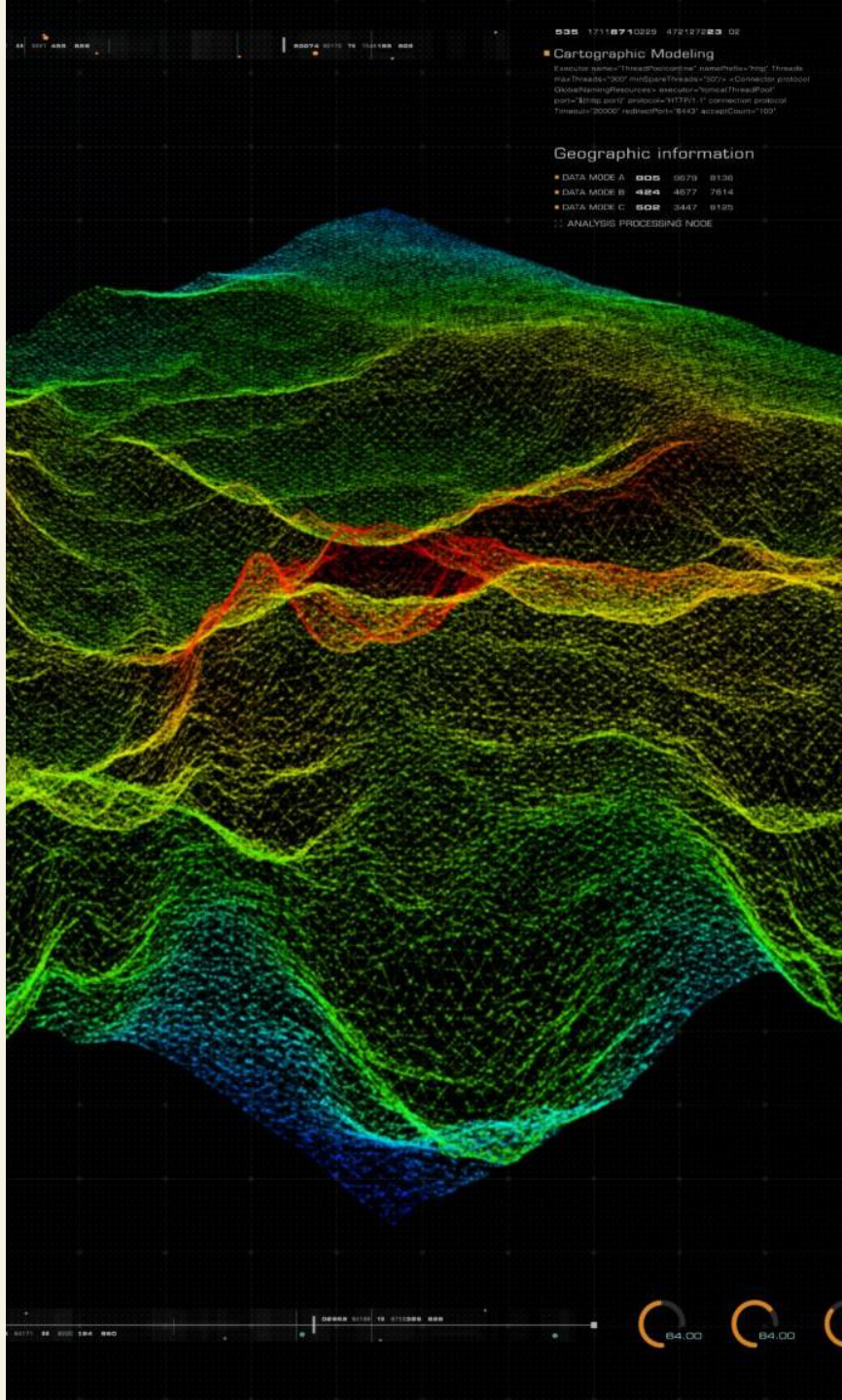
- PowerFactory and DSATools: steady state powerflow and contingency analysis, voltage stability, frequency stability, transient stability, control system tuning, compliance assessment and any RMS time domain simulations.
- PSCAD: electromagnetic transient studies, fault studies, sub-synchronous resonance studies and transient effects of renewable energy integration.

