REVIEW OF POWER SYSTEM DATA COMMUNICATION STANDARD

DRAFT REPORT AND DETERMINATION

Published: September 2022

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NOTICE OF SECOND STAGE CONSULTATION – National Electricity Rules – Rule 8.9

REVIEW OF STANDARD FOR POWER SYSTEM DATA COMMUNICATIONS

Date of Notice: 7 September 2022

This notice informs all Registered Participants and interested parties (**Consulted Persons**) that AEMO is commencing the second stage of its consultation on the Power System Data Communications Standard (the **Standard**[1]).

This consultation is being conducted under clause 4.11.2(c) of the National Electricity Rules (NER), in accordance with the Rules consultation requirements detailed in rule 8.9 of the NER (version 184).

Matter under Consultation

The Standard sets out the standards and protocols with which data communication providers must comply in providing, maintaining, and operating the equipment and systems used in the transmission and receipt of power system data and electronic instructions to and from AEMO control centres. The standard covers areas such as:

- Data representation, quality, and latency
- Remote control response times
- Reliability
- Security
- Data protocols and interfacing with AEMO
- Maintenance requirements such as response time.

AEMO is reviewing the Standard (last reviewed in 2017) to consider:

- Issues arising with a number of aspects of the current Standard such as data accuracy, data latency and response to failures.
- Issues that are expected to emerge due to power system and market changes over the next two to three years.

Invitation to make Submissions

AEMO invites written submissions on this Draft Report and Determination (Draft Report).

Please identify any parts of your submission that you wish to remain confidential and explain why. AEMO may still publish that information if it does not consider it to be confidential but will consult with you before doing so.

Consulted Persons should note that material identified as confidential may be given less weight in the decision-making process than material that is published.

Closing Date and Time

Submissions in response to this Notice of Second Stage of Rules Consultation should be sent by email to **Data.Comms@AEMO.com.au**, to reach AEMO by **5.00pm (AEST) on Friday 7 October 2022.**

All submissions must be forwarded in electronic format (both pdf and Word). Please send any queries about this consultation to the same email address.

[1] Refer https://www.aemo.com.au/-/media/Files/Electricity/NEM/Network_Connections/Transmission-andDistribution/AEMO-Standard-for-Power-System-Data-Communications.pdf for current version

Submissions received after the closing date and time will not be valid, and AEMO is not obliged to consider them. Any late submissions should explain the reason for lateness and the detriment to you if AEMO does not consider your submission.

Publication

All submissions will be published on AEMO's website, other than confidential content.

EXECUTIVE SUMMARY

The publication of this Draft Report and Determination (Draft Report) commences the second stage of the Rules consultation process conducted by AEMO to consider amendments to the **Power System Data Communications Standard** (the Standard) under the National Electricity Rules (NER).

The Standard sets out the standards and protocols with which relevant registered participants, referred to as data communication providers (DCPs), must comply in providing, maintaining, and operating the equipment and systems used in the transmission and receipt of power system data and electronic instructions to and from AEMO control centres. The standard covers areas such as:

- Data representation, quality, and latency
- Remote control response times
- Reliability
- Security
- Data protocols and interfacing with AEMO
- Maintenance requirements such as response time.

The Standard was last reviewed in 2017. AEMO is undertaking this current review to consider:

- Issues arising with a number of aspects of the current Standard such as data accuracy, data latency and response to failures.
- Issues that are expected to emerge due to power system and market changes over the next two to three years.

Principles of decision-making – cost and benefit considerations

Any enhancements to the Standard should be expected to deliver benefits for the NEM, but also may result in increased costs to the industry and ultimately consumers. In this review, AEMO has recognised and sought to address the risk that the costs of improving standards could be disproportionately high for smaller participants, while also considering where enhancements could reduce barriers to entry, increase efficiency and reduce costs in the longer term.

AEMO's approach to this review and the conclusions in this Draft Report are, therefore, underpinned by the guiding principles of the national electricity objective[2] and good electricity industry practice. The primary objective of changes to the Standard is to ensure effective support for acceptable power system security outcomes. For any proposed increase or change in the Standard requirements, AEMO has therefore considered:

- Where the current Standard falls short of good electricity industry practice for the NEM power system.
- The risks posed to power system security or resilience due to each of these gaps, both currently and expected in the medium term.
- A reasonable, efficient approach to address each of these gaps, having regard to technological feasibility and cost to the NEM, considering both immediate and longer terms costs and benefits.

In some cases, the Standard also needs to change to recognise or implement obligations already set, explicitly or implicitly, by the NER, an AEMO procedure or other legislation applicable to the industry or broader operations. In these cases, the Standard should not be seen as setting a new requirement.

Where implementation options are available, AEMO has endeavoured to allocate obligations under the Standard to the participants expected to be able to manage them most efficiently and recognise any

[2] Section 7 of the National Electricity Law

associated benefits that may accrue to participants from different options (where those benefits are likely to be in consumers' long term interests).

Issues with the current Standard

AEMO and stakeholders identified several issues with aspects of the current Standard, largely through a pre-consultation exercise conducted in late 2021, to inform an issues paper[3] which commenced AEMO's formal consultation. The principal issues identified through consultation to date are summarised below, together with AEMO's draft position on each of them.

Range of data to be provided

Some stakeholders suggested that the Standard needs to be more definitive on the range of measurements that need to be provided and indicated there is significant uncertainty on these requirements for new connections. AEMO has noted that the Standard cannot itself set specific obligations to provide data to AEMO; it can only refer to obligations set by other provisions in the NER or under instruments. In response to these submissions. AEMO will consider developing, an industry guideline or resource for information on specific data requirements. As regards the Standard itself, AEMO proposes to improve the general definitions in the Standard including the definition of power system data.

Participants covered by the Standard

It was noted that the Standard does not specify the full range of participants involved in the data communications process (e.g. participants providing inertia and system strength services; data from major industrial loads; virtual power plants and aggregated DER). AEMO proposes to update section 1.1 of the Standard to reflect recent NER changes in an inclusive manner, to cover all registered participants required under the NER to transmit and receive data to and from AEMO control centres in accordance with the Standard.

Consequences for a participant failing to meet the Standard

A stakeholder advocated for the Standard to be clear on the consequences for a participant failing to meet the requirements of the Standard. AEMO proposes to include in the Standard a summary of the measures which may be applied in the event of non-compliance with the Standard.

Requirements for DNSPs

A number of submissions indicated that the requirements specified for distribution network service providers (DNSPs) in the current Standard are unclear, including:

- The topology that applies for a DNSP.
- Whether a DNSP can have direct connection with AEMO rather than communicating data through a transmission network service provider (TNSP) facility.
- Diversity in communications between network service providers (NSPs) and between a TNSP or DNSP and AEMO.
- Specific requirements where there are two or more Intervening Facilities.

AEMO proposes to amend the Standard to clarify that, subject to appropriate transitional arrangements, DNSPs will be required to provide the services of an Intervening Facility in respect of remote monitoring and control equipment for plant within their network, involving the collection of data and relaying of control commands.

The amended Standard would allow flexibility for a DNSP Intervening Facility to directly connect to AEMO control centres, noting that a direct connection might be necessary in some cases to meet the

[3] Refer https://aemo.com.au/consultations/current-and-closed-consultations/review-of-power-system-data-communication-standard

performance requirements in the Standard. A further option, if practically feasible and agreeable to all parties, is for a DNSP's Intervening Facility to connect directly to one AEMO control centre and connect to the other AEMO control centre via the TNSP intervening facility. This arrangement would have the advantage of enhancing resilience of the data communications network.

Difficulties for new connections especially embedded participants and Wholesale Demand Response Providers

Stakeholders observed that the current data communications structure causes difficulties for new connections. For example, while new embedded scheduled and semi-scheduled generators have obligations under the NER and generator performance standards (GPS) to have automatic generation control (AGC) capability, this may not be possible through some DNSP SCADA systems. It was also reported that wholesale demand response providers are finding it very difficult to meet current data communications requirements.

AEMO's proposal outlined above for the Standard to clarify that DNSPs will provide the services of an Intervening Facility for connections within their network should address the majority of these issues. In cases where a market participant (e.g. an aggregator) is required to transmit and receive data between its facilities and AEMO control centres but has no obligation to provide similar data to its NSP, the Standard will provide the option of a direct connection with the market participant's facility and both AEMO control centres. Where it is not practicable to utilise existing data communication facilities, a direct connection will be facilitated. These 'non-NSP' Intervening Facilities will generally need to meet the same Standard requirements applicable to NSP Intervening Facilities for reliability, availability, and security, but in limited circumstances exceptions may be permitted to the requirement for communications to be made with AEMO over a secure private network. Exceptions will consider individual size and the significance of aggregate regional quantities for the relevant category of data or participant.

Data quality

Some stakeholders indicated that the Standard needs specific requirements and definitions for data quality. AEMO proposes to add a definition of good quality to the Standard and to expand the definition of a critical outage to include the failure of a facility to provide data of good quality.

Data accuracy

Some stakeholders emphasised the need for the Standard to set clear expectations regarding accuracy of data. AEMO proposes to add a data accuracy requirement and an obligation for DCPs to address any identified accuracy issues within a specified time.

Data latency and control command delays

The current Standard has no minimum requirements for data latency, which is basically the time it takes for data to be transmitted from the field to AEMO and from AEMO to the field. The current hierarchical architecture reflected in the Standard can mean extended delays in end-to-end transmission, in particular for embedded generation and storage. Poor data latency is creating significant issues for real time operational applications and other processes dependent upon analysis of real time data (e.g. the causer pays algorithm), and also for participants when receiving control signals from AEMO.

Current levels of potential data latency may have unacceptable impacts on power system security as the contribution of embedded resources increases. AEMO proposes to amend the Standard to provide clearer requirements for data latency and control command delays based upon end-to-end times, without reference to the number of Intervening Facilities between AEMO and the RME/RCE. This may result in a reduction in the required maximum transmission times for some individual facilities.

The end-to-end transmission time for status indications in the dispatch data and power system data categories is proposed to be tightened to 3 seconds in order to better ensure the accuracy of results of the State Estimator which are critical for power system security analysis.

It is also proposed to tighten the requirement for the maximum control command delay such that control commands must be transmitted to the relevant RCE within two seconds (on an end-to-end time basis). AEMO's experience is that this requirement is already being achieved by most DCPs with the exception of a limited number of legacy systems. An exemption and transition plan will be considered for such legacy systems.

Cyber-security

Some stakeholders have identified that there should be better alignment between the Standard and current or proposed legislation and regulations relating to cyber-security. AEMO proposes amendments to the Standard to reference the Australian Energy Sector Cyber Security Framework and require DCPs to assess and maintain compliance with the relevant security profile (security profile 1) and to refer to relevant provisions of the NER that apply to incident reporting.

Reliability of connections

A number of issues were raised in relation to the reliability provisions of the Standard, with regard to data criticality, interfacing arrangements and the extent of communications failure. AEMO has proposed amendments to address these issues. These include a requirement that all telemetry of operational data and transmission of commands to and from AEMO control centres should normally be by secure private networks, whether using an NSP's Intervening Facility or alternate telemetry options. It is proposed that these communication networks will be capable of remaining operational for up to 10 hours following loss of external AC supply. A similar requirement is proposed for telemetry of data in the more critical categories between the individual remote monitoring and control equipment and Intervening Facilities. This requirement will also apply to the Intervening Facilities themselves.

Variations to these requirements may be considered for smaller participants connecting directly to AEMO in appropriate circumstances, subject to individual and regional significance.

Scope of testing

Stakeholders observed that the current testing scope does not cover testing for correctness of data (as distinct from its communication). AEMO proposes to amend the Standard to make it clear that the scope of testing should include testing for data correctness.

PMU and HSM data

Submissions suggested that the Standard needs to cover phasor measurement unit (PMU) and high speed monitoring (HSM) data if it is deemed integral to power system security. AEMO proposes to include specific reference to PMU and HSM data in the Standard, where it is telemetered for real-time operational use as distinct to offline analysis. PMU and HSM data would be included in the definition of High-Resolution Data, with a separate process in the Standard to determine the requirements for PMU and HSM data.

Data protocols

Under the current architecture, the only communication protocol supported for connection to AEMO is the Inter-Control Center Communications Protocol (ICCP). If significant changes in the data communications structure are made, then the Standard may need to accommodate alternative protocols for connection to AEMO.

AEMO proposes to include an option in the Standard for use of the DNP3 Secure Authentication protocol (versions of DNP3-SAv5 and above), in circumstances where the Standard allows for direct connection to AEMO control centres from non-NSP Intervening Facilities that are not suitable for the ICCP.

It is appreciated that additional protocols might become more effective and feasible for AEMO to support as they evolve. In the short to medium term, the Standard will provide certainty for the use of a secure

DNP3 protocol for relevant data connections. To facilitate ongoing adaptation, AEMO may also specify additional supported protocols in future, without requiring an amendment to the Standard itself.

Transitional provisions

A number of stakeholders noted that any increased requirements in the Standard need to be transitioned to accommodate additional funding requirements to meet such increased requirements. To the extent that AEMO's proposed changes require time or resources to improve or upgrade to meet higher or additional requirements, AEMO has considered whether transitional provisions or exceptions are appropriate and invites submissions from affected DCPs on the implementation steps required and reasonable transitional periods and terms.

At this draft stage, AEMO has proposed a process by which increased or additional requirements may be implemented in accordance with a schedule agreed with AEMO, reflecting the implementation effort. To provide a level of certainty, the Standard would set out maximum implementation periods for DCPs, proposed as follows:

- for regulated NSPs, 12 months after the start of the next regulatory reset period after the amended Standard comes into effect; and
- for other DCPs, within 2 years after the amended Standard comes into effect unless the DCP is reliant on implementation of enhanced capabilities by an NSP. If this is the case, then the relevant DCP will be required to meet the increased requirement within 12 months of the commissioning of the necessary enhancements by the NSP.

Emerging Issues

Power system and market changes over the next two to three years are expected to result in additional emerging issues for power system data communications, which may require further consideration in the Standard. The identified issues, and AEMO's draft positions on them, are summarised below.

Introduction of 'Scheduled Lite'

Some stakeholders identified that the Standard may need to accommodate the Scheduled Lite reforms to provide visibility to AEMO of the output of distribution-connected aggregated DER in the form of five-minute data and, at a later stage, to enable distribution connected aggregated DER to participate in central dispatch.

AEMO proposes to clarify the normal reliability requirements of an Intervening Facility in the Standard. The Standard will also allow for AEMO to review and potentially approve certain telemetry planned to be provided with a lesser reliability, considering compliance with required cyber security measures and subject to aggregate limitations in each region.

Accommodating power system changes

As the power system continues to transform, data from a growing number of embedded battery generation, aggregated DER and VPP connections will need to be accommodated. Some stakeholders suggested changes should be made to the Standard to recognise these needs, including direct communication paths to DNSP aggregation systems and clarity of communication paths for different types of participants and equipment.

AEMO is proposing that the Standard will facilitate changes in data communications architecture so that:

- It will be clear that DNSP Intervening Facilities can connect directly to AEMO, with the option of having a secondary communication path via the Intervening Facility of its relevant TNSP where this practically feasible and agreeable to all parties.
- DNSP Intervening Facilities must have the capability to transfer control commands from AEMO to embedded participants connected to their networks (such as generating units and grid-level storage).

DCPs who are not required to provide data to an NSP may also connect directly to AEMO, if there is no practical opportunity to utilise existing data communication facilities. These non-NSP Intervening Facilities would be subject to appropriate protocols and communication paths, as described above.

