

RE: CONNECTED ASSET COMMISSIONING, TESTING AND INFORMATION STANDARD (CACTIS) – CONSULTATION

Dear Transpower System Operator,

APD Global welcomes the opportunity to provide feedback on Transpower's Connected Asset Commissioning, Testing and Information Standard (CACTIS) Consultation Paper.

ABOUT APD GLOBAL

APD Global is a consultancy highly skilled and experienced in the delivery of power system analysis, network modelling, engineering design services and project commissioning for a broad range of clients. APD hosts the largest power systems team in Australia and New Zealand (ANZ), with over 400 electrical engineers, including 130 Power System Analysis Engineers. Our NZ team consists of 10 power system analysis engineers dedicated to PSCAD, PowerFactory and PSSE studies; and is forecasted to grow to 20 by Q4 2026. We provide power system analysis and technical advisory services to clients across ANZ.

Our engineers have detailed knowledge, experience, and understanding of the different types of technologies in a rapidly changing market including photovoltaic inverters, wind turbine generators, storage technologies and ancillary support devices (Grid-Forming/Following BESS, Synchronous Condensers, STATCOMS, etc).

We take pride in developing strategic and pragmatic solutions, often engaging and hosting OEMs directly to gain insight into their latest models, to support the successful connection of complex projects to electricity transmission and distribution networks across ANZ.

APD has partnered with AEMO and NSPs across the NEM, NT, WA & NZ, renewable energy developers, EPCs, partnering consultancies and OEMs. Our detailed knowledge of the Electricity Industry Participation Code, regulatory requirements and stakeholder engagements, provides immense value in delivering positive outcomes for renewable energy development initiatives and projects.

Our detailed response is provided below.

Please do not hesitate to contact us if you would like to discuss this submission in further detail.

Vimeshan Pillay

Manager – Power Systems NZ (Future Grids)

APD Global

M: +64 (0) 20 4177 3604

E: Vimeshan.Pillay@apdglobal.com

Submitter:

APD Global (Alliance Power and Data Pty. Ltd.)

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?	<p>Agreed. The discovery of an ill-defined parameter and/or assessment criteria can significantly impact a project's critical path and overall commissioning timeline.</p> <p>It would benefit the System Operator (SO) and prospective Asset Owners (AO) if all key information required by the SO, is declared up front in the very early stages of the project and standardised. A deliverables checklist for each stage, together with templates provided by the SO for all key documents, would aid in setting expectations for all parties.</p> <p>The current CACTIS proposal would aid in this aspect.</p>
Q2. Do you agree with the proposal to mandate minimum time frames for the activities in Chapter 1 of the proposed CACTIS?	<p>Agreed that minimum time frames would help in managing potential delays to commissioning. Time frames help give the industry certainty. For the SO, the time frames would be critical in scheduling review resources and projection of the pipeline queue.</p>
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?	<p>The timelines presented in Figure 1 of the Proposed CACTIS, at first glance, look compressed, with only 2 months from commissioning potentially insufficient for connection studies given the increased modelling and study requirements, particularly for complex renewable + BESS hybrid arrangements which require the coordination of controllers and integration of different OEM models into a plant model. Protection coordination submission 2 weeks prior to commissioning also appears compressed.</p>

	<p>The CACTIS timeline in the proposal assumes minimal changes and review rounds following submission. There is benefit in clarifying the process if non-compliance was discovered in the 2-months from commissioning period?</p> <p>The wording as-is can be interpreted as extension / deferment is the default process.</p> <p>As Figure 1 will become one of the main references in the connections process, ideally it would reflect when the first submissions to SO should be made, timelines for subsequent reviews, as well as the post-review final version.</p>
<p>Q4. Do you agree that requiring asset owners to use a standard commissioning plan template would help streamline the preparation and review process?</p>	<p>APD agrees that a standardised commissioning plan template would help streamline the preparation and review process.</p> <p>There would be merit in differentiating between the commissioning and compliance parts of the test plan(s) (this appears to be referenced as the Engineering Methodology at this stage), as the asset owner will be performing tests which may not necessarily be required for Code compliance (e.g. site tests to meet OEM warranty obligations).</p> <p>We recommend that the SO publish an accompanying worked example. In APD's experience, this has helped streamline the discussions between the SO and AO.</p> <p>As with any template, some flexibility may be required to accommodate a wide combination of technologies and implementations. Ideally, the templates would also be accompanied by a checklist of deliverables, clear assessment guidelines, and with clear timeline implications for the review process.</p>
<p>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</p>	<p>Agree with the timelines for the Planning ACS. However, the pre-commissioning timelines presented in the Proposed CACTIS, at first glance, looks compressed, with only 2 months from commissioning potentially insufficient for</p>