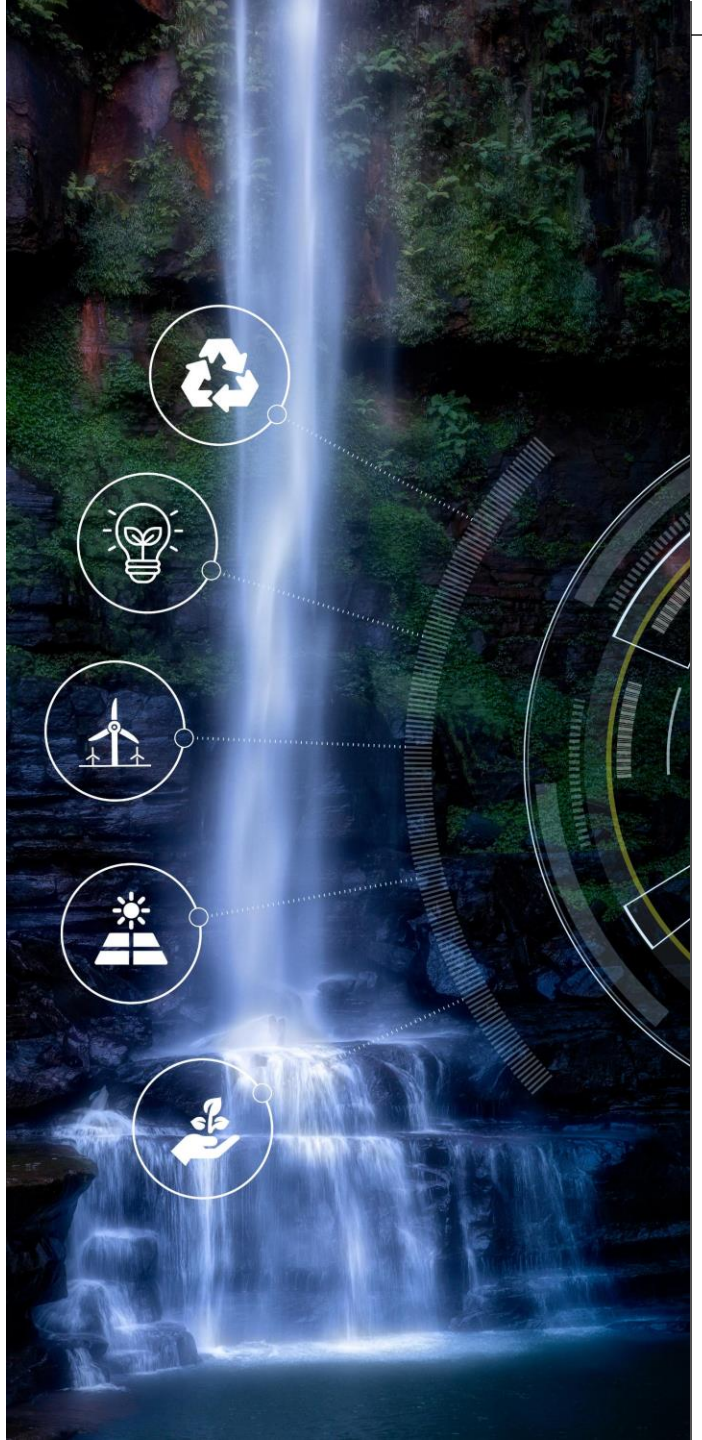
System Operator Uses of Tools

- PowerFactory: offline studies like SSF, post–event analysis and other planning stability studies.
- PSCAD: offline studies mainly for compliance assessment like fault-ride-through studies.
- DSATools: offline and online studies including voltage, frequency, and transient stability. Post-event analysis and specialist stability studies for Automatic Under-Frequency Load Shedding.

Future Applications

- PSCAD: impedance scanning to analyse control interaction and sub-synchronous resonance studies.
- DSATools: introduce small signal assessment tools (SSAT) to perform small signal analysis.
- Benefits: both impedance scanning and small signal analysis can reduce the effort to analyse control interaction related issues. SSAT can be applied online to assess oscillatory instability in real-time environment.





SYSTEM OPERATOR VIEWS

Dynamic and unpredictable

- Rapid growth of renewables, bidirectional flows from demand response and storage, hybrid HVAC/HVDC systems, increased use of power electronics, advanced protection technologies and evolving market behaviours.
- Dynamic and unpredictable behaviours require more accurate and frequent management to improve reliability and prevent of blackouts.

Dynamic Security Assessment (DSA) Tools

- Use system's current condition to assess system security, providing system operators with a "first line of defense" against disturbances and instability on the power system.
- This removes uncertainties related to generation mix, voltage profiles, and other key parameters essential for evaluating system stability.

Real-time applications

- Over 60 system operators in North America, South America, the Middle East and Asia use Powertech Labs online DSA tools in their control rooms.
- Powertech are currently deploying online DSA tools for the system operator in India and preparing for deployment with TenneT in the Netherlands.

Future needs

- Transpower uses DSA Tools in real-time to assess voltage stability, frequency stability and transient stability.
- Impedance scanning or small sign stability analysis can be used to effectively assess inverter related stability issues. SSAT is well-suited for control room application.

SURVEYS

Literature Research

- Most jurisdictions require either PSS/e or PowerFactory and PSCAD.
- Some ISOs in North America, Middle-East and Asia have started asking for TSAT, either based on type of project or on an as-needed basis.
- AEMO includes SSAT in their Power System Modelling Guideline as a preferred software.
- It is difficult to gauge if TSAT/SSAT has been mandated and types of model requested.

OEM Perspectives

- Contacted Siemens, Vestas, Power Electronics NZ, SMA, Huawei and Sungrow.
- All OEMs we talked to can provide TSAT models with no incremental cost, except Huawei.
- Some OEMs already have SSAT models to fulfil AEMO's requirement.
- OEMs are willing to support system operator's initiatives if we communicate our requirements.
- OEMs benchmark all the models they developed to ensure accuracy.
- OEMs can update their models within 3 months if there is no major re-work on the models.
- OEMs allow sharing of encrypted simplified models, except Huawei; they prohibit sharing of all their models.

New Zealand Consultant Perspectives

- Two consultants indicated that they have the capability to validate TSAT models.
- They estimate that validation generally takes two weeks' effort.
- However, they do not have TSAT licenses and indicated that licensing cost can be expensive.

MULTIPLE MODEL TYPES

The proposed CACTIS requested…

- For synchronous generating units: PowerFactory
- For inverter-based resources: PowerFactory, PSCAD, TSAT and WECC

Submissions:

- What is proposed is more demanding than international standards.
- A suggestion was made to align with jurisdictions such as North America, Australia and the UK.
- Concern was expressed that the proposed requirements could potentially increase project connection costs and completion time.
- The need of a detailed model was questioned.
- Concern was expressed on the difficulty of aligning the accuracy of the models across different software.