AEMO considers that the proposed architecture represents a necessary and efficient change to accommodate embedded connections and aggregations in a way that can effectively address both data security and power system security needs in the medium term.

As the power system continues to evolve in the longer-term, the Standard will also need to evolve, as the nature of the changes, associated issues and potential solutions cannot be predicted at the level of detail required for the Standard. For this reason, AEMO is proposing to hold annual workshops to review the performance of the Standard and the need for further changes[4].

Draft determination

AEMO's draft determination is to amend the **Power System Data Communications Standard** in the form published with this Draft Report. Subject to the outcome of further consultation, AEMO currently proposes those amendments will have an effective date of 3 April 2023, with transitional provisions in place for some requirements requiring material equipment or system changes.

[4] A formal review of the Standard requires significant resources and thus, whilst the workshops are intended to be held annually, formal reviews are likely to be conducted no more frequently than every two years unless there are significant relevant reforms.

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1. STAKEHOLDER CONSULTATION PROCESS

As required by clause 4.11.2(c) of the National Electricity Rules (NER), AEMO is consulting on **the Power System Data Communications Standard** (Standard) in accordance with the 'rules consultation procedures' in rule 8.9 (NER version 184). As this consultation commenced prior to the effective date of the *National Electricity Amendment (Improving consultation procedures in the rules) Rule 2022*, it will be continued and concluded under the previous rules consultation procedures.

This Draft Report uses several terms that are defined in the NER and in the existing Standard, which are intended to have the same meanings. There is a glossary of other terms and abbreviations at **Appendix A**.

AEMO's timeline for this consultation is outlined below. Future dates may be adjusted depending on the number and complexity of issues raised in submissions.

Deliverable	Date
Notice of first stage consultation [and Issues Paper] published	3 February 2022
First stage submissions closed	15 March 2022
Draft Report & Notice of second stage consultation published	7 September 2022
Submissions due on Draft Report	7 October 2022
Final Report published	16 November 2022(*)

(*) Indicative only

AEMO's issues paper outlined a series of issues with the current Standard which had been identified by AEMO and by stakeholders through an extensive pre-engagement exercise, as described in the issues paper. The issues paper also noted that AEMO was extending this consultation beyond Network Service Providers (NSPs) to all registered participants and interested parties, as the requirements in the Standard affect the obligations of registered generators, some customers, demand response service providers, and the providers of ancillary services and other system security services.

AEMO received ten written submissions on its issues paper and held one confidential meeting requested by a stakeholder in March 2022. The participants who made written submissions were AGL, CIGRE Australia, CS Energy, Delta Electricity, ElectraNet, Enel X, Energy Queensland, Hydro Tasmania, Powerlink, and SA Water. The issues paper and all written submissions (excluding any confidential information) have been published on AEMO's website at:

https://aemo.com.au/consultations/current-and-closed-consultations/review-of-power-system-data-communication-standard

The publication of this Draft Report marks the commencement of the second stage of consultation.

2. BACKGROUND

2.1. NER requirements

The Standard is made under clause 4.11.2(c) of the NER and relates to the facilities and equipment used for transmitting data and signals to and from AEMO for the purposes of its market and power system security functions. The Standard incorporates the standards and protocols referred to in clause 4.11.1 and 4.11.2(a) of the NER and referenced in the access standards in the schedules to Chapter 5 of the NER.

The purpose of the Standard is to set out the standards and protocols with which Data Communication Providers (DCPs) must comply for:

- Installing and maintaining remote control and monitoring equipment

- Providing and maintaining communication facilities for transmitting data and instructions to and from NEM control centres.

Under the NER, the communication standards and protocols in the Standard apply to DCPs in the following categories:

- NSPs under clause 4.11.2(a) of the NER;
- Generators under clauses 4.11.1(a) and S5.2.6 of the NER, subject to relevant conditions of their performance standards;
- Customers (in respect of substations, where required by their agreed performance standards) under clauses 4.11.1(a) and S5.3.9 of the NER;
- Market Network Service Providers (in respect of substations) under clauses 4.1.1(a) and S5.3a.4 of the NER, subject to relevant conditions of their performance standards;
- Providers of ancillary services, system strength and inertia services under clause 4.11.1(b) of the NER;
- Demand Response Service Providers (DRSPs) under clause 4.11.1(c1) of the NER.

2.2. Context for this consultation

AEMO has collated a wide range of issues for review in relation to the subject matter of the Standard, identified by stakeholders and by AEMO itself in the course of NEM operations. For the purposes of its review, AEMO separated these into issues relating to the Standard's current application and requirements, and issues that may need to be addressed to support efficient and effective data communication across the range of facilities, services and operational requirements expected to exist in the NEM in the relatively near future.

The issues with the current Standard that AEMO identified for consultation related to:

- The need for more responsive control loops in AEMO's Automatic Generation Control (AGC) system.
- Data latency, with data in some cases being tens of seconds old before being received by AEMO.
- Lack of specificity in requirements regarding data quality accuracy and reliability.
- The need to reflect the latest expectations regarding security of data related to critical infrastructure.
- Insufficient clarity on obligations of different parties and boundaries of responsibility between them.
- Lack of specific requirement to resolve issues with data communications.

Looking to the future, AEMO was keen to ensure that, as far as practicable, the Standard can accommodate the significant changes expected in the NEM over the next two to three years as a result of the ongoing power system transition and reforms. These include growth in:

- Wholesale demand side response aggregators
- Virtual Power Plants
- Energy storage systems
- Aggregators of small-scale generators
- The number of distribution-connected solar farms.

The implementation of the Scheduled Lite Visibility Model is also expected to occur in this timeframe.

The impact of these changes on NEM data communications requirements going forward was therefore a key part of AEMO's review, in particular considering:

- Developing more appropriate methods of data communication for smaller embedded generators and aggregators.
- The possibility of direct data connection to AEMO for some participants, including use of alternative interfaces and data protocols.

- The need to cover new sources for real time data such as phasor measurement unit (PMU) data.

AEMO recognised that it may not be possible to address every issue (particularly for future development) in the next version of the Standard, where a need is established through this review it was intended that a process will be identified to address that need in a timely manner.

3. LIST OF MATERIAL ISSUES

Based on the material issues identified for the issues paper, AEMO identified 54 discrete questions on which feedback was invited for this Draft Report, noting that there is a degree of overlap between some of them. A further 5 issues were identified from submissions. These 59 questions are listed in the following table and discussed in Section 4.

No.	Issue	Raised by
1.	Does the Standard need to be more specific on the range of data it covers?	In Issues Paper
2.	Does the definition of power system data need to be extended?	In Issues Paper
3.	Does the definition of control commands need to be extended?	In Issues Paper
4.	Do the definitions of RCE and RME need to be extended?	In Issues Paper
5.	Other than changes required to accommodate additional participant categories identified in clause 4.11.1 of the NER, does the Standard need to extend or specify other participants or subgroups within a category?	In Issues Paper
6.	Should requirements under the Standard be varied according to how critical the data is?	In Issues Paper
7.	Are there examples where AEMO has specified requirements beyond those set in the Standard?	In Issues Paper
8.	Are there examples where the Standard has not kept pace with developments in data communications technology?	In Issues Paper
9.	Is there an opportunity for the Standard to encourage enhancement of resilience through design?	In Issues Paper
10.	Should the Standard set out the consequences for a participant failing to meet its requirements?	In Issues Paper
11.	What changes to the current Standard are required to clarify the requirements for DNSPs?	In Issues Paper
12.	Are there specific examples where the current data communications structure is making it difficult for new connections or embedded participants?	In Issues Paper
13.	What difficulties are wholesale demand response providers finding when connecting for data communications under the current arrangements?	In Issues Paper
14.	What difficulties do DNSPs have in communicating AGC control signals?	In Issues Paper
15.	Is the current secure ICCP specified in the current Standard still appropriate?	In Issues Paper
16.	What protocols should apply for connections to AEMO WAN?	In Issues Paper
17.	What additional detail is required in the Standard to provide more clarity on the boundary of both operational and financial responsibilities?	In Issues Paper
18.	Should an obligation for parties to work together be added to the Standard?	In Issues Paper
19.	Does the Standard need to clarify that connection is required to both AEMO control room sites?	In Issues Paper
20.	Should the Standard include a specific requirement that data sent should be of good quality?	In Issues Paper

No.	Issue	Raised by
21.	Should all data be sent with quality flags?	In Issues Paper
22.	Should the Standard include a more specific requirement regarding data accuracy?	In Issues Paper
23.	How material is the issue regarding clamping of values for semi-scheduled units?	In Issues Paper
24.	Should the Standard include a specific requirement regarding data latency?	In Issues Paper
25.	How material is the issue regarding timing differences due to RME?	In Issues Paper
26.	Should an additional requirement be included in the Standard to allow ongoing monitoring of end-to-end response times?	In Issues Paper
27.	What would the implications be if the specification of maximum delay for control commands was tightened to 2 seconds?	In Issues Paper
28.	How material is the issue of unreliability of connection to AEMO's market portal?	In Issues Paper
29.	Should the specification of control command delays in the Standard take into account the number of Intervening Facilities?	In Issues Paper
30.	What specific obligations regarding maintenance of security should be included in the Standard?	In Issues Paper
31.	Does the legislation adequately cover security obligations and requirements or is there a need for more detailed obligations in the Standard?	In Issues Paper
32.	What would be the implications of including a specific obligation for DCPs to advise on cyber security risks?	In Issues Paper
33.	Should the Standard be enhanced to better identify and support the protection of the confidentiality of data?	In Issues Paper
34.	What changes would be required to clarify reliability requirements in the Standard?	In Issues Paper
35.	Does the Standard need to set enhanced expectations regarding monitoring and reporting of availability?	In Issues Paper
36.	Does any lack of redundancy currently restrict the ability of participants to apply software security patches in a timely manner?	In Issues Paper
37.	What change to Section 2.2 of the Standard would be required to clarify the requirement for adequate notice?	In Issues Paper
38.	What issues have arisen that would justify including in the Standard a specific requirement regarding response time to forced outages?	In Issues Paper
39.	What issues have arisen that would justify expanding the scope of testing specified in the Standard?	In Issues Paper
40.	What are examples of testing requirements that are considered too onerous for new generators?	In Issues Paper
41.	What changes to the definition of an "upgrade" are required?	In Issues Paper
42.	Should section 6.4(c) of the current Standard be amended to encourage use of standard test procedures?	In Issues Paper
43.	What issues have arisen that would justify expanding the scope of augmentations required to be advised under the Standard?	In Issues Paper
44.	What issues have arisen that would justify the Standard specifying the provision of testing environments for data links?	In Issues Paper

No.	Issue	Raised by
45.	In what circumstances would transitional provisions be justified for increased requirements in the Standard?	In Issues Paper
46.	Does the Standard need to cover PMU and HSM data?	In Issues Paper
47.	Does the Standard need to cover SGAs?	In Issues Paper
48.	Are changes to Standard required now to accommodate the Scheduled Lite Visibility Model, or future changes to accommodate the Scheduled Lite Dispatchability Model?	In Issues Paper
49.	Is it likely that future changes to the Standard will be required to cover provision of real time data from AEMO to participants beyond current control signals?	In Issues Paper
50.	Does the Standard need to incorporate or reference requirements for generators and others to provide real time power system data to their NSPs?	In Issues Paper
51.	Are there any specific factors AEMO should take into account in assessing the costs and benefits of a proposed enhancement to the requirements of the Standard?	In Issues Paper
52.	What changes to the current NEM power system data communications structure are likely to be required?	In Issues Paper
53.	If generators and other participants were permitted to communicate directly with AEMO, what types of data protocols would be preferred?	In Issues Paper
54.	If for cyber security and other reasons, only a single protocol could be accommodated in addition to secure ICCP, what criteria should AEMO use to determine the most suitable protocol?	In Issues Paper
55.	Definition of analogue value	Energy Queensland
56.	Data quality	Hydro Tasmania
57.	Review of Standard	Hydro Tasmania
58.	Data for power system modelling	ElectraNet
59.	Specific NSP obligations	SA Water

A detailed summary of views expressed, and issues raised by Consulted Persons in submissions, together with AEMO's responses, is contained in **Appendix B**.

4. DISCUSSION OF MATERIAL ISSUES

This section describes the material issues associated with each of the questions listed in Section 3, with any views expressed in first stage submissions, AEMO's analysis and draft conclusion. Any proposed amendments to the Standard are reflected in the draft published with this Draft Report.

Principles of decision-making – cost and benefit considerations

To frame this discussion, it is useful to commence with guiding principles. A number of questions and submissions referenced the need to assess changes to the Standard – either for individual aspects or generally – with regard to their costs and the benefits they are expected to bring. For example, Delta Electricity submitted that any improvements need to be justified having considered overall objectives of the Standard and whether it is necessary for secure operation of the NEM. Delta Electricity argued there should be a demonstrable need (supported by cost/benefit analysis) highlighting where the standard is inadequate or failing for all participants.

AEMO is conscious that any change to strengthen requirements often comes at some cost for existing participants, although it may also lead to a reduction in overall costs, or efficiency benefits, over the longer term. For new participants, changed requirements could increase or decrease the cost of entering the market.

Any enhancements to the Standard should be expected to deliver benefits for the NEM, but also may result in increased costs to the industry and ultimately consumers. It is possible that the costs of improving standards could be disproportionately high for smaller participants. On the other hand, enhancements may also reduce barriers to entry, increase efficiency and reduce costs in the longer term.

AEMO's approach to this review of the Standard and the conclusions in this Draft Report are, therefore, underpinned by the guiding principles of the national electricity objective[5] and good electricity industry practice. The primary objective of changes to the Standard is to ensure effective support for acceptable power system security outcomes. For any proposed increase or change in the Standard requirements, AEMO has therefore considered:

- Where the current Standard falls short of good electricity industry practice for the NEM power system.
- The risks posed to power system security or resilience due to each of these gaps, both currently and expected in the medium term.
- A reasonable, efficient approach to address each of these gaps, having regard to technological feasibility and cost to the NEM, considering both immediate and longer term costs and benefits.

In some cases, the Standard also needs to change to recognise or implement obligations already set, explicitly or implicitly, by the NER, an AEMO procedure or other legislation applicable to the industry or broader operations. In these cases, the Standard should not be seen as setting a new requirement.

Where implementation options are available, AEMO has endeavoured to allocate obligations under the Standard to the participants expected to be able to manage them most efficiently and recognise any associated benefits that may accrue to participants (and ultimately consumers) from different options.

Inevitably, the cost of enhancements to the standard will affect individual NSPs and other participants differently depending on their current circumstances and status of their equipment and systems. While seeking to ensure that no individual cost is unreasonable, AEMO's focus is on the overall benefits and costs of changes, in the long term interests of consumers. Where necessary, particular impacts on individual participants are expected to be managed through reasonable transitional arrangements.

4.1. Range of data covered by the Standard

4.1.1. Issue summary and submissions

Some stakeholders suggested that the Standard needs to be more definitive on the range of measurements to be provided, as there is significant uncertainty as to what will actually be required for new connections. AEMO cautioned, however, that the Standard cannot itself set obligations as to the data that must be provided to AEMO; it can only refer to obligations set by other provisions in the NER, such as access standards.

There appears to be a general understanding among stakeholders that the range of data covered by the Standard is quite broad, with the aim of providing maximum flexibility and minimising limitations based on technology changes. Whilst some indicated they were comfortable with determining the measurements that need to be provided, others suggested that it would be beneficial to expand on requirements, potentially as a separate guideline.