commissioning process, and for the system operator to review them?	<p>connection studies, given that the stated ACS is based on the connection studies.</p> <p>Ideally the process would accurately reflect when the first submissions to SO should be made, as well as the post-review final version.</p>
Q6. Do you agree that formalising the asset capability statement assessment requirements will provide clarity for asset owners?	<p>Agreed that there is benefit in the formalisation of assessment requirements.</p> <p>It would benefit the SO and prospective AO if all key information required by the SO is declared up front in the very early stages of the project, and standardised e.g. templates, checklists.</p>
Q7. Do you agree with the proposal to formalise requirements for asset owners to provide urgent or temporary changes to asset capability statements?	<p>Agreed in principle. Modification to critical plant components / parameters should trigger a formal assessment by the SO to ensure risk of meeting PPOs is mitigated. Whilst this is a valid concern, a pragmatic approach should be considered and outlined by the SO explicitly.</p> <p>In APD's experience, complex or onerous requirements following plant changes may deter further investment into improved or enhanced performance of existing plant.</p>
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?	<p>Agreed that there is benefit in formalising minimum time frames for model submissions. Currently, the CACTIS proposal is worded such that there is a review round following final submission, 2-months from commissioning. The timeline in the proposal assumes minimal changes and review rounds following submission, particularly for the m1 model stage.</p> <p>Ideally, the process would accurately reflect when the first submissions to SO should be made, as well as the post-review final version.</p> <p>There is benefit in clarifying the process if non-compliance was discovered in the 2-months from commissioning period?</p> <p>For comparison, AEMO in Australia, typically requires the submission of the equivalent initial "m1" model at least 6 months before</p>

	<p>commissioning, to allow sufficient review rounds and revisions, particularly if SO resource capacity for assessments is constrained. Notably, the NEM requires AOs to conduct pre-test simulations during the commissioning period.</p> <p>Whilst recent NEM projects have achieved shorter "m2" equivalent registration timelines, this is with standardised information submission requirements, compressed review cycles and significant experience with the established process.</p> <p>The New Zealand market would benefit from clarity on submission milestones and consideration for multiple review cycles as well as consideration for industry resource constraints.</p> <p>The industry would also benefit from a dedicated Power Systems Studies Panel, distinct from the Transpower Design Panel (of which APD is a part of), as currently, it is common to conflate substation and line design with power system studies. Detailed dynamic and EMT wide-area power system studies are a very niche and specialised skillset. With the increased volume in projected connections, clarity from the SO, upfront, would aid potential AOs in their procurement of the required skilled services, and provide confidence that the mandated timeframes can be met, and potentially streamline the review process for the SO.</p>
<p>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?</p>	<p>Yes, APD agrees with the necessity to update the requirements. To aid connection process efficiency, and to avail the NZ power system with a wider pool of prospective generation developers, the requirements should be tailored to the capabilities of power system software with previous track record of implementing generic/OEM models that are considered mature and have been widely used in other jurisdictions.</p>

	<p>Imposing a modelling requirement unique to NZ demands a large amount of initial research and development effort and risks turning projects in the NZ grid into a test bed for bugs and issues, adding unnecessary complexity and challenges during the connection process.</p> <p>From APD's experience, the modelling requirements themselves have not been as much of an impediment compared to the technical requirements. However, when the platform is limited in the ability to represent the plant, then this likely makes it a costly requirement to meet.</p> <p>Regarding the requirement details, the m2 acceptance criteria could benefit from having explicitly stated error metrics and "transient windows". Similar criteria could be applied for any benchmarking done between RMS and EMT models for the plant.</p> <p>Given the limitations of the tests done in a controlled environment, in APD's experience, there could be further fine tuning of m2 models based on actual system events during normal operation of the plant, and that this should be considered in an ongoing manner.</p> <p>The industry would benefit from clarification between the Code amendments and that acceptance is tied to the acceptance criteria in the Guide, as well as clarifications surrounding the process for dealing with non-acceptance, margins for negotiation and fine tuning. Generally, it is challenge to comment firmly on timelines if the guide and assessments are subject to frequent changes.</p>
<p>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?</p>	<p>APD Global agrees that advanced modelling tools are essential for SO to maintain power system security and meet the PPO, especially as the generation mix becomes more complex.</p> <p>PSCAD is widely recognised as the industry standard for EMT studies, particularly for inverter-based resources, and is well supported by OEMs globally. Its use is justified</p>

for detailed EMT analysis, which is increasingly necessary in the New Zealand context.

Conversely, TSAT, is primarily used for online dynamic security assessment and is embedded in the system operator's real-time operations toolkit. While TSAT has been used effectively for RMS studies and dynamic assessments, it is less commonly supported by OEMs and may impose additional costs and resource requirements on asset owners and proponents.