System operator responses:

- Most jurisdictions request two model types and the trend now is to request a third model like SSAT for AEMO.
- Most OEM's can provide TSAT model without additional cost; the system operator will work on options to reduce model validation effort.
- System operator has received 5 TSAT models so far.
- A generic model is adequate for some stability studies like frequency stability, but detailed models are required for oscillatory stability studies.
- OEMs are expected to provide accurate models, with benchmarking methods that are proven and reliable.

We recommend retaining the TSAT model requirement. To reduce costs, the system operator may undertake the TSAT model validation, provided a cost recovery mechanism is in place to support this process.

Since we can develop the WECC model in-house, we propose removing the WECC model requirement.

OTHER SUBMISSIONS

Updating models for new software versions

Submissions:

- Request to extend the 1-month time frame for submitting updated models for new software versions to allow for model preparation.
- Submitters suggested the system operator should assess compatibility before requesting an updated version.

System operator responses:

- System operator will assess compatibility before requesting model updates.
- OEMs indicated that they update a model within a month if the model does not need re-work. They prefer to have more time to ensure they can deliver.
- **We recommend extending the period allowed for software updates from 1 to 3 months.**

Model accuracy

Submissions:

- Requested clarification about the criteria used for model acceptance, validation and benchmarking.
- Highlighted the difficulty of assessing model performance across different software platforms and that the presence of confidential information makes it difficult to obtain and validated the data.

System operator responses:

- Instructions and criteria for model acceptance, validation and benchmarking can be found in our modelling guidelines.
- System operator acknowledges the concerns regarding the difficulty assessing model performance due to confidentiality.
- **We recommend keeping the model accuracy specifications at a less prescriptive level in CACTIS and provide more detailed updates in our modelling guidelines.**

CONNECTION STUDY OVERVIEW

EMT study requirements

Submissions:

- Recognised the need to perform EMT study where an RMS simulation is not adequate to identify potential stability issues.
- EMT studies require more resources and incur higher consultant costs.
- Should not have a blanket requirement for all assets to provide EMT studies; the need should be based on system conditions.

System operator responses:

- System operator acknowledges the concerns raised by the submissions.
- System operator has already made significant efforts to reduce resource requirements and cost by providing regional PSCAD network models as a base for studies.
- System operator will continue to investigate effective methods and to update our guidelines to reduce the effort needed to run EMT studies.
- **We recommend keeping the requirement to perform selective EMT studies. Asset Owners will still need to derive EMT study scope collaboratively with system operator.**

Sharing models to run studies

Submissions:

- Agreed that accurate studies depend on accurate models.
- Asset owners cannot obtain model from neighbouring asset owners due to confidentiality concerns.

System operator responses:

- We acknowledge the submitters' concern with intellectual property rights.
- We suggest a viable option is for the system operator to perform the study that is affected by model sharing issue.
- **If an asset owner cannot access neighbouring asset models (e.g., Huawei), the system operator may complete the dependent study portion if a cost recovery mechanism is in place.**

Review time frame

Submissions:

- Raised a concern that time frame of 20 business days for system operator to review connection studies might be too long.

System operator responses:

- Time frame requirements refer to deadlines for submitting the **final** version of the studies.
- Asset owner will have to submit drafts of studies well before the agreed final version deadline.
- **We recommend keeping the 20-day review period and note that this requirement applies to the final copy of the studies.**

Number of studies and contingencies

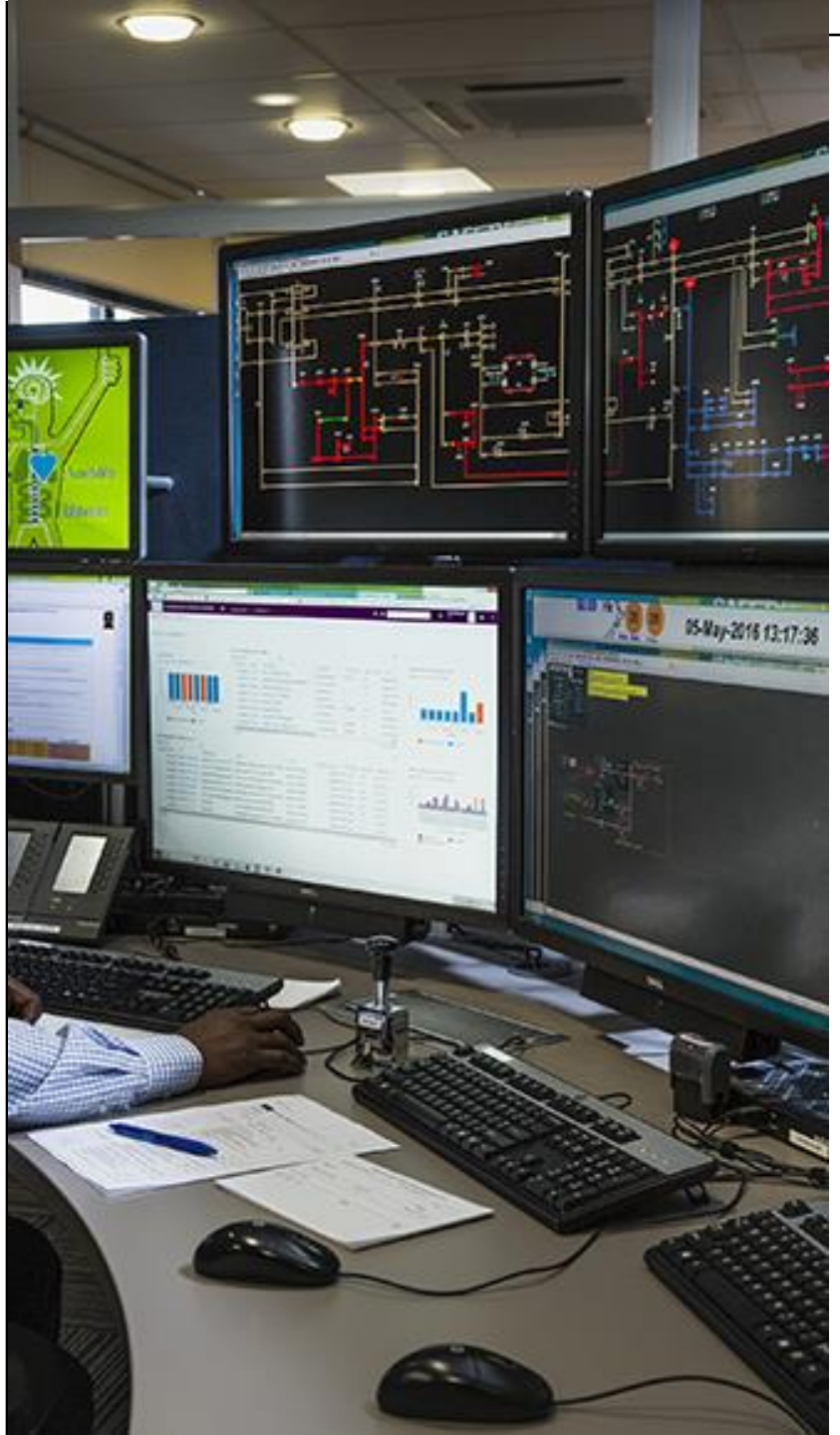
Submissions:

- Questioned the need to perform powerflow and contingency analysis studies as asset owners will have carried out their due diligence assessment already.

System operator responses:

- System operator acknowledges the submitters' views.
- Asset owners can share their due diligence assessment report(s) if the models and all study scenarios and contingencies from the connection study requirements are adequately covered.
- We also need to ensure sufficient studies are carried out to demonstrate asset performance meets Code requirements.
- **We recommend keeping these requirements.**

TEST PLAN REQUIREMENTS



Test Plan Requirements

CACTIS requested Test Plans be submitted in the following circumstances:

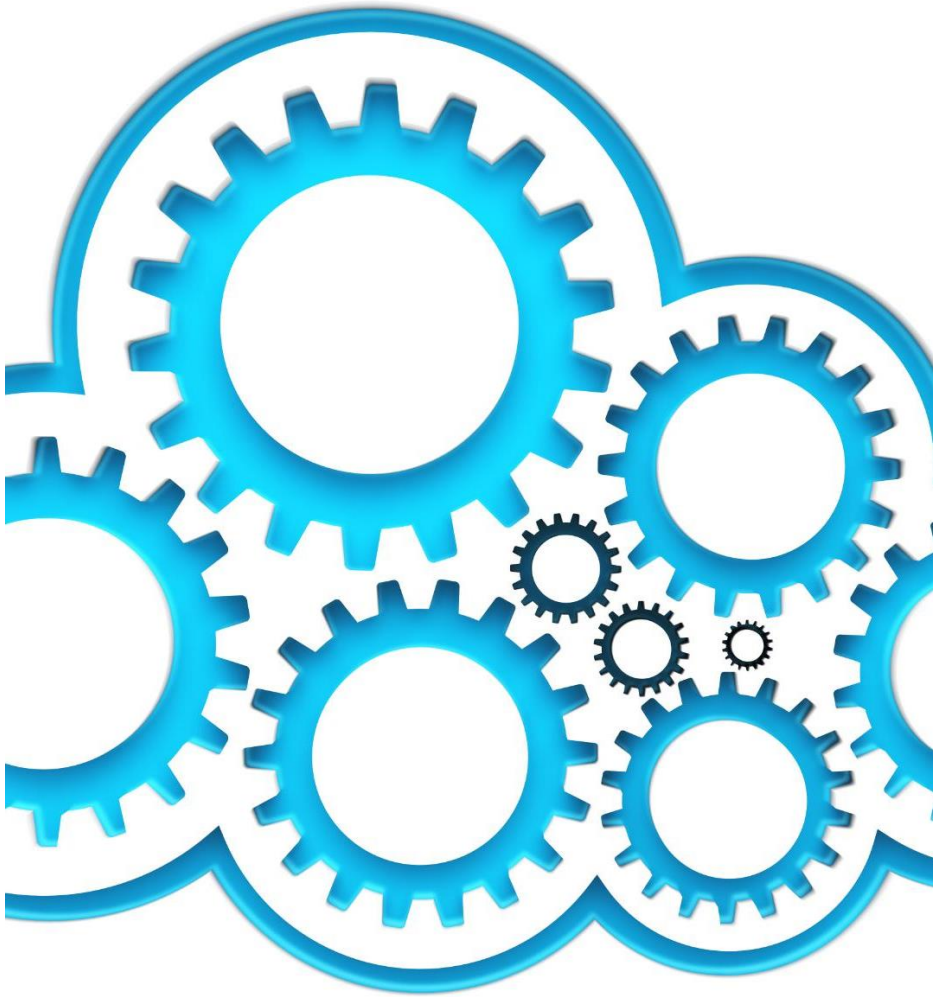
- For work being carried out under a Commissioning Plan; and
- If it is necessary to perform a system test to determine asset capability; and
- When the planned work may affect:
  - The system operator's ability to plan to comply, or comply with the PPO's; and
  - May affect the system operator's ability to achieve the dispatch directive or the accuracy of operational communications.