The following further suggestions were made in submissions:

[5] Section 7 of the National Electricity Law

- The Standard needs to be more specific on emerging connections, for example, the standards specifically for generators or DNSPs, and how these differ (if they do) from existing connections.
- Consideration should be given to the inclusion of data requirements that are in addition to existing obligations under the NER, such as access standards.
- The Standard should provide a definitive list of data requirements, the 'Operational Data' category is considered too broad.
- Clarify that the Standard separately covers data exchanges:
  - between DNSPs and AEMO;
  - between TNSPs and AEMO;
  - between connecting (or connected parties) and AEMO (including AEMO direct link);
  - between connecting (or connected) parties and DNSPs; and
  - between connecting (or connected) parties and TNSPs.
- Expressly require that all DCFs of all DNSPs and TNSPs (located anywhere in the communication path) have the capability to exchange all signals from generation, battery energy storage systems (BESS) and load with AEMO as facilitators of Operational Data exchange between AEMO and parties connected to NSP networks.

4.1.2. AEMO's assessment

Different categories of 'Operational Data' exist in the Standard in order to allow some differentiation of performance requirements depending upon the nature of the data. AEMO has taken the opportunity to review these categories to more closely describe and differentiate on the basis of the ultimate uses which are made of the particular data in relation to power system security. This is considered the key determinative factor for the required performance in the Standard. The result of this review is summarised in the following table

Table 1 Proposed Data Categories

Category	Description/examples	Reason
High Resolution Data	Measurements of the following types of data: • System frequency. • Electrical Time. • Measured by PMUs and HSM and provided in near real-time to AEMO	Necessary to assess high speed response
Dispatch Data	• MW output of all scheduled and semi-scheduled units for 5 minute dispatch including FCAS providers and market aggregated units/services[6] • MW flows on interconnectors • Commands providing market dispatch instructions • Data related to AGC operation	Necessary due to direct involvement in AGC control which operates on a 4 second control cycle
Primary System Security Data	All telemetered data related to transmission and dual function assets[7] [8]	Necessary for:

[6] Output of the individual physical units in a market aggregation is not classified as Dispatch Data unless individually required for dispatch or AGC processes.
[7] As defined in the NER, Chapter 10
[8] Data from generating units connected directly to such assets would also be categorised as Primary System Security Data unless already categorised as Dispatch Data

Category	Description/examples	Reason
		• Inputs to Power System State Estimation process (runs on a 30 second cycle) • Inputs to constraint equations used in the market dispatch process (runs on a 5 min cycle) • Var Dispatch process (runs on a 5 minute cycle)
Secondary System Security Data	Telemetered data not in the above categories but required for market and system security purposes, e.g. as: • Inputs to short term forecasting systems • Inputs to dynamic rating systems	These telemetered values, whilst necessary for maintaining power system security, have an indirect impact only. Thus some performance requirements are less critical than for Primary System Security Data

As indicated in the table, the output of a market aggregated scheduled unit would always be categorised as Dispatch Data.

If required by AEMO as real time data, data regarding the output of individual physical units forming part of a market aggregated unit would be categorised as:

- Dispatch Data if individually required for use in dispatch or AGC purposes.
- Primary System Security Data if not individually required for dispatch, but the physical units are directly connected to transmission or dual function assets.
- Otherwise, Secondary System Security Data.

If there is a broad consensus on the need for more specific information, one option to provide that could be an industry guideline with more details on the data requirements for connecting participants.

4.1.3. AEMO's conclusion

AEMO proposes to revise the data categories in the Standard to better describe the data categories by reference to the use or application of the data that drives the communication requirements under the Standard. AEMO will also expand section 2.1 of the Standard to provide a more comprehensive description of the types and uses of telemetered data that are considered 'Operational Data'.

AEMO will consider the development of an industry guideline to provide more specific details on the data requirements relevant to new connections or services, after further discussion with industry stakeholders.

4.2. Extending the definition of power system data

4.2.1. Issue summary and submissions

The current Standard defines 'Power System Data' as:

> *"Data concerning all plant within:*
> *1. A Substation containing plant that operates at a nominal voltage of at least 220 kV.*
> *2. A Substation having at least four sources of supply, including power station sources".*

Some stakeholders indicated that, with the growth of embedded generation and the need for AEMO to monitor power flows in distribution systems which impact on the security of the transmission network, this definition needs to be expanded.

There was broad support for this view, with submissions highlighting lack of clarity in the following areas:

- Whether only one or both conditions (in parts 1 and 2 of the definition) need to be true to be identified as Power System Data.
- Is DNSP data covered by the Standard if their plant is less than the 220 kV voltage stipulated?
- Does the Standard cover data from small generators transmitted to AEMO either via DNSPs or directly?
- Power System Data is referenced within the definition of Other Data (but operating at voltage of less than 220kV) - it would be helpful to understand the intended outcome and whether this includes embedded generation.

Submissions also suggested that the definition needs to consider the changing dynamics of the NEM with regular reviews to capture evolving requirements not yet identified, and that examples of the types of data covered by the Power System Data definition would be helpful.

Energy Queensland suggested different grouping of data types using terms like 'DER Data', 'Transmission Data' and 'Distribution Data'. Delta Electricity suggested simplifying the definition as simply any data that is necessary for secure operation of the power system, which would therefore include some AEMO control and indication data not defined in the present definition.

4.2.2. AEMO's assessment

As described in Section 4.1.2, AEMO proposes to revise and rename the data categories to more closely describe the data categories based on the use of that data. The data categories determine the required performance in the Standard.

4.2.3. AEMO's conclusion

AEMO proposes to amend the Power System Data and Other Data definitions as follows:

- Power System Data is renamed Primary System Security Data,[9] and the requirement for 'substation having at least four sources of supply' is replaced with the concept of *dual function assets,* as defined by the NER.
- Other Data is renamed Secondary System Security Data and includes all the data that is required under the NER in real time for power system and market operation, but is not High Resolution Data, Dispatch Data or Primary System Security Data.

4.3. Extending the definition of control commands

4.3.1. Issue summary and submissions

The current Standard defines Control Command as "A representation of an instruction to perform a defined action (for example a generation increase)." Some stakeholders suggested that this definition is inadequate as it does not cover the full range of control commands sent out from AEMO NEM control centres.

Although the term is well understood within the industry, some submissions supported further clarification and updating of the definition to avoid potential confusion, including a full list of current and future control commands required by AEMO (mindful not to be locked into a limited set of control commands). It was also suggested that the definition of Analogue Value needs review, as some control commands can be analogue values. Updated definitions could use terms commonly known to control and instrumentation technicians, such as analogue signals, analogue to digital converter and digital to analogue converter.

[9] Such data includes data required to manage short term reliability

4.3.2. AEMO's assessment

It is understood that NSPs and DCPs in the NEM will adhere to their own standard functional specifications, which are based on this standard. These functional specifications are considered the most appropriate location to define specific control and command definitions applicable to specific equipment.

4.3.3. AEMO's conclusion

AEMO proposes not to include a list of control commands in the definition but has proposed minor adjustments for additional clarity. A change to the definition of Analogue Value is discussed in Section 4.55.

4.4. Extending the definitions of RCE and RME

4.4.1. Issue summary and submissions

The current Standard describes RCE (remote control equipment) as "Equipment used to control the operation of elements of a power station or substation from a control centre", and RME (remote monitoring equipment) as "Equipment installed to enable monitoring of a facility from a control centre".

It has been suggested that these definitions may no longer adequately describe new technology for data acquisition. For example, does RCE include SPS (special protection schemes), RAS (remedial action schemes), RPC (reactive plant control), LOLS (line overload load shedding), and other circuit breaker (CB) operated schemes? Does RME include DLR (dynamic line ratings), DTR (dynamic transformer ratings), QoS (quality of supply) monitors, HSM (high speed monitors), PMU (phasor measurement units), disturbance recorders, etc?

Delta Electricity's submission noted that these terms are defined in the NER and therefore should not be contradictory in the Standard. CS Energy suggested that new technology for data acquisition should be reconciled with the identified requirements prior to finalising the updated definition. CIGRE AU noted the definition of RCE and RME is very broad and that AEMO should consider including a further overview of the functions of the equipment. Energy Queensland added that an RTU (remote terminal units) performs both RCE and RME functions and therefore considers RTU as a replacement term.

4.4.2. AEMO's assessment

The existing Standard defines RCE and RME by referencing the NER-defined terms ('remote monitoring equipment' and 'remote control equipment'). This is done for the purpose of specifying the high-level architecture, reliability, and testing requirements for that equipment, as envisaged in NER 4.11.1. Control or telemetry from SPS, RAS, RPC, LOLS and other CB operated schemes clearly falls within the RME/RCE definitions and must therefore meet the Standard where it transmits Operational Data, as defined by the Standard and derived from the NER obligations under clause 4.11.1.

In reviewing the NER definitions of these terms, however, AEMO noticed that the NER limits the definition of remote control equipment to power stations and substations, even though rule 4.11 and other NER provisions clearly contemplate the use of this equipment in relation to other facilities and services. AEMO therefore considers it is necessary to modify the NER definition of RCE for the purposes of the Standard.

4.4.3. AEMO's conclusion

AEMO considers there is no need to redefine the definitions of RCE and RME, other than to confirm that RCE can relate to facilities other than power stations or substations.

4.5. Greater specification of participant categories subject to the Standard

4.5.1. Issue summary and submissions

AEMO's issues paper noted that a number of NER changes effective since the last review of the Standard need to be recognised, in particular to add DRSPs and system strength and inertia providers.

As well as pointing out these requirements, some submissions identified a need to recognise data from specific groups of participants like major industrial loads; virtual power plants and aggregated DER.

CIGRE AU suggested that any other participants and subgroups would be covered under the ancillary service provider category. Energy Queensland considered that generic statements such as 'The Standard applies to Participants, including but not limited to:…' are more appropriate. ElectraNet suggested that standard may need to be extended to include additional categories such as load available on UFLS in a region or sub-region, DER available to shed in a region or sub-region and FFR availability (from BESSs and VPPs) as these parameters assist in the management of power system security. There may be additional parameters that may need to be added as the energy transformation progresses. Delta Electricity added that change is only necessary if it is required to achieve overall objectives of the Standard as necessary for secure operation of the NEM.

4.5.2. AEMO's assessment

AEMO agrees that the Standard needs to incorporate data to be communicated to and from plant that provides wholesale demand response, system strength and inertia providers as contemplated by the NER. However, AEMO considers that the Standard does not need to prescriptively define the types of participants or functions that are subject to it (as these are set by the NER). AEMO does not believe there is a need to extend the definitions to include additional categories such as load on UFLS, etc, as this can already be considered Operational Data if presented via the existing telemetry architecture to manage operational limits in the power system.

Clarification will also be provided on the allowable topology of communications links with an updated architecture diagram which shows the connection of RME and RCE via the Intervening Facilities. AEMO intends to clarify that the Standard applies to high integrity, high availability, and high reliability, real-time streaming of Operational Data. New forms of participation will need to achieve these requirements in order to continue to maintain power system security in the NEM.

4.5.3. AEMO's conclusion

AEMO proposes to define Data Communication Providers inclusively, so it will extend to existing and potential future registered participants required under the NER to transmit or receive data to or from AEMO in accordance with the Standard.

4.6. Variation of requirements according to criticality of data

4.6.1. Issue summary and submissions

Some stakeholders suggested that the requirements set under the Standard for different classes of data need to take into account the use of the data and its criticality.

There is a general understanding that a higher level of data prioritisation (including redundancy) may be required, for example data necessary for automatic control of the system should have a higher priority than data that provides indications of conditions to human controllers only. However, it was suggested that a review should cause minimal disturbance to the existing systems.

CS Energy suggested that data should be grouped according to priorities and that data outages should be managed analogous to outages of primary protection. AGL added that criticality could be determined based on the level of response to unplanned outages e.g. non-conformance is required to be submitted.

CIGRE AU did not see the need for the Standard to be varied according to criticality, stating that data applicability is as per the power system data definition.

4.6.2. AEMO's assessment

All data transferred for the purposes of interfacing with RCE or RME is considered Operational Data. There are some differences in performance requirements depending on the use of the data, and thus AEMO has proposed to redefine the data categories as described in Section 4.1.

4.6.3. AEMO's conclusion

AEMO considers that the changes proposed in Section 4.1 will address this issue.

4.7. Different or more stringent communication requirements in other instruments

4.7.1. Issue summary and submissions

Some stakeholders suggested that other instruments dealing with specific matters (e.g. the Market Ancillary Service Specification [MASS]) contain more stringent data requirements than those in the Standard.

Submissions noted the MASS was more detailed and suggested that reference to the Standard should be made in the MASS and other related documents. However, it was also pointed out that the MASS is a specification which by its nature will be more detailed. The potential to develop a detailed data list for the full range of transmitted data can be considered as a separate question, if there is broad consensus that this would be a useful document for the industry (similar to the proposed guideline discussed in Section 4.1 above).

4.7.2. AEMO's assessment

The Standard should describe expected performance criteria relating to the transfer of data. There is a need to ensure the requirements of the Standard are not inconsistent with other documents, such as the MASS and the communication system failure guidelines, and the Standard should support the implementation of those more detailed requirements.

At the same time, there are some areas outside the scope of other instruments, for which the Standard may set more stringent requirements. These may be appropriate to ensure the necessary level of data integrity to support secure power system operation.

4.7.3. AEMO's conclusion

AEMO intends to reference the MASS and the communication system failure guidelines as documents that are related to the Standard, since the Standard must support implementation of these requirements. However, in areas that are not directly within the scope of those instruments, the Standard may include requirements that are more stringent, without being inconsistent.

4.8. Keeping pace with developments in data communications technology

4.8.1. Issue summary and submissions

Some stakeholders commented that the Standard seems to assume that all participants in the data communications process operate data centres.

Submissions noted that the drawing in Section 1.3 of the Standard is ambiguous and does not reflect the current state. They suggested reviewing this diagram to address the following points:

- The diagram is just one example of how DCPs connect to AEMO.
- It implies that each substation has a primary and backup communications path (this is not correct for most DNSPs).
- It implies that an intervening data centre is available and that all connections require primary and backup communications. Further clarification is required on what redundancy is required within the DCP e.g. from Data Concentrator to RME/RCE. For example, does this require redundancy of only the comms link, redundancy of both the comms link and the RME/RCE? Alternatively does the Standard need to only define the link to AEMO and the reliability and availability standards are used by the DCPs to make their own decisions on this? It is unclear if dual RTUs are required by all parties (e.g. a small generator).
- There is a potential contradiction in the Standard regarding redundant elements, redundant communications paths are not required if reliability requirements in section 3.1 of the Standard can be met.

It was suggested that clarification could be provided by developing either a guideline document with examples of different configurations and/or Standard could include more information on the architecture requirements based on current specifications.

4.8.2. AEMO's assessment

AEMO agrees that the Standard could be clearer in its application to different types of registered participants involved in the transmission of data to and from AEMO.

AEMO proposes to amend the Standard to provide greater clarity and more options for participants to access an Intervening Facility or, where this is not practical, establish direct connections with AEMO control centres. This will entail redefining the Intervening Facility and reviewing the general structure of data communication facilities in section 1.3 of the Standard. The proposed structure is discussed in further detail in Sections 4.11 to 4.13.