Based on APD's experience in Australia, it is becoming increasingly difficult to get OEMs to adapt models to new software platforms. OEMs make commercial considerations such as market size and costs to service jurisdiction-specific requirements. There are known instances where OEMs have withdrawn from a market after balancing these considerations. A striking example would be in Australia's NT, which for a while, was the only market requiring EMT in PowerFactory, resulting in withdrawal of renewable generation projects from the connection pipeline. Of those that remained, there has been significant costs to the AO and local system operator to work through issues presented in the use of a platform not widely used for EMT by OEMs in the region.

The requirement for TSAT models should be carefully considered, with awareness of the associated costs, licensing, and support challenges for proponents and OEMs. Feedback from asset owners on the practicality of providing TSAT models should be sought. There may be some exploration of opportunities for SO to work with OEMs directly to meet the TSAT requirements, similar to how unencrypted models are currently handled.

The last part of the response to this consultation question concerns the embedment of proprietary software platforms

	<p>within the Code. Given that changes to the Code involve significant consultation, ideally it'd be reasonably platform agnostic such that the changes would be relatively enduring.</p>
<p>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?</p>	<p>APD recommends allowing adequate time between receipt of the final m1 deliverables and reviews. The SO should encourage AOs to submit in the m1 model and study report together as a coherent package rather than be delivered and reviewed in a piecemeal manner. In APDs experience in performing due diligence on behalf of the Australian system operators and network operators, a new model iteration doesn't necessarily result in an improved performance. Subsequent model iterations, in some cases, degraded previously valid components while attempting to address initial concerns. Therefore, one cannot assume that subsequent review rounds would require diminishing effort from the AO or SO.</p> <p>The pre-commissioning timelines are potentially insufficient, given increased modelling and study requirements, uncertain assessment criteria, and undefined review periods. There would be benefit from clarity on submission milestones, including first submission, with consideration for review cycles and resource constraints.</p>
<p>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?</p>	<p>APD, in principle, supports the use of screening RMS studies for initial scenario screening and EMT studies for detailed fault ride-through analysis of IBRs.</p> <p>In Australia and other jurisdictions, we have increasingly seen OEMs default to EMT modelling due to the limitations of capturing fast acting electronics in the RMS domain. This is particularly the case in low SCR conditions. The accurate representation of performance during asymmetrical faults is limited in the RMS domain (typically DQ-frame), and OEMs recommend assessing performance through such faults, especially where non-zero residual</p>

	<p>voltage is simulated through the EMT domain. (typically $\alpha\beta$-frame)</p> <p>The industry would benefit from greater clarity on the conditions leading to a case being considered for detailed EMT studies. To avoid risk, AOs would likely have to study more than may be requested by the SO, and it may very well be in the AO's interests to study in the EMT / frequency domain to ensure robust controller tuning to expected system contingencies is attained.</p> <p>However, it is recognised that the study cases are set on a project specific basis. There is additional burden on the SO to identify these cases for agreement with the AO early, or to start RMS screening as early as possible. Due to the time constraints in an EMT domain, there is strong incentive to start this as early as possible. However, relying on RMS findings (assumed SO reviewed and approved findings) could significantly increase timelines in producing a study package.</p> <p>To ensure consistent interpretation and application of the standard, APD recommends:</p> <ul style="list-style-type: none"> • The methodology and objectives of the initial RMS-based screening should be clearly defined to avoid ambiguity in its implementation. • Information required from the SO, prior to embarking on studies, e.g. contingency list, and the timelines AOs can expect to receive this information. • The environment(s) in which the assessments will be conducted, e.g. SMIB vs Wide-Area Network. • The criteria and specific thresholds or conditions that trigger the need for detailed EMT studies using PSCAD should be outlined. This will provide a transparent framework for AOs and the SO to assess and negotiate study requirements.
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	<ul style="list-style-type: none"> • Clarifying if an EMT model is required, despite any screening ruling out EMT studies. • Clarifying when in the timeline, the SO intends to review the RMS package to determine the requirement for EMT studies.
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?	<p>The proposal is supported in principle, provided that the changes are material and have the potential to impact FRT performance. Not all parameter changes should necessitate a full repeat of FRT studies. A risk-based approach is recommended.</p> <p>Asset owners could maintain a change log and notify the system operator of all control system changes, with a joint assessment to determine if a repeat FRT study is necessary. This approach maintains system security while avoiding unnecessary burden on asset owners for minor changes.</p> <p>Independent of a trigger for repeated studies, it would be prudent for any m2 submission to re-affirm the validity of the m1 supporting documentation submission. Notably, evidence that cannot be checked through routine compliance testing should have its validity confirmed at this stage.</p>
Q14. Do you support the proposed process for accessing encrypted models from other asset owners when needed for fault ride through studies?	<p>APD Global supports the proposed process, provided that confidentiality and intellectual property are appropriately managed. In line with established practice in the NEM, it is effective for AEMO to release the RMS network model to proponents for their own studies, while retaining the EMT network model in-house. This approach allows proponents to independently undertake required RMS studies and demonstrate compliance, while ensuring that sensitive EMT models, often containing proprietary information from multiple parties, are protected and used only by the system</p>