Submissions:

- The term "asset" is very wide; it is unclear how far into a local network or a direct consumer's equipment the proposed CACTIS applies.
- It is unclear which assets are included in the term "Network"
- A control system setting or firmware change may not always change performance of the asset.

System operator responses:

- Our proposed grouping of generating stations ≥ 10MW and dynamic reactive power control devices ≥ 10MW clarifies which assets are of interest
- The list of possible changes in those assets that could alter characteristics at the grid interface remain unchanged from the Part 8 of the Code.
- Control setting and firmware changes must be notified within the required timeframes, with supporting evidence (e.g. modelling studies), even if no grid impact is expected—so the system operator can assess them.
- **We recommend to retain this wording in this Section of the proposed CACTIS.**



Testing Requirements

Testing

CACTIS proposes to supplement existing test requirements in Appendix B of Technical Code A with:

- An ability for asset owners to utilise event data in lieu of testing for smaller generators; and
- A requirement to submit an Engineering Methodology; and
- Test requirements for technologies producing power from wind, solar, or BESS.

Submissions:

- There was a concern that the requirements for testing IBRs would result in a large volume of information being needed.
- It was suggested that asset owners should be able to decide when to carry out routine testing of assets.
- Clarity is needed needs to confirm protection coordination at the grid interface in the case of embedded generation.
- The use of test data could be a challenge when data is recorded at a station basis.

System operator responses:

- Most IBR test requirements are set at a station level to reflect the single control system that manages multiple elements. This should reduce the volume of results.
- One of our working principles was that the proposed CACTIS would not be a mechanism to modify aspects of Technical Codes that were imported unchanged. As such, suggestions on the periodicity of testing and on the proposed use of test data to avoid scheduling testing were not considered further.
- Protection testing requirements were also brought into the proposed CACTIS unchanged. Clause 4 of Technical Code A sets out that the obligation for protection coordination sits with asset owners and the grid owner either side the grid interface.
- **We recommend retaining this wording in this Section of the proposed CACTIS.**

Operational Communication Requirements

Phase-in time

Submissions:

- Called for a transitional or phase-in period for existing assets to whom new indications would apply.

System operator responses:

- We share submitters' concerns and are supportive of a phase-in period.
- **We recommend to the Authority to consider to include a clause in part 8 to allow a transition period of 18 months after the proposed CACTIS takes effect to facilitate controllable loads indications being implemented on existing assets.**