As regards requirements for path redundancy, AEMO's view is that the Standard should not be prescriptive on this (aside from the requirement for connection to both AEMO control centres). Each DCP will be able to determine the appropriate level of redundancy it needs to meet the reliability requirements specified in the Standard.

4.8.3. AEMO's conclusion

The Standard will be modified to clarify its application to all registered participants involved in the communication of data with AEMO and to provide more options for participants to access an Intervening Facility or make direct connections where necessary. For further details refer to Sections 4.11 to 4.13.

4.9. Encouraging enhancement of resilience through design

4.9.1. Issue summary and submissions

A stakeholder observed that there is an opportunity to design vulnerability out and design security in, as opposed to putting in place processes to manage the emergence of security issues. It was suggested that the Standard could possibly encourage enhancement of resilience through design.

There was support in submissions for a proactive approach to enhancing resilience through design. Security and resilience are arguably non-negotiable risks, suggested CS Energy. Delta Electricity suggested that design requirements belong in construction specification, and the Standard should provide high level guidance for the designers in expectation of the outcome. Hydro Tasmania suggested a similar approach and proposed development of a specific standard for designing security into future systems.

4.9.2. AEMO's assessment

Resilience of power system data is a key objective of the Standard. Further guidance on the resilience requirements of some communications links is provided in the communication system failure guidelines[10]. Similarly, AEMO and some NSPs are currently collaborating on the development of a special protection scheme design guideline[11] through the NEM Operations Committee. Such guidelines provide an opportunity to specify appropriate risk-based assessments which are based on the NER and consulted standards, including the Standard.

Proposed changes in the Standard regarding system architecture allow for options to enhance the resilience of the data communications system. For example the changes regarding connection of DNSP Intervening Faculties allow for an option to enhance resilience of the system against a loss of systems at AEMO (refer Section 4.11.3). Also the Standard sets out in more detail the requirement to be able to maintain communications following loss of external supply to intervening facilities and communication paths (refer Section 4.34).

4.9.3. AEMO's conclusion

AEMO supports the development of design guidelines or functional specifications which cater for resilience through design, where these are based on the specific requirements of the Standard.

4.10. Consequences for failing to meet the Standard

4.10.1. Issue summary and submissions

One stakeholder advocated for the Standard to be clear on the consequences for a participant failing to meet the requirements of the Standard.

Some submissions suggested that consequences for participants failing to meet the requirements of the Standard could also be defined or explained in a separate guideline document, and that there may be value in considering a compliance and enforcement regime to ensure participants comply with the requirements of the Standard. Delta Electricity, on the other hand, considered that law, regulations, and rules are the place for such information and the NER are already adequate for this purpose. Hydro Tasmania said it would support a multi-stage response: allowing a participant to correct any initial breaches to the standard, rather than being immediately deemed non-compliant, but setting out consequences for continual, prolonged, or intentional breaches of the Standard.

[10] https://www.aemo.com.au/-/media/files/electricity/nem/network_connections/stage-6/communication-system-failure-guidelines.pdf

[11] Refer https://aemo.com.au/consultations/current-and-closed-consultations/publication-of-draft-remedial-action-scheme-guidelines

4.10.2. AEMO's assessment

AEMO considers that the NER, not the Standard, is the appropriate place to specify consequences of non-compliance, and notes that the AER ultimately has responsibility for compliance and enforcement. AEMO also recognises, however, that compliance with the Standard has been variable and that promoting awareness of the broader regime in which the Standard operates may be helpful. As compliance with the applicable requirements of the Standard is a NER obligation (both directly under rule 4.11 and within some access standards), the Standard can indicate the potential consequences of non-compliance under the rules framework. In relevant circumstances, examples can include refusal of registration or curtailment.

Given the potential impacts for power system security, AEMO also considers that the Standard should encourage self-reporting of any data communication performance, linking to the performance standards compliance regime in the NER where applicable, and confirming that a rectification plan should be put in place for timely remediation. The Standard should also confirm that AEMO will refer non-compliances to the AER where required to do so by the NER, or in other circumstances where it becomes aware of a continuing non-compliance that is not being managed.

4.10.3. AEMO's conclusion

AEMO will amend the Standard to include a new section 8, to provide examples of the potential consequences of failure to achieve the requirements of the Standard, by reference to the NER, emphasise the importance of reporting, provide or refer to a process for managing timely remediation, and confirm the role of the AER.

4.11. Clarification of application of Standard to DNSPs

4.11.1. Issue summary and submissions

NER 4.11.2 obliges all NSPs to provide and maintain primary and back-up communications facilities from relevant local sites to AEMO-nominated interfacing terminations in accordance with the Standard, while AEMO is required to provide and maintain the communication facilities between TNSP and AEMO control centres.

Without being explicit, the current Standard reflects the original assumption that data communications will be routed to AEMO via Intervening Facilities operated by TNSPs and is not explicit about the role of DNSP data communication facilities in the topology. It has been suggested that the Standard should:

- Reflect the topology that applies for a DNSP (e.g. not covered in section 1.3 or tables 4 and 5).
- State whether a DNSP can have direct connection with AEMO rather than going through the TNSP.
- Account for diversity in communications between TNSPs, DNSPs and AEMO.
- Specifically address the situation where there are two or more Intervening Facilities.

In submissions, CS Energy suggested that the Standard needs to define consistent approach across the NEM for all participants. Submissions also identified the following issues requiring review or clarification:

- It is unclear whether embedded generators need to connect via their DNSP for data communications or can use other means.
- The Standard does not include requirements specific to the links between the generator and DNSP or definitions of lines of responsibility. For example: who is responsible for equipment upgrade and obsolescence? This should be better defined in the performance and reliability sections.
- The diagram in section 1.3 of the Standard is ambiguous and does not reflect topologies for DNSPs/embedded facilities. It should be updated to show end-to-end architecture from generating facility through to AEMO control centre. Inclusion of DER, VPP and ancillary services should be

illustrated to show interconnection at appropriate layers. The diagram also implies each substation has primary and backup communications paths, which is not correct for most DNSPs.

- DNSPs, and potentially other participants, should be permitted to directly connect to AEMO rather than going through the TNSP. This capability would reduce ambiguity around reliability where there are presently multiple Intervening Facilities.

SA Water suggested that the Standard should include requirement that TNSPs and DNSPs (separately):

- Have their own Standard-compliant ICCP link (capable of exchanging all "Generator Signals" and "Load Signals" regardless of the number of connecting parties using the link).
- Grant access to the ICCP link to connecting (or connected) parties to enable them to satisfy their NER obligations to exchange operational data with AEMO on reasonable, market benchmarked terms and conditions upon request.
- The embedded connecting party should only have one contractual interface for access to an AEMO data link either with the DNSP or TNSP. This approach is efficient because TNSPs and DNSPs leverage existing telecommunications assets and promotes efficient investment in the NEM.

SA Water provided further details of proposed responsibilities between NSPs and connecting parties for efficient exchange of data with AEMO, where the connecting party is utilising NSPs facilities and experience. The SA Water proposal is discussed further in Section 4.17.

4.11.2. AEMO's assessment

An increasing number of loads, generation and storage connected to distribution networks are actively participating or looking to participate in the wholesale energy market. AEMO agrees that there is a lack of clarity in the Standard on the role of DNSPs in the provision of Intervening Facility services for telemetry and control signals, which is currently impacting market participation and compliance.

AEMO considers it is appropriate for the Standard to directly address the role of DNSPs in relation to the collection and transmission of data between embedded RCE/RME and AEMO control centres. The DNSP appears best placed to provide these services, and as noted by Energy Queensland, in some cases provision of telemetry is already a part of the connection agreement. Looking forward to the medium term, the need for visibility is consistent with the emerging distribution system operator role of a DNSP.

To facilitate improved communication to support participation and compliance, the Standard will provide flexibility for DNSP Intervening Facilities to have a direct ICCP link to one or both AEMO control centres[12], and clarify the application of the Standard to DNSP facilities (whether linked directly to AEMO or only via a TNSP facility). While it is not within the scope of the Standard to prescribe communications between TNSPs and DNSPs for purposes other than the communication path to and from AEMO control centres, the topology in the Standard should also be consistent with such obligations.

4.11.3. AEMO's conclusion

AEMO proposes to include a new section 1.4 in the Standard to explain the roles of TNSPs and DNSPs in providing Intervening Facilities. This will clarify that, subject to appropriate transitional arrangements, DNSPs will be required to:

- Provide the services of an Intervening Facility to connections within their network.
- As an Intervening Facility, collect and relay data from RME and relay control commands to RCE.

The Standard proposes to allow flexibility for a DNSP Intervening Facility to directly connect to AEMO, noting in some cases this might be necessary to be able to meet the requirements in the Standard.

[12] If there is only one direct connection to the AEMO control centres, then a second link via a TNSP intervening facility will be required provided that such an arrangement is practically feasible and agreeable to the three parties.

The Standard also proposes to allow an arrangement where, if practically feasible and agreeable to all parties, the DNSP Intervening Facility directly connects to one AEMO control centre and connects to the other AEMO control centre via the TNSP's Intervening Facility. This arrangement recognises the necessity of operational communications between the networks (outside of the Standard requirements), and also has the advantage of enhancing resilience of the data communications network.

If a DNSP connects directly with AEMO, it may also have an obligation to provide data to the relevant TNSP. Provision of such data by a DNSP to a TNSP is outside of the scope the Standard as such data would be required by the TNSP for its own purposes not AEMO's.

4.12. Issues with current data communications structure for new connections or embedded participants

4.12.1. Issue summary and submissions

Stakeholders observed that the current data communications structure presents challenges for new connections.

New embedded scheduled and semi-scheduled generators have obligations under the rules and generator performance standards (GPS) to participate in AGC. However, some stakeholders indicated that this is not possible through some DNSP SCADA systems.

Submissions highlighted challenges experienced in relation to embedded connections, and others suggested that participants should be using TNSP and DNSP experience and infrastructure to exchange required data with AEMO. Submissions flagged that the key challenges relate to resourcing, lack of experience with the process and lack of consistent messaging from AEMO around how to connect and suggested that the process could be defined in the Standard or a separate guideline document.

Enel X suggested that the Standard is not fit for purpose and must be updated to accommodate new architecture and data protocols (DRSPs have no clarity on the telemetry obligations which is creating significant regulatory and investment uncertainty).

Energy Queensland added that inability to connect directly to AEMO is creating issues for participants. Intervening facilities may not be able to prioritise connections to suit participants and there are no options for participants to seek alternative and more cost-effective solutions.

SA Water suggested that connecting participants should be able to utilise NSP communication infrastructure (ICCP links) and their experience to exchange all the required data with NSPs and AEMO and enable the connecting party to satisfy its obligations under the NER.

4.12.2. AEMO's assessment

The issue is closely related to the issue explored in section 4.11. There is a need for clarity on the role of the DNSP and AEMO considers that the proposal for DNSPs to provide the services of an Intervening Facility is likely to go a considerable way to addressing most of the issues raised. For participants required to provide telemetry for their facilities to NSPs under a connection agreement, this approach will avoid unnecessary duplication of links and expertise. In this regard AEMO also notes the potential relevance of NER 5.3A.10(e).

For participants, such as aggregators, that do not have obligations to provide telemetry to NSP through connection agreements and operate aggregations across multiple distribution networks, there is currently no clear path to provide the telemetry required for communication with AEMO under the NER. In these cases, AEMO considers it is appropriate for the Standard to allow for direct communication via a 'non-NSP' Intervening Facility. For efficiency and security purposes, efforts should be made, where practical, to utilise any suitable available links first. The Standard will also need to confirm the requirements to be met by a non-NSP Intervening Facility, with the intent that they meet equivalent reliability and availability standards

AEMO does not consider that it is within the scope of the Standard to collate the data communication obligations for new connections but intends to review the information currently provided to new connections regarding data communication requirements to see where it could be improved.

4.12.3. AEMO's conclusion

As described in Section 4.11, the Standard will clarify DNSP requirements to provide the services of an Intervening Facility for relevant connections within their network. For DCPs who are not obliged to provide relevant data to an NSP, AEMO will provide a process in the Standard to enable such a DCP to seek direct connection to AEMO where an appropriate link cannot be identified. This would include facilitation of discussions to confirm whether there is an opportunity to utilise existing data communication facilities. If this is not practical, then AEMO will facilitate direct connection.

This would require the DCP to develop an Intervening Facility to gather and transmit all real time data required to and from both AEMO control centres, within the standards for reliability, availability, and security applicable to NSP Intervening Facilities. In limited circumstances, an exception from the requirement to provide a secure private network may be permitted. This is discussed in Section 4.48.

4.13. Data communication issues for wholesale demand response providers

4.13.1. Issue summary and submissions

It has been reported that DRSPs are finding it difficult to be connected for data communications under current arrangements.

While this was initially identified as a separate issue, it is covered by the preceding sections. Submissions that specifically mentioned wholesale demand response facilities indicated that:

- There is a need for further clarification on connection paths for DRSP facilities.
- Difficulties may be occurring because connection agreements are finalised without technical and data communications requirements being fully understood (Energy Queensland).
- Lack of clarity in telemetry obligations can create significant regulatory and investment uncertainty (Enel X).

4.13.2. AEMO's assessment and conclusion

Please refer to Sections 4.11 and 4.12.

4.14. Communication of AGC control signals via DNSP facilities

4.14.1. Issue summary and submissions

Some stakeholders considered there should be increased use of dispatch signals via SCADA through the NSP, on the basis that their connection to AEMO's market portal was considered unreliable and failure to meet dispatch requirements increases system risk.

Energy Queensland indicated that issues may be experienced with timing or data latency requirements, especially via Intervening Facilities. CIGRE AU added that legacy equipment and systems may be the cause of issues.

CS Energy suggested that the Standard is required to be fit for purpose to enable the DNSP to either modify or to ensure the inclusion of requirements in upgraded DNSP energy management system (EMS). Based on the current assessment of some DNSPs, there may have to be a transitional period to enable DNSPs to meet the requirements of an updated Standard.

4.14.2. AEMO's assessment

The current Standard requires Intervening Facilities to relay control commands from control centres to the RCE. The resolution of issues in Sections 4.11 and 4.12 will require DNSPs to provide the services of an Intervening Facility and hence relay control commands to the RCE.

Embedded scheduled and semi-scheduled generating units are required to maintain the capability to participate in the AGC system. If DNSP facilities did not support control commands for embedded schedule generation, then each generating unit would require a separate data communications path to receive AGC control signals – a clearly inefficient and impractical result. The proposed amendments to the Standard to confirm the DNSP role and requirements, including the ability for direct connection between DNSP Intervening Facilities and AEMO control centres, avoids duplication of links and expertise for those facilities that would be required to provide telemetry to NSPs in any event through their connection agreements or other arrangements.

4.14.3. AEMO's conclusion

AEMO's proposal to include explicit requirements in the Standard for DNSPs to provide the services of an Intervening Facility for relevant connections within their network should address the need to support control commands such as AGC. Transitional provisions will be included where required to enable some DNSPs to make material changes to systems.

4.15. Current ICCP as the secure protocol

4.15.1. Issue summary and submissions

The current Standard specifies ICCP IEC60870-6 TASE.2 and its extensions as a secure ICCP protocol. One stakeholder questioned whether this can actually be considered a secure protocol.

There were mixed views in submissions on the appropriateness of the ICCP Protocol. Powerlink, Energy Queensland and ElectraNet considered the secure ICCP as appropriate for secure data transfer, although ElectraNet added that it needs measures for adding data integrity to make it truly secure. ElectraNet and CIGRE AU suggested the security architecture should be considered as a whole rather than protocol specific. CIGRE AU also suggested that ICCP is for inter-control centre communication by design, and distributed energy systems need faster communications (e.g. DNP3/MODBUS/MMS).