	<p>operator for detailed system strength and stability assessments.</p> <p>Our experience has been that Network Operators in Australia prefer conducting EMT wide-area network studies in-house, whilst sharing SMIB EMT and encrypted RMS network models for their specific fault ride through studies.</p> <p>This process maintains transparency and efficiency for proponents, while safeguarding commercially sensitive information and ensuring consistency in EMT studies. Clear protocols should be established for model access, confidentiality obligations, and the roles of all parties involved.</p>
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?	The time frames proposed are generally supported. The specific tests can only be finalised following the confirmation of the ACS and the review rounds.
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?	It appears that the Engineering Methodology is looking at the tests to demonstrate compliance. There may be merit in combining the Engineering Methodology with the Test Plan.
Q17. Do you agree with the proposed testing requirements for wind, solar photovoltaic and BESS technologies	<p>The requirements are not clear for hybrid plant, e.g. Q-control for no irradiance periods for solar+BESS, any curtailment logic?</p> <p>A testing requirement which may benefit from formalisation are the required hold-points during the commissioning phase, what ramp steps tests will be conducted at etc. There may also be benefit in having clarification on if the plant is de-energised or can be a market participant for the period following final tests but before acceptance of the Final ACS and supporting artefacts compiled.</p> <p>Consideration should also be given to grandfathering of legacy type projects, where</p>

	<p>obtaining an EMT model would be a challenge in such cases (for example where OEMs are no longer in operation).</p> <p>APD recommends the SO consider making provision for network event-based validation, where system conditions or dispatch prevents the testing of the plant capability.</p>
<p>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?</p>	<p>APD Global supports the proposal for the additional data set out in Ch8.</p> <p>APD would also enquire if the following is being considered by the SO:</p> <ul style="list-style-type: none"> • Plant setpoints or dispatch targets. • Auxiliary load related quantities. • particularly for generation placed in weaker parts of the grid. • PQ related measurements, including status of any harmonic filters. (capacitor banks), especially for any voltage control schemes which rely on the Mvar capacity of the filter. • Status of the anti-islanding protection. <p>These would aid in retrospective compliance testing and event investigation.</p>
<p>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?</p>	<p>APD is generally supportive of increasing system visibility and having access to high-speed data.</p> <p>It would benefit the industry if the requirement for additional hardware and appropriate instrument transformers is firmer upfront, so that AOs can consider this at the design stage.</p> <p>Please also consider that existing instrument transformer frequency signatures may be largely unknown, if the intent is to validate EMT models using this data.</p>
<p>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?</p>	<p>The proposed sampling rate aligns with minimum requirements in the NEM. However, this may be an issue when investigating system events involving fast transients or high frequency stability issues.</p>

	<p>Assuming the AO would have to install an IEC 61000-4-30 Class A PQ meter, with suitably rated instrument transformers, there could be opportunity to trigger signals from those instruments, thereby exceeding the minimum specification outlined in the proposed CACTIS. The increased resolution and the actual waveform would be useful in investigating high-speed events or phenomena.</p> <p>APD would also enquire if the following is being actively considered by the SO:</p> <ul style="list-style-type: none"> • reliability / redundancy requirements • Repair time • Minimum storage of data <p>If so, it would be of benefit to include these in the draft Proposed CACTIS.</p>
<p>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?</p>	<p>APD expect that the proposed additional information requirements are in-line with requirements in other jurisdictions and will be able to be provided by OEMs and AOs. The TSAT model request should be carefully considered.</p> <p>Through experience, APD notes that deviations from established processes in other jurisdictions can cause significant delays and cost. Where these are required by the SO, transitional arrangements should be communicated to industry, as examples: AEMO's transition to PSCAD V5 and 64-bit models and PSS/E version 36 transition.</p> <p>Notwithstanding the costs imposed on AOs, this doesn't appear to be a significant technical impediment to implementation. Modern computing architecture and setups allow EMT studies to be run a lot faster.</p> <p>APD has heavily invested in our ability to serve the industry's growing requirements through the development of our engineering teams' skillsets and resources, backed by the investment in the software, hardware, and</p>

	datacentres necessary to conduct the volume of studies proposed.
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