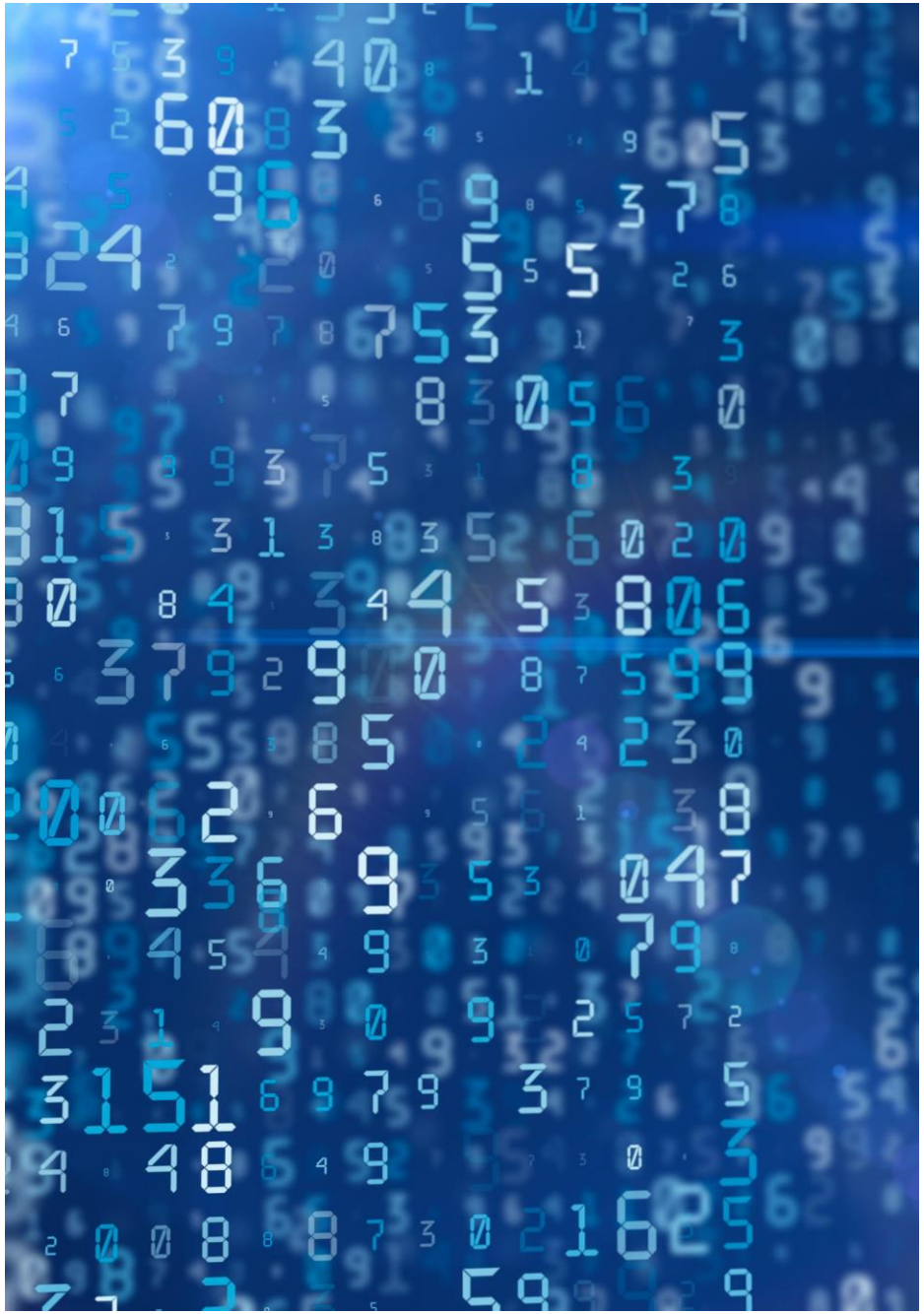
Wind and solar data

Submissions:

- Submitters questioned whether it is essential to request for wind and solar data.
- A suggestion was made that this data might be available in another source like centralised forecasting.

System operator responses:

- The system operator requires this data for variety of purposes including validating forecasts and carrying out event investigation analyses.
- We understand there needs to be a balance between information requirements to ensure power system security and the demands we place on participants for data.
- **We recommend changing the unit for wind speed from km/h to m/s but otherwise to retain this Chapter as written.**



Controllable Load Requirements

Submissions:

- Concerns were expressed that the accuracy requirements requested for controllable loads were not achievable.
- Some submissions questioned the purpose of this requirement and whether it aligns with the flexibility requirements of an evolving electricity system.
- Others asked whether this requirement would replace the obligations to submit difference bids.

System operator responses:

- System operator acknowledged the submitters' concern that asset owners may not have visibility of these loads and as a result would not be able to guarantee the accuracy.
- The proposed CACTIS provides for the future system given the current understanding of system complexities and within the boundaries permitted by the Code.
- **We recommend to update the proposed CACTIS to require a "best-endeavours" accuracy for load that is controlled by the connected asset owners.**

Terminology, sufficiency and other matters

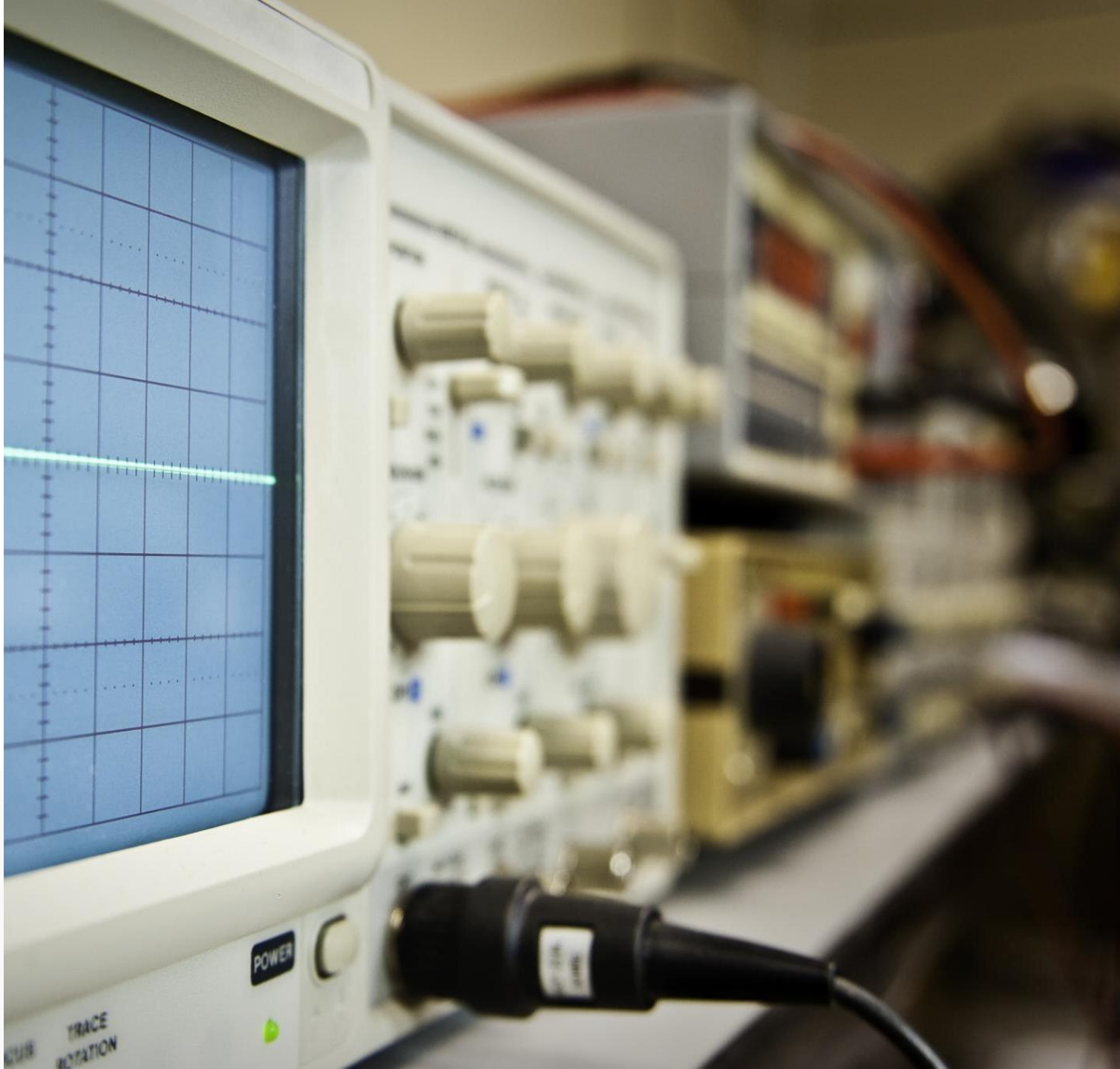
Submissions:

- Requested clarification on the terms:
  - Frequency control mode,
  - Whether circuit values apply to embedded generation
  - Station MV bus voltage for IBR
  - SOC indication unit (% or MWh)

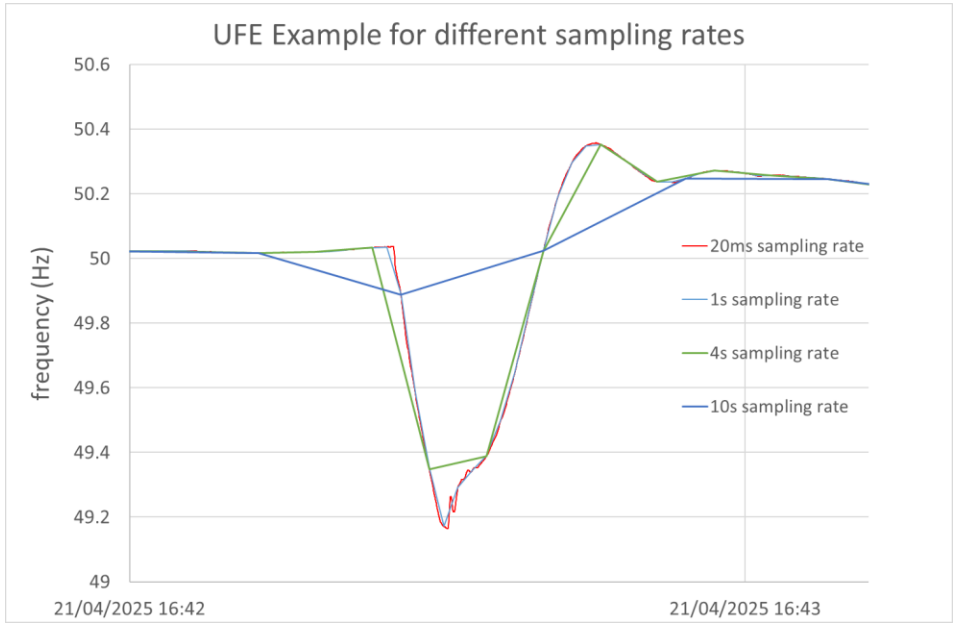
System operator responses:

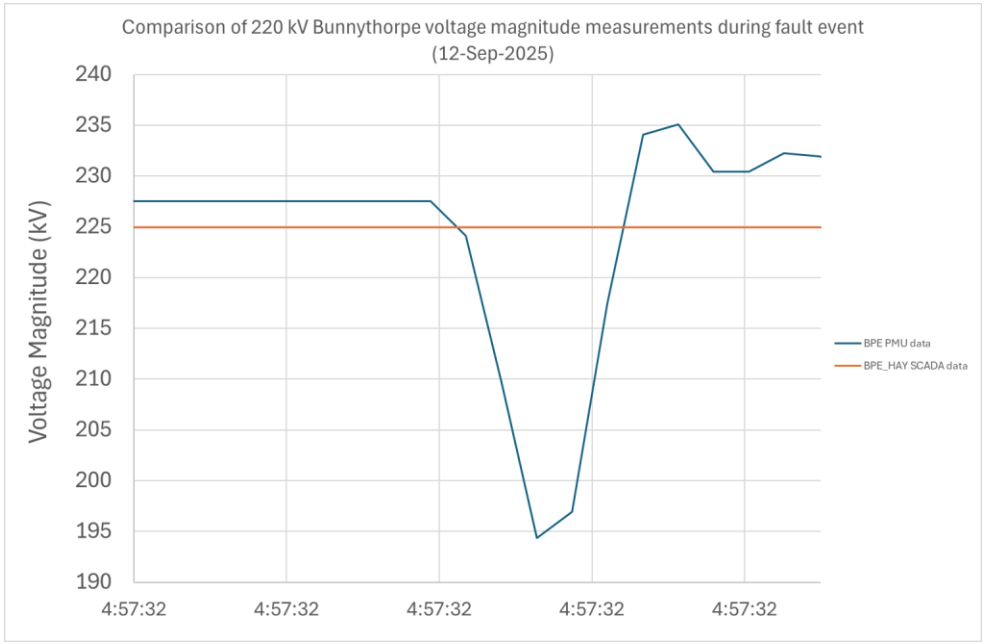
- Frequency control mode refers to mode in the frequency control system such as TWD (Tail Water Depressed), MW control or normal frequency control. The system operator can use this to configure frequency control model in online TSAT.
- Expect circuit value at the point of connection to be provided.
- Station MV bus voltage refers to collector bus of IBR.
- We acknowledged that there are many methods to calculate SOC. We use SOC % to configure our online TSAT model.
- **We recommend no change to the proposed CACTIS.**

High-Speed Monitoring Requirements



High speed data requirements





Submissions:

- Opposed high-speed monitoring (HSM) to be retrofitted to existing station, citing high cost and lack of justification.
- Support this requirement for new stations only.
- Others suggested that this should only apply to IBR and not synchronous stations.