CS Energy and Powerlink suggested that guidelines for the implementation of ICCP / secure ICCP would be beneficial.

4.15.2. AEMO's assessment

ICCP was designed to standardise communications between control centres, however, ICCP applications now also include communication between control centres and power plants and substations[13]. IEC 62351-3 and IEC 62351-4 provide security extensions to TASE.2 at both application and transport layers to provide end-to-end data integrity, authenticity, and confidentiality.

AEMO agrees with the view that the security architecture should be considered as a whole rather than protocol specific. Whilst secure ICCP provides sufficient security services between the AEMO control centres and Intervening Facilities, the Standard does need to address requirements for secure communications between the Intervening Facilities and field devices more explicitly. Specifically, Intervening Facilities should implement protection of communications with field devices against threats as outlined in IEC 62351: Power systems management and associated information exchange – Data and communications security. As a minimum, this entails:

[13] Inter-Control Center Communications Protocol (ICCP, TASE.2): Threats to Data Security and Potential Solutions, EPRI, Palo Alto, CA:2001. 1001977.

- Authenticating communications and implement integrity measures to prevent message tampering, replay or spoofing, person-in-the-middle and masquerade attacks.
- Protecting the confidentiality of communications using encryption.
- Giving priority to implementing security services at the application layer and implemented at the transport or network layer as an additional layer of defence or when it is infeasible to implement at the application layer.

The protocols and algorithms used by these security services should preference Australian Signals Directorate (ASD) approved protocols and algorithms as detailed in their Guidelines for Cryptography advice.

4.15.3. AEMO's conclusion

The secure ICCP provides secure data communication in conjunction with the security provisions on AEMO WAN and computer networks. The secure ICCP is considered secure and appropriate. With the inclusion of clearer requirements on the architecture and security components of the Standard the use of the ICCP Protocol is considered sufficiently secure for transmission of data between NSP Intervening Facilities and AEMO control centres. As regards protocols for transmission of data between Non-NSP Intervening Facilities and AEMO refer Section 4.53.

AEMO proposes to update the Standard is proposed to provide more explicit guidance on the security requirements for communications between Intervening Facilities and field devices.

4.16. Protocols for connections to AEMO WAN

4.16.1. Issue summary and submissions

A stakeholder suggested that the Standard (section 5.1) should be more specific on the protocols used when AEMO WAN is connected to another party's DCF.

NSPs contributing to the consultation who currently provide Intervening Facilities generally viewed the present details in the Standard as sufficient for connection to AEMO WAN. CIGRE AU also considered that the Standard lists enough details, adding that the issue may lie with the design being unclear or the architecture not being fully defined. CS Energy suggested that protocols should be consistent and applicable to all parties connecting to AEMO WAN.

4.16.2. AEMO's assessment

AEMO considers that the details in the Standard on the data network connections layer do not need expansion. Specific details on links should be resolved during the design phase of any new data connection. Application protocols such as ICCP are covered in Section 4.15.

4.16.3. AEMO's conclusion

No change to the Standard is proposed.

4.17. Boundary of operational and financial responsibilities

4.17.1. Issue summary and submissions

Some stakeholders indicated that the Standard needs to provide more clarity on the boundary of both operational and financial responsibility between:

- Generator and NSP.
- DNSP and TNSP

- AEMO and TNSP

Some submissions supported the need for further clarity on the delineation of responsibilities, including equipment maintenance and reliability obligations. It was also suggested that:

- Many new generators are unclear on what it is they need to do to connect to AEMO.
- It is inappropriate to imply in the generator access standards (NER S5.2.6.1 and/or S5.2.6.2) that a participant has obligations for equipment performance outside of their control.

SA Water suggested a division of responsibility between NSP and Generator as follows:

- When a connecting party connects its facility to an NSP's network, the NSP should provide appropriate points of interface for secondary systems, including systems capable of exchanging "Operational Data" signals between the connecting party and AEMO at the point where the connecting party's facility connects with the regulated network (Telco Interface).
- The Standard should provide that the NSP is financially and operationally responsible for all DCF assets located on the network site of the Telco Interface, all the way through to AEMO, as a regulatory obligation which must be complied with by all NSPs to enable the costs associated with such assets to be incurred by the NSP as a regulated expense (i.e., for the benefit of all regulated network users).
- The Standard should also provide that the NSP may charge connected or connecting parties reasonable and market benchmarked rates for access to its ICCP link, provided that all relevant information regarding its ICCP link and access to such link is provided to the connecting party at the connection enquiry phase, so they have ample time to consider all available options).
- The connecting party should have financial and operational responsibility on their facility side of the Telco Interface.

4.17.2. AEMO's assessment

AEMO does not believe it is the role of the Standard to specify the financial responsible party or processes for recovery of costs. AEMO notes that some of the challenges faced by the DNSP and connecting parties has been through a lack of clarity on roles, which in turn affects the recovery of associated costs,

As discussed in Section 4.11, AEMO proposes that the Standard will explicitly require DNSPs to provide the services of an Intervening Facility for relevant connections within their network. AEMO considers that greater clarity on the DNSP's role in this regard should also enable costs and fee arrangements to be appropriately allocated.

4.17.3. AEMO's conclusion

AEMO does not propose any further changes to the Standard to address financial or cost recovery issues, noting that the changes proposed in Section 4.11 should provide role clarity to support appropriate financial arrangements.

4.18. Obligation for parties to work together

4.18.1. Issue summary and submissions

A stakeholder observed that in some cases two parties are required to work together to ensure a requirement is met. It was suggested that the Standard should state the obligation of parties to work together to resolve such problems.

Submissions supported a requirement for relevant parties to work together. Some suggested formalising obligations under the Standard including operational and financial.

CIGRE AU suggested that there is an implicit obligation for parties to collaborate to meet reliability and availability requirements but commended that there is a need to establish mechanism for resolving disagreements and this could be done via a state-based regulator.

Delta Electricity suggested the NER is the place for setting obligations of different parties. However, as the Standard is necessary for AEMO to achieve power system security obligations, AEMO should manage the performance issues including their resolution, where identified by AEMO or through reporting by participants.

4.18.2. AEMO's assessment

The efficient establishment and on-going operation of communication systems for power system data will be critical to maintaining power system security as the number of facilities actively participating in the NEM increases. AEMO agrees with submissions indicating that explicit recognition of the need for relevant participants to cooperate to achieve the Standard would be beneficial, but also agrees that the Standard should not require an individual DCP to exceed its substantive obligations under the Standard or the NER.

4.18.3. AEMO's conclusion

AEMO proposes to add an explicit recognition in section 1.6 of the Standard of the interdependence of data communication facilities and an expectation for relevant parties to cooperate to achieve the requirements of the Standard, within the limits of their individual obligations.

4.19. Requirement for connection to both AEMO control room sites

4.19.1. Issue summary and submissions

One stakeholder stated that the Standard should clarify that connections are required to both AEMO control room sites.

Some submissions suggested that this is covered in the reliability and availability sections of the Standard. Others suggested it would be beneficial to clarify this requirement in the Standard, particularly if direct connections to AEMO are permitted. Delta Electricity supported connection to both AEMO control room sites if it is necessary to achieve secure operation of the NEM, however, AEMO should demonstrate why both connections are necessary.

4.19.2. AEMO's assessment

There is a requirement to transmit Operational Data to both AEMO control centres in the current Standard. AEMO does not propose to change this, as it considers this requirement as a key element to maintain resilience in power system data communications, otherwise either AEMO control room is a single point of failure. As stakeholder responses indicate this requirement may not be clear, AEMO will make minor changes to remove any ambiguity.

4.19.3. AEMO's conclusion

The requirement for data transmission connect to both AEMO control centres will be maintained to support resilience in power system data communications, and more clearly documented in the Standard.

4.20. Need for specific requirement for data to be of good quality

4.20.1. Issue summary and submissions

Some stakeholders indicated that the Standard needs a specific requirement that data sent is of good quality.

Submissions on this topic generally agreed that data quality is an important factor, but some sought further explanation of what constitutes good quality, with analysis to support the need for any changes and consideration of implementation requirements and costs. AGL expressed a preference for bad data to be discarded on an individual use basis, noting their understanding that this is the current practice. Powerlink highlighted the need to define accountability for ensuring data quality and resolution of bad quality data.

4.20.2. AEMO's assessment

The transmission of data that is of good quality – that is, the transmission represents the current value, is a fundamental feature of SCADA communications and protocols. The quality of data being received by AEMO directly impacts availability and use of incorrect input data in AEMO's dispatch and system security monitoring systems could have serious consequences.

Traditionally SCADA systems have a good quality monitoring processes which detect abnormal or inconsistent measurements at the RME and set a quality flag to alert AEMO systems that this is suspect data. Thus in the past data quality has not been a major issue but there are now increasing instances of significant issues. A typical example has been one where a solar farm sends a measure indicating that its output is 100MW in the middle of the night, without the systems setting the quality flag to indicate that the value is suspect. In another recent example, all switches in a substation showed open and good quality and all analogue measurements zero and good quality which was not a true representation. The station was generating over 300MW at the time and feeding into the grid.

AEMO believes that the Standard needs to be upgraded to ensure better management of this growing issue.

4.20.3. AEMO's conclusion

Transmission of data with appropriate data quality representing current values is a requirement of the existing Standard (section 2.2). A definition of good quality is proposed to be added to the Standard and its application made clear. AEMO will also amend the definition of a critical outage to include the failure of a facility to provide data of good quality.

4.21. Quality flags for data

4.21.1. Issue summary and submissions

Some stakeholders indicated it is possible for a connection to be available and the data to be unusable due to quality.

Most submissions indicated general support for data to be sent with quality flags. Energy Queensland added that data quality flags are essential and implied in the use of the ICCP protocol, but clarification would be beneficial. On the other hand, ElectraNet and Hydro Tasmania pointed out that not all metering installations or monitoring equipment support the use of quality flags. Delta Electricity noted that there should be a demonstrated need for quality flags to meet the overall objective of the Standard and agreement by all participants that the quality flags are indeed required. AGL added that if quality flags are not available from a source device, the quality flag should be artificially set to good.

4.21.2. AEMO's assessment

The transmission of data quality with the current value is a fundamental feature of SCADA communications and protocols and all data should be sent with quality to the full extent allowed by the applicable protocol. Any new metering installations or monitoring equipment will be expected under the Standard to support the use of quality flags, and these are expected to be implemented in the communications system. In the

case of legacy equipment which does not the use of quality flags then the quality flag should be artificially set to good.

4.21.3. AEMO's conclusion

The Standard currently specifies data is to be transmitted with quality flags. However In the case of legacy equipment which does not the use of quality flags it is proposed that the Standard clarify the position by stating that the quality flag should be artificially set to good in such circumstances.

Any new metering installations or monitoring equipment will be expected to support the use of quality flags, to be implemented in the communications system. In the case of legacy equipment which does not support the use of quality flags then the quality flag should be artificially set to good.

4.22. Need for specific requirement regarding data accuracy

4.22.1. Issue summary and submissions

Some stakeholders observed that the Standard does not have an effective requirement to ensure the accuracy of data, in particular to ensure that RME remains calibrated. They considered that monitoring and remediation is problematic and indicated that kilovolt (kV) measurements at some stations can vary by over 10kV.

Most submissions indicated that any additional data accuracy requirements in the Standard should be well specified and demonstrably required. They should take into account the cost for participants of increased calibration requirements with regard to the risk of less accurate data for power system security. Energy Queensland also pointed out that NSPs already have their own data accuracy requirements, and generators should be designing to a certain level of metering accuracy.

4.22.2. AEMO's assessment

AEMO considers that data accuracy requirements for RME should be more clearly specified in the Standard, requiring DCPs to maintain their RME to ensure data accuracy within the Standard. The Standard itself should not dictate a calibration period.

AEMO proposes that the Standard should specify a total accuracy requirement rather than specify individual requirements for specific elements such as current transformers and transducers, with a reasonable value for overall accuracy proposed for analogue values to be within +/- 1% of true value. AEMO views true value to mean a perfect measurement in an ideal world. It assumes zero measurement error in the measurement process, from the sensor to the measurement instrument.

AEMO acknowledges NSPs will already have their own accuracy requirements as per Australian Standards, however, previously there have been questionable values transmitted for extended periods that have been flagged as unusable in AEMO systems. This creates issues both for accuracy of market dispatch and maintenance of power system security in the following areas:

- Inaccuracy in estimating scheduled demand resulting in incorrect pricing and frequency excursions requiring unnecessary use of primary frequency control services.
- Flows on transmission elements either being unnecessarily constrained thus impacting on pricing outcomes or having flows actually exceeding secure limits meaning that system is actually insecure without AEMO being aware of this.

State Estimation and other checking processes are used by AEMO to help manage these risks, but such measures would become ineffective if significant errors become widespread.

As inaccuracy of dispatch and system security data can have wide consequences, AEMO believes that it would be good practice to ensure that accuracy was as good as reasonably achievable. AEMO believes that

an accuracy of +-1% would be reasonably achievable but is seeking feedback from DCPs as to whether this is the case and if not, what a reasonably achievable measure might be.

AEMO notes the Standard does not prescribe a maximum time for the DCP to remediate inaccurate data which means such errors could continue indefinitely. AEMO thus believes that the Standard needs to set a normal maximum time for rectification. Based on experience, a maximum time of 30 days after DCP becomes aware of the issue is considered reasonable in that most accuracy issues can be addressed by recalibration. If the particular issue requires more significant action, then a remediation plan along the lines set out in Section 4.45.2 would need to be agreed between the DCP and AEMO.

Inaccurate measurements can be identified via observation of the AEMO State Estimator. A State Estimator is a commonly used scheme which provides a real-time data base for many of the central control and dispatch functions in a power system. The estimator processes the imperfect information available and produces the best possible estimate of the true state of the system. Possible inaccuracies can then be detected by comparing actual measurements against the estimates provided by the State Estimator.

4.22.3. AEMO's conclusion

It is proposed to amend the Standard to include:

- A specific requirement for accuracy for analogue values to be within +/- 1% of true value.
- A normal maximum period for remediation of inaccurate measurements of 30 days after the DCP becomes aware of the inaccuracy.

In unusual cases where a 30 day period to remediate is not practical then a remediation plan along the lines set out in Section 4.45.2 would need to be agreed between the DCP and AEMO.

AEMO proposes to define true value in the Standard as a perfect measurement in an ideal world.

AEMO is seeking feedback from DCPs as to the implications of the proposed approach for their equipment, in order to identify any need for additional transitional provisions or limited exceptions or a variation to the proposed requirement.

4.23. Clamping of Values for Semi-Scheduled Units

4.23.1. Issue summary and submissions

A stakeholder raised a specific issue with metering of semi-scheduled units, namely that all semi-scheduled units were clamped in SCADA (at the AEMO end) such that telemetered MW values could not be negative. This was considered undesirable, noting that participants are responsible for providing accurate data and separate metering of auxiliary loads.

AGL and Energy Queensland considered that clamping of two-way power flows is not appropriate and that negative values should be allowed. Energy Queensland added that bi-directional flows would be required for batteries.

4.23.2. AEMO's assessment

In April 2021, AEMO introduced changes to floor the SCADA MW of all semi-scheduled generating unit to zero, to ensure a consistent approach in the calculation of causer pays factors for semi-scheduled generating units during periods when the unit was offline but had auxiliary load present. The floored unit SCADA MW values are used in NEMDE, dispatch conformance, regulation FCAS contribution factors (causer pays) and in the calculation of the NEMDE "as generated" demand forecast, so that the auxiliary load of semi-scheduled generating units is effectively supplied as part of energy market dispatch rather than as additional FCAS regulation. To date, AEMO has not identified any issues with these changes and is now considering extending the clamping to all scheduled generating units and scheduled loads for

consistency and to ensure all auxiliary load is met by energy market dispatch. AEMO agrees with Energy Queensland that SCADA bi-directional flows for batteries would remain unfloored.

AEMO further notes that the raw, unfloored unit SCADA MW values continue to be used in its EMS security applications.

4.23.3. AEMO's conclusion

AEMO considers that the question of clamping of SCADA MW values is outside the scope of the review of this Standard. However, AEMO will work with stakeholders outside this review to discuss the way forward with clamping of SCADA MW values.

4.24. Need for specific requirement regarding data latency

4.24.1. Issue summary and submissions

Data latency is basically the time it takes for data to be transmitted from the field to AEMO and from AEMO to the field. The current hierarchical architecture of the NEM power system data communications process can introduce significant delays, in particular for embedded generation and storage. Some data can be many tens of seconds old before AEMO receives it, creating significant issues for real time operational applications and other processes dependent upon analysis of real time data (e.g. the causer pays algorithm, dispatch conformance monitoring and FCAS delivery). It may also cause issues for participants in when receiving control commands from AEMO.

Some stakeholders identified that the Standard is not clear on requirements for data latency or end-to-end response times. There is currently no minimum requirement for data latency.

Energy Queensland suggested that latency is addressed in Section 2.3 (Age of Data, Table 2), however, the requirements are difficult to interpret and do not account for multiple Intervening Facilities. Energy Queensland further suggested that only one time interval should be specified (as opposed to separate time intervals for data transmitted through a data concentrator), which includes any time within an Intervening Facility. Hydro Tasmania recommended that, for consistency, any Standard changes regarding data latency be applied to all participants in the communication system. CS Energy noted that latency affects the requirements and data functions and suggested a transitory period for addressing the requirements in the Standard. Delta Electricity suggested that if a latency issue exists, it needs to be demonstrated through statistics to support any change to the Standard.

SA Water provided an alternative proposal suggesting that latency needs to be specified in the Standard and be a realistic, achievable value. SA Water suggested that the latency specification needs to "separately cover ICCP links between connecting/connected parties to AEMO via: (a) direct AEMO link; (b) TNSPs only; (c) DNSPs only; (d) two NSPs i.e., DNSP to TNSP to AEMO, so that all options are available and not excluded due to unachievable data latency."

ElectraNet suggested that latency requirements should be aligned to protocol operation. ElectraNet questioned if ICCP continues to be a suitable protocol for near real time operations.

4.24.2. AEMO's assessment

AEMO agrees with Energy Queensland's submission that a separate time interval is not needed for data transmission to AEMO through a data concentrator and that the Standard should specify a time interval that includes any time within an Intervening Facility. This provides for a straightforward requirement that focuses on the critical issue of the end-to-end timing for data transmission. For the purposes of the Standard AEMO proposes to define end-to-end times as the time between (as applicable):

- Detection of event or change in value at an RME and receipt of information at the AEMO control centres.
- Transmission of command from an AEMO control centre and the receipt of command at RCE.

Currently there is a wide range of end-to-end transmission times from RME to the AEMO control centres ranging from about 2 seconds to often in excess of 12 seconds. There have been some quite extreme cases observed. For instance, testing in 2018 demonstrated that the latency from a switch operation from a semi-scheduled generating unit through to AEMO was 5 minutes. Other testing in 2020 demonstrated that the delay for some CB status indications was approximately 20 seconds, while the transducer measurands were delayed by nearly 60 seconds.

The longer times generally relate to data from embedded generating units in the distribution networks. This is creating problems in a number of areas:

- AEMO's Automatic Generation Control (AGC) system operates on a four second cycle and end-to-end transmission times well in excess of 4 seconds can create operational issues for the AGC System.
- The wide spread in transmission times means that the sequence of events recorded at the AEMO control centres following a major incident may be out of actual sequence, which could impact on AEMO's immediate response.
- The spread of transmission times can also impact on the accuracy of dispatch in terms of the initial MW output of a generating unit at the start of a five minute interval and the calculated regional scheduled demand which is the sum of the initial MW output of a generating unit and the flows on the interconnectors.
- These longer delays also impact on the causer pays calculations, which attempt to correlate movement of generating units with movement of frequency. Distortions here can mean that the causer(s) of a frequency deviation may not be accurately identified.

It is likely that the number and aggregate size of embedded generation will continue to grow over time, making this situation worse. For this reason AEMO believes that it is now necessary to for the standard to specify maximum end-to-end response times that correlate to the required application of the data and commands to be transmitted.

The potential alternative of modifying the AGC algorithm to account for these delays is unlikely to be effective due to the wide spread in response times.

A second issue concerns the end-to-end times for transmission of status indications in the dispatch data and primary system security data categories. AEMO proposes to amend the Standard to specify an end-to-end time for these status indications as 3 seconds.

The reason for this is that State Estimator runs every 30 seconds and solves from a snapshot of telemetry at the time it runs. It then solves/estimates the power system measurements based on the topology (status indications) at the time of the run. The State Estimator does not correct the topology, it assumes it is correct. If the values are materially out of date, the result will be a valid but incorrect SE solution. The accuracy of the state estimated values is important as they used as the input for most power system security monitoring tools.

Most instances of excessive end-to-end response times arise where data needs to be transferred through multiple data communication facilities. Thus the proposed changes in architecture which to allow DNSP Intervening Facilities to connect directly to AEMO will assist, if adopted.

At this stage AEMO believes the ICCP remains appropriate for real time operations. It is appreciated that, as protocols evolve, other protocols might become more effective. In the longer term, there may be a need to support further protocols. As discussed in Section 4.53 AEMO proposes to include in the Standard a provision which allows a new protocol to be supported without the need to amend the Standard.

4.24.3. AEMO's conclusion

AEMO proposes to update the Standard to remove the separate time interval for data transmission to AEMO through a data concentrator and specify maximum end-to-end response times for each category of data in Table 2 of the draft Standard. In particular the maximum end-to-end time interval for dispatch data (except for status indications) is proposed to be set at 6 seconds.

The end-to-end transmission time for status indications in the dispatch data and power system data categories is proposed to be tightened to 3 seconds in order to better ensure the accuracy of results of the State Estimator which are critical for power system security analysis.

4.25. Materiality of timing differences due to RME

4.25.1. Issue summary and submissions

The experience of some stakeholders has been that significant timing differences can exist particularly for RME that uses coordinated universal time (UTC) and the conversion of this to AEST. Greater clarity may be required on the requirements for calibration, testing, validation, and maintenance of the time stamp quality.

Submissions generally supported addressing the timing differences across RMEs if it is demonstrated that this is an issue impacting participants and secure operational control of the NEM. It was suggested that timing differences across RME may adversely affect outage restoration requiring retuning of devices. Also, conversion time may contribute to latency and a transitory period suggested for addressing the requirements in the Standard.

The following suggestions were offered to help address timing differences due to RME:

- Stipulate the use of market time across all in-scope equipment and retune devices across the NEM;
- Add a section to the Standard on time-stamping requirements, which may include GPS clock signal or time via a network protocol and the expected timestamp resolution, e.g. minute, second, millisecond, etc. (it is noted that this could be a significant overhead for DCPs, particularly if installation of a GPS clock is required, although it is expected that accurate time should be available within the participant's design).

4.25.2. AEMO's assessment

This is not an issue for AEMO as SCADA events (not PMU data) are timestamped when the event is received by AEMO. The more important concern is the age of data. The cost implications of the suggested options could be significant and before deciding upon any action, AEMO seeks to better understand:

- How common this issue is and how timing differences across RME may adversely affect outage restoration.
- The cost implications of including time stamping requirements in the Standard.
- Whether the increasing installation of PMUs would have any bearing on this issue.

4.25.3. AEMO's conclusion

Based on the information available to it at this stage, AEMO is not proposing further changes to the Standard to address RME timing differences.

4.26. Requirement for ongoing monitoring of end-to-end response times

4.26.1. Issue summary and submissions

One stakeholder observed that monitoring end-to end update times is difficult post commissioning.

AGL and CS Energy submissions indicated in-principle support for ongoing monitoring of end-to-end response times, both with qualifications on implementation costs. As for several other issues canvassed in the review, Delta Electricity indicated that statistics identifying the impact of the issue should be provided to support any proposed change.

Energy Queensland suggested that ongoing monitoring of end-to-end response times would be very difficult and onerous to undertake, and several factors would need to be considered, including:

- What would be timing of the test (round-trip time impacted due to network congestion)?
- How are costs going to be proportioned?
- Whether Intervening Facilities will also need to be involved?

4.26.2. AEMO's assessment

AEMO agrees with Energy Queensland's assessment that the ongoing monitoring of end-to-end response times is likely to be difficult and onerous. However, AEMO also recognises the importance of ensuring these times are met and considers that some form of compliance monitoring is desirable.

4.26.3. AEMO's conclusion

AEMO does not propose to introduce the ongoing monitoring of end-to-end response times in the Standard but intends to consider development of a process to be able monitor response times for short periods in particular cases where an issue has been indicated. The installation of additional PMUs is likely to assist with ad hoc, short-term monitoring.

4.27. Implications of tightening maximum delay for control commands

4.27.1. Issue summary and submissions

Some stakeholders identified that the AGC system is showing performance issues which suggest that a more responsive control loop is needed. With the current 4 second AGC cycle, it was suggested that updates at a minimum of less than 2 seconds are required. There have been incidents where AGC used to control a battery is stale (20 seconds old) resulting in unwarranted discharge and charge cycles and at times oscillations. This occurs mainly because the communication delay is more than 97% of the response delay time.

Submissions varied on the specification of maximum delays for control commands. AGL supported a maximum without suggesting a value, while Delta Electricity indicated it had no issue with a 2 second delay. ElectraNet noted its view that poll-based communications are not appropriate for near real time operations, and that migration to secure ICCP will introduce additional delay. Energy Queensland considered that the entire communication network would require a review to achieve tightened timeframes and significant costs may be involved to change communications infrastructure.

Hydro Tasmania noted they currently have 8 second response time to control commands specific to Tasmania and requested clarification of how proposed response time would be relevant or applicable to Tasmania as opposed to current arrangements.

CS Energy provided an impact assessment of current AGC controls on their plant. This same assessment was also provided into the Primary Frequency Response (PFR) rule change consultation. CS Energy provided extensive feedback in relation to AGC controls, including:

- AEMO's dispatch conformance alert system is yet to align with the PFR rule changes intended to clearly legitimise being off target to help correct frequency. Traders continue to receive "Off Target" alerts despite PFR contributing to a significant portion of the "MW Error" in AEMO's dispatch compliance system due to:
  - the discrepancy between the "Total Cleared" in AEMO's AGC system and the actual AGC setpoints seen by generators when PFR provides a head start to load ramping, and
  - PFR itself still being included in the "MW Error", which is simply "Total Cleared" minus "Actual MW" (supporting charts provided in submission). This then potentially impacts subsequent decisions.
- Participants do not receive a linear AGC setpoint ramp. This appears to be principally due to resetting the "Total Cleared MW" to "Actual MW" at the start of each Dispatch Interval (DI). The resultant flat spots in AGC ramps at DI boundaries if "Actual MW" is lagging an AGC setpoint ramp before the start of the DI, and the inconsistent ramp rate between DIs is directly responsible for degrading the ramping response of generators.
- The AGC setpoint ramping should not be reset to Actual MW every DI, rather it should just continue from the AGC setpoint at the end of the previous DI with no pause. In this way, it would be decoupled from any PFR influence. Unlike AGC setpoint changes, PFR is not rate limited and should not be allowed to alter the base AGC setpoint ramping. If the reason for resetting "Total Cleared MW" to "Actual MW" at the start of each DI is because the energy market dispatch engine does not account for the influence of frequency deviations on system load, then AEMO needs to model the frequency influence on load and generation and factor into the dispatch an estimate of the change in generation needed to correct frequency.
- The non-linearities in AEMO's AGC setpoint ramping distort the legitimacy of any causer-pays framework. Causer pays performance factors are judged by comparing actual MWs against a linear trajectory between dispatch targets, whereas they should be judged against the AGC set points as received by the generator and that are sent back to AEMO with the actual MWs.
- There is strong push for the DSCP response to be measured against each unit's rate limited AGC target, which is send back to AEMO together with the actual load. This would also avoid timing discrepancies between the two principal values being compared, which could otherwise be another significant source of error. Why assume a linear trajectory when the trajectory is precisely known at the same time as each load measurement? Using the unit's AGC setpoint may incentivise AEMO to update its AGC system to include a linear ramp as the non-linear AGC setpoint ramping causes sub-optimal unit control by pushing rate of change feed-forward influences in and out.
- For units that are dispatched for Regulation FCAS, measuring against the unit's AGC setpoint would measure their PFR response independently from their regulation AGC response, thus decoupling DSCP payments for PFR from existing payments for Regulation FCAS. That would remove any objection around 'double dipping'. At present, good or bad Regulation FCAS response is neither rewarded nor penalised.

4.27.2. AEMO's assessment

The current delays in transmission of control commands are creating issues for the effective operation of AEMO's AGC system. The AEMO AGC can issue controls to a facility every 4 seconds. The issue cycle may be reduced in the future as fast responding generation facilities enter the market. A long end-to-end command delay results in facilities responding to stale data and banking of controls which may result in unnecessary oscillations.

It is likely that the size of scheduled and semi-scheduled embedded generation will grow over time, making this situation worse. For this reason AEMO believes that it is now necessary to require lower maximum end-to-end command control delay times.

This will be an increased requirement compared to the current Standard. However AEMO's experience indicates this requirement is already being achieved by most DCPs with the exception of a limited number of legacy systems.

An alternative of modifying the AGC algorithm to account for these delays has been considered but is unlikely to be effective due to the wide spread in end-to-end response times.

In most cases the long delays for transmission of control commands arise where data needs to be transferred through multiple data communication facilities. Thus the proposed changes in architecture which to allow DNSP Intervening Facilities to connect directly to AEMO will assist, if adopted.

AEMO notes the particular control systems identified by Hydro Tasmania are unique for historical reasons and are considered by AEMO to be subject to special arrangements.

AEMO acknowledges the issues raised by CS Energy on the dispatch conformance alert system and detailed aspects of operation of the AGC. These are considered outside the scope of the Standard and will be examined separately by AEMO.

4.27.3. AEMO's conclusion

AEMO proposes to specify in the Standard that control commands must be transmitted to the relevant RCE within two seconds (on an end-to-end time basis) of receiving a control command from AEMO. The control command response from the RCE to AEMO should be also received within two seconds (on an end-to-end time basis).

Since AEMO understands that there are some facilities with legacy systems introducing delays in facilities responding to control, an exemption and transition plan will be considered for them.

Maximum end to end timing for control commands from AEMO control centre to RCE/RME

4.28. Materiality of unreliability issues in connection to AEMO's market portal

4.28.1. Issue summary and submissions

Some stakeholders believed that there should be increased use of dispatch signals via SCADA through the NSP, on the basis that their connection to AEMO's market portal was considered unreliable and any failure to meet dispatch requirement increases system risk.