System operator responses:

- HSM allows assessment of performance and post-event analysis when equipment has fast dynamic responses. SCADA data with a slow sampling rate is inadequate for these assessments.
- Both synchronous generating units and IBRs will respond to system faults typically in the time window of between hundreds of milliseconds to seconds.
- We acknowledge the cost will be high to retrofit existing generating stations.
- **We encourage existing stations to install HSM as soon as they practically can, even if grandfathered.**
- **We also recommend to require provision of HSM data from existing assets if asset owners have the data available.**

Benefits of High-Speed Monitoring (HSM) Data

Submissions:

- Want clarification on the relationship between monitoring and testing requirements.
- The system operator may be underestimate the overall system cost of implementing HSM without articulating a clear benefit.
- Other suggested that this should only apply to IBR and not synchronous stations.

System operator responses:

- To use event data recorded by HSM in lieu of routine testing in some cases, for generating station exporting 10 MW or more but less than 30 MW.
- HSM helps system operators by making event analysis and compliance checks easier. It also cuts down the time needed to collect and verify data from asset owners.
- Other benefits can include performing detailed fault analysis, performance optimisation and proactive maintenance of critical equipment within the station.

Data submission and sufficiency

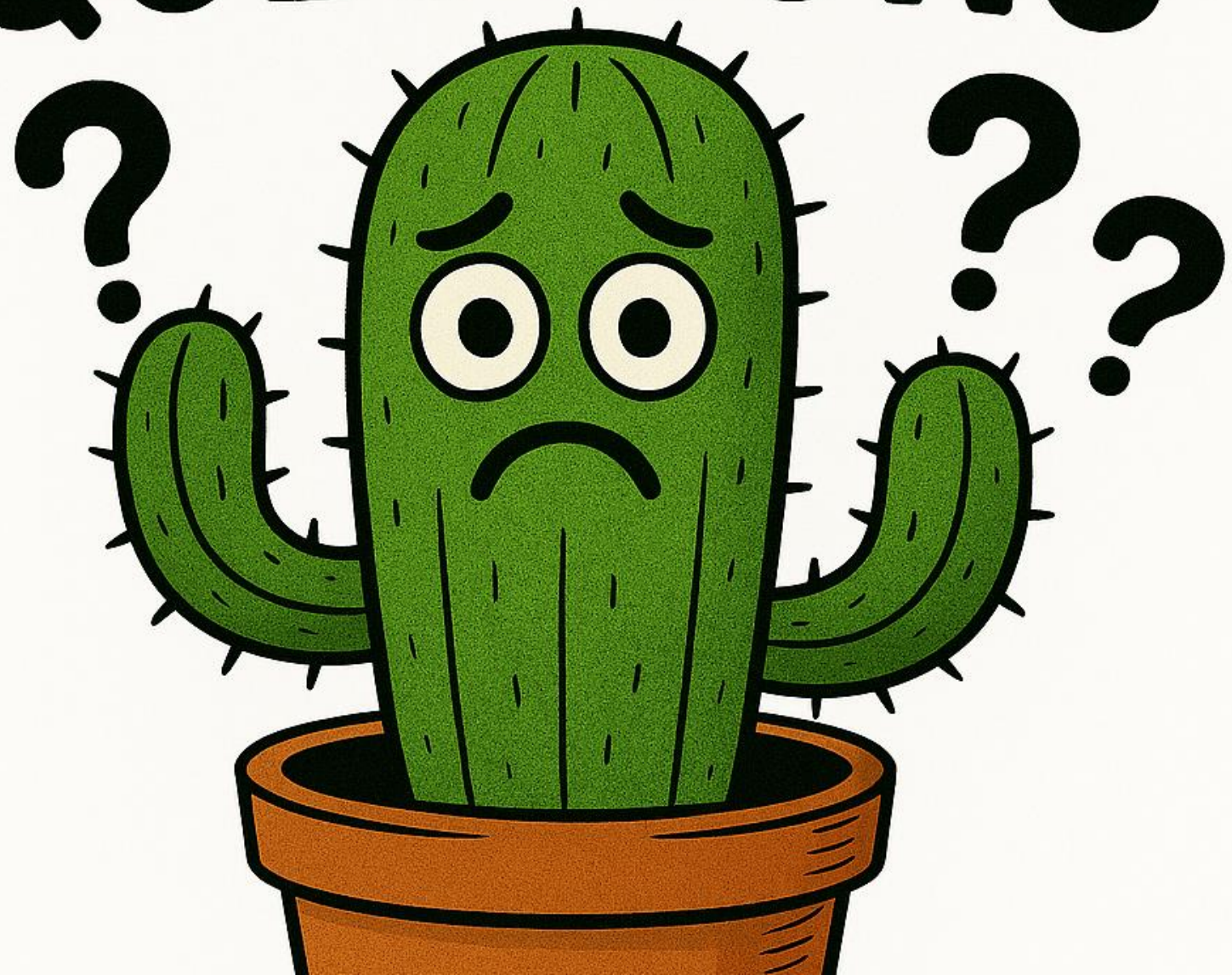
Submissions:

- Questioned the logic of requiring data submission in specific format that could create unnecessary work.

System operator responses:

- We considered the formats specified are ones commonly used and would not be too onerous to provide.
- System operators receive data from multiple asset owners, so standardising the data format is essential to simplify and reduce the effort required for data consolidation.

QUESTIONS



ELECTRICITY AUTHORITY
TE MANA HIKO

THANK YOU