CS Energy's submission flagged the need to address material issues with unreliable connections to the market portal. AGL and Delta Electricity indicated they had not experienced any material issues, but AGL noted issues with the reliability of remote networks, provided by third parties, to remote locations. AGL observed that without highly available network connections, there is a risk of not being able to comply with dispatch instructions whether they are provided by SCADA or the market portal. AGL said it would

welcome the ability to leverage the highly available, highly secure, highly managed TNSP and DNSP SCADA networks.

Energy Queensland submitted that responsibility for reliability of the market portal rests with AEMO and any performance issues should therefore be addressed by AEMO. Dispatch signals through the NSP should only be used as a last resort or backup option, not as an alternative to a poorly performing system.

4.28.2. AEMO's assessment

This issue is considered to be outside of the scope of Standard, as the Standard deals with real time operational provided to AEMO's control centre and control signals sent from these centres.

4.28.3. AEMO's conclusion

No change to the Standard is proposed.

4.29. Need for control command delays to account for number of intervening facilities

4.29.1. Issue summary and submissions

Submissions were divided on this issue.

AGL supported a specification of a maximum delay for control commands but did not offer a suggested maximum value. If, due to location and the necessity to have multiple Intervening Facilities, the delay exceeds the maximum specified by the standard, AGL suggested an exemption should be formally raised and reviewed periodically to ensure the exemption is still valid with regards to improvements to technology.

CS Energy noted that any requirements regarding maximum delays would ideally take into account the number of Intervening Facilities through which the command signal needs to be relayed and the final requirement in the Standard would ideally be reflective of rigorous cost benefit analysis.

ElectraNet considered that the specification of control delays should not take into account the number of intervening stages. ElectraNet believes the communication of control commands should be reviewed to transition from a queue and dispatch model to one that leverages unsolicited dispatch. This should be done with a view to eliminate the amount of time data spends idle across Intervening Facilities (in both directions). While this would require the introduction of significant change, ElectraNet submitted it will allow the control commands to keep pace with emerging technology and market opportunities.

Energy Queensland suggested that the best option is to specify one time interval and that the time interval should take into consideration the involvement of any Intervening Facilities.

4.29.2. AEMO's assessment

As stated previously in this Draft Report, the critical issue for power system security is ultimate end-to-end data latency and control response times. For this reason AEMO believes it is inappropriate to have different requirements depending upon the number of Intervening Facilities. In addition, other changes proposed in the Standard provide increased options to reduce the number of Intervening Facilities.

4.29.3. AEMO's conclusion

AEMO proposes that the specification of maximum delays should not take into account the number of Intervening Facilities through which the command signal needs to be relayed.

4.30. Obligations regarding maintenance of security

4.30.1. Issue summary and submissions

It has been observed that the current Standard does not include clear obligations with regard to the security of the data (physical, personnel and cyber) and of control protocols at the level required for nationally important critical infrastructure. The interconnected nature of energy infrastructure means that the compromise of one entity can have cascading effects that disrupts others, potentially with catastrophic effects where this causes prolonged and widespread failure in energy infrastructure.

Submissions offered different suggestions on how the security obligations could be further improved in the Standard (noting organisations are already making significant investments in security). Suggested security arrangements or improvements for the Standard included:

- CIGRE AU submitted that the security section of the Standard should align with or reference AESCSF, including a particular maturity level, with transitional arrangements to allow DCPs to get to this level (noting that that smaller companies may not have the resources to fully comply).
- CS Energy submitted that the Standard should clarify obligations of the parties about the security of the data (physical, personnel and cyber) and of control protocols at the level required for critical infrastructure
- Delta Electricity noted that power stations can operate on local control and emphasised the need to identify any security risks, their causes and how to address them. If there are none, no change is needed.
- ElectraNet and Hydro Tasmania pointed to obligations in place as part of the SOCI legislation and the need to avoid any overlap or conflict. ElectraNet noted AEMO may need to specify some specific technical obligations where these are required to secure others connected to the network, without contradicting existing obligations. ElectraNet suggested use of (or reference to) the ASD Essential Eight maturity model would provide a concise mechanism for specification of these controls.
- Energy Queensland considered the Standard should reference the Australian Energy Sector Cyber Security Framework (AESCSF) and Security of Critical Infrastructure (SOCI) legislation without covering security requirements in detail.
- SA Water commented that security requirements for any ICCP direct link between AEMO and connecting/connected parties need to be defined.

4.30.2. AEMO's assessment

There are two dimensions to consider in relation to security of data communications. The first is the cyber security environment of the DCF, the second relates to the security (integrity, availability, and confidentiality) of telemetry and control signals exchanged between AEMO and the DCF.

On the first, for those entities covered by the SOCI Act, there are current obligations that will come into effect to require entities to establish a risk management plan that addresses material risks to their critical functions and addresses the domains of physical, personnel, supply chain and cyber security. The AESCSF is identified in the legislation as one of the relevant documents that an organisation can use in formulating their risk management plan. These risk management plans must be reviewed and attested to by the Board or other relevant entity for the organisation. Detailing in the Standard the expectation that entities are complying with obligations under the SOCI Act, specifically adhering to the requirement to annually produce a risk management plan addressing material risks across physical, personnel, supply chain and cyber dimensions and that plan is attested to by the organization's board would be required to make this expectation clear.

On the second, the use of secure ICCP can provide security protections against the threats of eavesdropping, fabrication or replay of messages, ensure the authenticity of participants in the communications, and prevent person-in-the-middle attacks. It should be noted that any additional protocols supported by the PSDCS would require equivalent security protections as defined in a suitable industry accepted standard. Furthermore, while secure ICCP will secure communications between AEMO, and the Intervening Facility consideration must also be given to how communications from the Intervening Facility to RME/RCE are also secured against a range of security threats. Specifically, DCFs must be able to authenticate systems participating in the communication, prevent eavesdropping, fabrication, replay or manipulation of messages, and person-in-the-middle attacks on data exchanged and relayed to or from AEMO.

4.30.3. AEMO's conclusion

The following changes to the Standard are proposed:

- Detailing in the Standard the expectation that relevant DCPs are complying with obligations under the SOCI Act, specifically adhering to the requirement to annually produce a risk management plan addressing material risks across physical, personnel, supply chain and cyber dimensions, to be attested to by the organisation's board,
- Adding a requirement to use secure ICCP between AEMO and NSP Intervening Facilities with an option for secure versions of other protocols to be supported in future for non-NSP Intervening Facilities.
- Adding a requirement that DCFs adequately secure communications with ultimate destinations for telemetry or control signals relayed to or from AEMO.

4.31. Need for Standard to include or reference detailed security obligations

4.31.1. Issue summary and submissions

In 2018 AEMO established the AESCSF to assist energy sector organisations in understanding their criticality to grids and markets, their current maturity with respect to eleven practice domains, and appropriate criticality-based target states for maturity.

Further to the AESCSF, the Commonwealth Department of Home Affairs introduced amendments to the SOCI Act in December 2021 that, amongst other requirements, places positive security obligations on entities covered by the legislation. Further amendments are scheduled to address enhanced security obligations for systems of national significance, the most critical elements of critical infrastructure[14].

Some stakeholders identified that alignment between the Standard and current and proposed regulations requires consideration. CS Energy supported security principles being codified in the regulations and the detailed security obligations and requirements specified in the Standard. Hydro Tasmania supported the setting of standards by AEMO, that maintain the quality of existing security systems.

Powerlink observed that the SOCI legislation is broad and principle-based. It sets the minimum standard that everyone must adhere to. While AEMO may expand on the minimum requirements, Powerlink noted there may be cost implications of doing more than what is legislatively required.

4.31.2. AEMO's assessment

The SOCI legislation is broad, principle-based and establishes minimum requirements from an economy-wide perspective. The AESCSF is a sector specific maturity framework that defines criticality-based target security profiles and may be better positioned to provide required assurance around the security posture

[14] Information and resources on the reforms are available on the Cyber and Infrastructure Security Centre website at https://www.cisc.gov.au/legislative-information-and-reforms/critical-infrastructure

and maturity of organisations connecting to AEMO's most critical network environments. The AESCSF is one of the supported frameworks defined under the SOCI Act and AEMO's view is that all DCPs should be using this specific framework rather than the alternatives offered.

AEMO considers it would be appropriate and reasonable to require the minimal security posture of target security profile level 1 under the AESCF. Further analysis and consultation would be required to quantify the cost and benefits of requiring connecting participants to satisfy other criticality-based target security profiles under the AESCSF and having to provide evidence that they have achieved the requisite target state.

4.31.3. AEMO's conclusion

AEMO proposes to amend the Standard, consistent with the SOCI Act inclusion of the AESCSF as a relevant document for the purposes of establishing critical infrastructure risk management programs, to require all DCPs, including those not directly subject to the SOCI legislation, to assess their maturity against the AESCSF and maintain compliance with security profile 1 as a minimum.

4.32. Requirement for DCPs to advise on cyber security risks

4.32.1. Issue summary and submissions

Some stakeholders identified that the Standard should require participants to advise AEMO of any known relevant cyber security issues, or when abnormal risks to cyber security arise. A related question was whether any such obligation should be coupled with or have the same requirements as those proposed under the SOCI rules.

CIGRE AU's submission commented that a notification requirement should be included in the Standard if it did not already exist in other regulations, while Delta Electricity and Energy Queensland did not favour its inclusion in the Standard.

CS Energy considered that participants would be obliged to advise on cyber security risks under NER 4.8.1 (Registered Participants' advice).

ElectraNet and Hydro Tasmania both supported a reporting requirement, with a clear path for notification. ElectraNet added that there should be explicit conditions for reporting, as well as the reporting method, time frame and use of reported information by AEMO or others, noting that clarity is needed for incident response plans.

4.32.2. AEMO's assessment

AEMO agrees that the requirement for all registered participants to advise AEMO of certain events and conditions under NER 4.8.1 (extract below) is broad enough to cover reporting of cyber security threats or incidents potentially affecting Operational Data:

> *A Registered Participant must promptly advise AEMO or a relevant System Operator at the time that the Registered Participant becomes aware, of any circumstance which could be expected to adversely affect the secure operation of the power system, or any equipment owned or under the control of the Registered Participant or a Network Service Provider.*

AEMO maintains a role of Cyber Duty Manager that is a rostered position and contactable 24/7 that would be the initial point of contact for reports of these incidents. Consistent with AEMO's Policy 020113: Electricity Market Management Systems Access Policy and Procedure[15], there would be benefit in clarifying market participants' requirement to provide and maintain contact details of a nominated cyber security

[15] This procedure was established in accordance with NER Rule 3.19

contact that could be reached 24/7 by the AEMO Cyber Duty Manager, noting that initial contact details are provided in the registration process.

DCP reporting timeframes and thresholds should meet the requirements of NER 4.8.1 (promptly, where the circumstances could be expected to adversely affect secure operation of the power system or equipment), and also align with the SOCI Act which has reporting timeframes and thresholds (12 hours for significant and 72 hours for relevant cyber impact). AEMO requires this information to facilitate the identification and management of potential or realised impacts on grid and market operations.

4.32.3. AEMO's conclusion

AEMO proposes to update the Standard to explicitly reference reporting requirements and processes that are already in place outside the Standard and confirm that these apply to cyber security threats or incidents impacting Operational Data communication. These include:

- NER 4.8.1.
- Maintaining 24/7 reporting contacts for both AEMO and DCPs under AEMO's Electricity Market Management Systems Access Policy and Procedure (contact numbers will not be included in the Standard as it is a public document).
- Reporting thresholds and timeframes to be consistent with NER 4.8.1 and otherwise aligned with SOCI Act requirements.

4.33. Protecting confidentiality of data

4.33.1. Issue summary and submissions

There are questions of who owns Operational Data, who has control of the data and when, and who has rights to it and when. While these are not specifically related to the Standard, it was suggested that the Standard must nonetheless fully support and enable these requirements.

Energy Queensland suggested that confidentiality of information requirements are made clear in section 4.1(d) and note 3 of the Standard. However, there may be a need to add further detail with some commentary regarding ring-fencing obligations.

CIGRE AU added that there should be clarification of who has the rights to and owns generation data.

4.33.2. AEMO's assessment

Clarity on data ownership, rights and confidentiality obligations are important issues, as are higher level controls such as ring fencing, but AEMO does not consider them to be within the scope of the Standard to regulate. With regard to confidentiality, the Standard is limited to regulating how the confidentiality of information stored or processed by AEMO and DCFs for use in AEMO control centres is protected.

4.33.3. AEMO's conclusion

The requirement to use secure ICCP (or equivalently secured variants of other protocols supported by the Standard) will secure the confidentiality of data in transit. Existing statements in the Standard require that DCFs have processes in place to keep information confidential and are sufficient to address confidentiality.

AEMO does not propose any specific changes to the Standard on this issue.

4.34. Clarification of reliability requirements in the Standard

4.34.1. Issue summary and submissions

A number of stakeholders identified the need for greater clarity in section 3.1 of the Standard regarding the specification of reliability requirements. In particular:

- In table 4 the standard term RCE needs to be better defined.
- Tables 4 and 5 are not clear. For instance, does the 6 hour requirement apply to a single site or all sites?
- Possible inconsistency between tables 4 and 5.
- Difficulty in understanding how tables 4 and 5 apply to DNSPs.
- Need to better define what is meant by a critical outage in Section 3.1, i.e. does it refer to total loss of data or simply loss of a redundant path?
- The critical outage timeframes set out in Table 4, for RME/RCE over a 12-month period, may not always be achievable due to failures in remote locations.
- Tables 4 and 5 (Total period of Critical outages of Intervening Facility over a 12-month period) do not take into account where there are multiple Intervening Facilities (for example, a solar farm sends data to the DNSP, who sends the data to the TNSP, who sends the data to AEMO).

Submissions offered a range of views on the specification of reliability requirements. Delta Electricity suggested they should be considered with regards to data criticality, interfacing arrangements and the extent of communications failure, for example giving priority to signals necessary for automatic control or loss of multiple data points. ElectraNet stated that the Standard needs to be explicit and unambiguous with regards to reliability requirements, in order to justify the cost of implementation, while CIGRE AU suggested a guidance document to clarify how different DCPs should meet redundancy obligations.

Energy Queensland supported greater clarity, providing specific changes or alternatives to Tables 4 and 5 of the Standard and suggested further clarification in relation to planned outages. It noted that the timeframes specified in Table 5 for Intervening Facilities should be fair and reasonable given Intervening Facilities are merely facilitating data transfer between the generator and AEMO and should not need to build in reliability requirements greater than their own needs.

Hydro Tasmania expressed support for the aim of maintaining a high quality, safe, reliable, and secure data transmission system. Powerlink provided an alternative view, stating that the reliability is responsibility of individual entity and AEMO should not mandate how each entity runs its business.

4.34.2. AEMO's assessment

AEMO agrees that Tables 4 and 5 in the Standard should be consistent and should refer to the categories of data rather than the type of equipment.

Section 4.11 of this Draft Report discusses the role of DNSPs and clarifies the applicability of the Standard requirements to DNSPs in relation to Intervening Facilities. AEMO agrees that an outage of an Intervening Facility may affect all data but recognises that partial outage of an Intervening Facility and also outage of individual RME/RCE is likely to impact power system operation differently. Outages affecting Dispatch Data adversely affects the market operation and system security and is linked to timing of market suspension. It is therefore identified as a crucial aspect of monitoring in Table-4/5, with separate metrics for Dispatch Data and System Security Data. Critical outages for RME/RCE and Intervening facility are currently defined in section 1.2 of the Standard - for RME/RCE there is a threshold of 5% data loss and for an Intervening Facility there are time specific requirements on Dispatch Data. AEMO will consider any constructive suggestions to improve on these definitions.

AEMO acknowledges that availability and outage metrics both aim to measure the data availability but considers that basing the metrics on outage times gives clearer guidance regarding limiting/remediating outage instances.

To ensure the resilience of the data communications system during periods of serious supply disruption, AEMO proposes to include an additional requirement in the Standard that all telemetry of Operational Data and transmission of commands to and from AEMO control centres should be by secure private networks, whether using an Intervening Facility or alternate telemetry options. Such secure private networks should be capable of operation for a continuous period of more than 10 hours during the loss of external ac auxiliary supplies. This 10 hour requirement is consistent with the requirement already established for voice communication circuits[16].

Also as regards data communications between an Intervening Facility and an individual RME/RCE, AEMO proposes to include a requirement in the Standard that all telemetry of Operational Data and transmission of commands should be by secure private networks where the individual RME/RCE where the individual RME/RCE gathers data which falls within the categories of either Dispatch Data or Primary System Security Data

The general industry accepted design standard for TNSP communications batteries has been 10 hours since before the commencement of the NEM. These communications links have also supported operational voice communications channels, which were then supplemented with additional emergency links using satellite phones and terrestrial radio. Due to the increasing number of participants in the NEM, the AEMO System Restart Communications Protocol now formally recognises the design requirement for voice communications to have a stand-by availability for 12 hours. Similarly, AEMO considers the Standard should explicitly identify the 10 hour requirement which has been utilised by the industry for many years.

The importance of maintaining a minimum 10 hour telemetry availability via the intervening facility can be seen in recent critical incidents, both locally and globally:

- Arizona Blackout (Sept 8 2011):
  - SDG&E took 12 hours to restore 100% of its load
  - CFE took 10 hours to restore 100% of its load
  - IID APS, and WALC restored power to 100% of their customers in 6 hours.
- India Blackout (July 30 2012):
  - 2 stations in the region received start-up auxiliary power within 1 hour
  - 8 stations received 'start up auxiliary power' after 4 hours
  - The total restoration time is unknown.
- Northern Territory (July 30 2012):
  - The incident occurred at 1am
  - Power was restored to some northern suburbs of Darwin by 10am.

  Turkey (March 30 2015):
  - Restoration was estimated to be up to 6 hours for some provinces
- South Australian Blackout (Sept 28 2016):
  - Initial load restoration commenced after 3hrs
  - Restoration of 60% of load after 7.5 hours
  - Restoration of 80% of load after 16 hours.

[16] Refer SRAS Communications Protocol Section 4.2 AEMO | Power system operation

An exception to the requirement for a secure private network will be considered for some non-NSP Intervening Facilities connecting directly to AEMO in limited circumstances as detailed in Section 4.48.

AEMO does not agree with EQL's comment that Intervening Facilities are merely facilitating data transfer between the generator and AEMO, implying they should not need to build in reliability requirements greater than their own needs, If this principle was to be adopted then all scheduled and semi-scheduled generators would have to connect directly to AEMO for the purposes of dispatch and AGC control. This would represent a major unnecessary duplication of data communication assets.

4.34.3. AEMO's conclusion

AEMO proposes to replace the reference to RCE in Table 4 of the Standard with Primary and Secondary System Security Data to be consistent with Table 5.

AEMO proposes to include in the Standard a requirement that all Intervening Facilities (other than specifically exempted non-NSP facilities) and secure private networks will be required to be capable of operation for a continuous period of more than 10 hours during the loss of external ac auxiliary supplies.

AEMO proposes to include a requirement in the Standard that all telemetry of Operational Data and transmission of commands, to and from AEMO control centres, should normally be by secure private networks, whether using an Intervening Facility or alternate telemetry options, subject to limited exceptions.

4.35. Expectations regarding monitoring and reporting of availability

4.35.1. Issue summary and submissions

Some stakeholders suggested that the Standard should set expectations on the level of monitoring and reporting of reliability that is required. For instance, should a comprehensive heartbeat facility be required?

Two submissions opposed enhanced monitoring and reporting of availability unless AEMO is experiencing issues with data reliability. Delta Electricity suggested that performance standard compliance programs are appropriate for supervision of maintenance objectives for relevant signals, and otherwise they should be maintained under good electricity industry practice. ElectraNet highlighted that "heartbeat" facility already exists between ElectraNet and AEMO and that this provides useful quality feedback. This should be mandated based on criticality of connection.

4.35.2. AEMO's assessment

AEMO considers there is currently insufficient transparency on how monitoring and reporting of availability is done. Currently, several methods are used including monitoring a heartbeat signal and detection of frozen SCADA. The detection of frozen data is reported to TNSPs in the form of SCADA Minutes Lost (SML) and is used by some TNSPs in their internal reporting on performance. Current methods have had issues in the past and fail to truly report on availability, especially data quality. For example, a link that is available but sending bad data should be considered as unavailable.

AEMO will investigate options to improve monitoring and reporting. The reporting should cover both availability and percentage of good quality contributing to availability. This reporting can be used to ensure obligations under the Standard are being met.

4.35.3. AEMO's conclusion

It is proposed to add a provision to the maintenance section of the Standard covering reporting requirements between AEMO and Intervening Facilities to meet their obligations under the Standard.

4.36. Impact of lack of redundancy on ability to apply timely software security patches

4.36.1. Issue summary and submissions

Frequent and rapid applications of software patches are becoming an increasing requirement for maintaining cyber security. One stakeholder queried whether new or additional redundancy may be needed at DCFs to allow rapid application of patches without disrupting operations.

Submissions on this topic have stated that application of security patches in a timely manner is implicit in availability and reliability requirements. However, redundancy requirements of different NSPs may need to be clarified, for example, are multiple communications nodes / firewalls / RTUs required at all sites to allow for software updates?

There was general agreement in submissions that software patching should be managed by individual responsible entities as required for their assets, consistent with good industry practice and current best practice. Energy Queensland added that DNSPs already have redundancy built into their systems such that patching does not affect their day to day operations.

4.36.2. AEMO's assessment

AEMO considers that the current reliability and availability requirements do not need to be supplemented to explicitly provide for the application of software patches. As for general maintenance, DCPs need to be able to patch their systems within the availability standards. It this is not possible, additional redundancy should be provided.

4.36.3. AEMO's conclusion

No change is proposed to the Standard on this issue.

4.37. Adequate notice requirement for change to sign convention

4.37.1. Issue summary and submissions

Section 2.2 of the current Standard states that "DCPs must notify AEMO of their sign convention when applying to AEMO for registration as a Registered Participant. To change the sign convention, DCPs must give 60 business days' notice to AEMO". A stakeholder queried whether this requirement applies to small scale changes to correct individual sign conventions or only to a major change following a change in policy.

Two submissions commented on this issue. CS Energy indicated that it would be beneficial to clarify what changes require notification and the notice period, by reference to the risk being managed. Energy Queensland considered that sign convention should be the same for all participants and not subject to change. The Standard could provide clarification on sign conventions, for example based on power direction relative to a DER source.

4.37.2. AEMO's assessment

The requirement to notify sign conventions changes applies to all DCPs. Changes to correct individual issues are handled as part of normal database procedures and do not require a 60-day notification period.

4.37.3. AEMO's conclusion

AEMO believes that a supplementary document that specifies required measurements including sign convention would be beneficial to all. AEMO is planning to compile and publish a "Real-time data equipment measurement guide".

AEMO proposes to update Section 2.2 of the Standard to clarify how small sign convention issues are addressed.

4.38. Response time for forced outages

4.38.1. Issue summary and submissions

A stakeholder observed that the Standard has no specific requirements for the times required to return to service following forced outages and that in practice failed data can take a long time to rectify. Tables 4 and 5 of the current Standard refer to a reliability requirement rather than a specific response time.

Submissions also noted that:

- There are too many types of issues that can occur and setting a timeframe for response would be arbitrary.
- The requirements detailed in the National Electricity Rule 4.6.5 (Partial outage of partial protection systems) and AEMO's procedure SO_OP 3715 Power system security guidelines should be considered.
- Cost implications need to be considered with any change.

4.38.2. AEMO's assessment

The Standard should document the requirements for responding to failures, including requirement to maintain contacts (phone and email) and expected response time to begin restoration.

Response times are inferred by the maximum annual duration of critical outages in Tables 4 and 5 of the Standard.

Participants are responsible for managing their response to outages and ensuring they meet availability requirements.

4.38.3. AEMO's conclusion

AEMO will make it more explicit that the maximum duration of critical outages is set by Tables 4 and 5 of the Standard.

4.39. Expanding the scope of testing specified in the Standard

4.39.1. Issue summary and submissions

Stakeholders observed that the current testing scope does not include testing whether the data is correct. The current testing only confirms that data is being communicated. Another stakeholder observed that "our experience is that the RCE and RME are not being robustly tested, calibrated, and validated. For example, greater requirement for testing of "Control Commands" via point-to-point testing then status and value indications. There is a greater requirement for calibration of timing data for status, value and high-speed data to allow for accurate alignment system events and incident investigations".

CS Energy submitted that, in addition to the quality flags, testing is a key risk management measure and is required for maintenance of the integrity of the process and Standard. ElectraNet had not identified particular issues, but in principle supports more comprehensive testing of data correctness. As with a number of other issues, Delta Electricity flagged the need to demonstrate any additional requirements were necessary, while Hydro Tasmania sought further information. Energy thought participants should be responsible for testing their own assets, noting that data points would have been tested during the commissioning phase and only basic checks should be required. Energy Queensland suggested it may be worth considering full end-to-end testing of controls.

4.39.2. AEMO's assessment

AEMO agrees with Energy Queensland's view that, following the point-to-point testing during commissioning (when any gross errors are expected to be detected and remediated), ongoing plant maintenance and regular testing should be the responsibility of the equipment owner. Equipment owners should have procedures and processes in place to ensure equipment is maintained. It is appreciated that AEMO will need to provide support to DCPs when testing performance on an end-to-end basis. In some cases support from other DCPs will also be required as discussed in Section 4.18.

It is AEMO's understanding that when installing, upgrading, or replacing an RME/RCE, a DCP will select equipment complying with its obligation to provide requisite data as per the Standard with respect to quality, resolution, accuracy, and timing requirements.

AEMO believes that good practice requires that the scope of testing needs to cover data correctness (e.g. that data is not mis-identified). Use of the wrong data can have as serious a consequence as relying upon inaccurate or poor quality data.

4.39.3. AEMO's conclusion

The current testing scope should include testing for data correctness and AEMO proposes to update section 6.5 of the Standard accordingly.

4.40. Burden of testing requirements for new generators

4.40.1. Issue summary and submissions

A stakeholder suggested that the level of testing required for new generators is onerous.

In submissions, Delta Electricity suggested that the Standard only needs to describe conditions of data communications as necessary for AEMO's secure operation of the NEM to avoid unnecessary cost burden to participants in the NEM. Energy Queensland added that if data points have already been fully tested during the commissioning phase, there is no need for full retesting to AEMO.

4.40.2. AEMO's assessment

AEMO agrees that the Standard need only require testing that allows AEMO to meet secure operation obligations, and that testing should be undertaken as part of the normal commissioning processes for new, upgraded or replacement equipment. There is no need to retest unless specific issues have been identified.

4.40.3. AEMO's conclusion

No change is proposed to the Standard on this issue.

4.41. Definition of an upgrade

4.41.1. Issue summary and submissions

A stakeholder noted that Section 6.4 of the current Standard is not clear on what constitutes an "upgrade".

ElectraNet and Energy Queensland did not see the need to make changes to the definition of an "upgrade" suggesting that the current wording is adequate and clear. Delta Electricity added that Rule 5.3.9 may apply here and therefore further clarification of an upgrade may not be required in the Standard. CS Energy would like to see material change defined with an appropriate threshold.

4.41.2. AEMO's assessment

AEMO agrees with the majority of submissions on this issue indicating no further clarification is required. AEMO is concerned that an attempt to set a materiality threshold risks either including or excluding upgrades inappropriately, and considers it is appropriate to rely on a common sense interpretation.

4.41.3. AEMO's conclusion

No change is proposed to the Standard on this issue.

4.42. Use of standard test procedures

4.42.1. Issue summary and submissions

A stakeholder commented that the requirement under section 6.4(c) of the current Standard is unclear and that for sake of efficiency it should encourage the use of standard test procedures.

Three of the four submissions on this issue were generally of the view that standard test procedures and procedures should be adopted by the industry. Delta Electricity considered that section 6 should not be in the Standard at all but belongs in the performance standard compliance template or some other industry guide on data communications system maintenance.

4.42.2. AEMO's assessment

The Standard should not contain procedures for testing. It should only set the requirement for testing, and it is for each DCP to determine how to meet the Standard for its equipment. AEMO does consider it appropriate for section 6 to remain in the Standard, however, as the GPS compliance regime is only applicable to a subset of DCPs and would not address the necessary coordination requirements in any event.

4.42.3. AEMO's conclusion

No change is proposed to the Standard on this issue.

4.43. Scope of augmentations required to be advised under the Standard

4.43.1. Issue summary and submissions

It was suggested that due to the changing nature of the power system, the requirements for advice on augmentations under the Standard need to be increased.

Energy Queensland stated that data updates regarding network augmentation are typically managed by the TNSP (or DNSP) independent of the Standard. ElectraNet was of the view that provision of timely information on communication system changes is becoming more critical with increasing complexity of the power system. Delta Electricity added that NER 5.3.9 may be relevant in addressing this question.

4.43.2. AEMO's assessment

Currently there is a 15-day notification for minor augmentations and 30 days for major augmentations. AEMO is currently not aware of any significant issues that would require changes to current notification period.

The scope of NER 5.3.9 is limited to generators intending to alter their generating systems. While it may well cover changes to RCE or RME associated with a generating system, it is not generally applicable to other DCFs.

4.43.3. AEMO's conclusion

No change is proposed to the Standard on this issue.

4.44. Specification of testing environments for data links

4.44.1. Issue summary and submissions

Some stakeholders have suggested that the Standard needs to require the provision of an appropriate testing environment for data links.

CS Energy and ElectraNet submissions strongly supported the provision of a testing environment for adequate and timely testing of data links. Energy Queensland also considered a testing environment may be helpful, but not necessarily specified in the Standard. Delta Electricity reiterated its view that section 6 of the Standard fits better as part of the performance standard compliance template or some industry guide on data communication system maintenance.

4.44.2. AEMO's assessment

AEMO considers that the test procedure referred to in clause 6.4(c)(ii) should include a reference to the test environment. The type of test will determine the environment. Some tests are carried out on live production systems and some on dedicated test systems. It is therefore appropriate for the agreed test procedure to specify which system is used, as the Standard itself cannot usefully mandate the test environment for every type of test.

AEMO considers it appropriate for each DCP to be responsible for developing and maintaining a test environment which is fit for purpose.

4.44.3. AEMO's conclusion

No change is proposed to the Standard on this issue.

4.45. Transitional provisions for increased requirements in the Standard

4.45.1. Issue summary and submissions

A number of stakeholders stated that any increased requirements in the Standard need to be transitioned to accommodate additional funding requirements to meet such increased requirements.

Submissions supported transitional provisions for increased requirements in the Standard, in addition to seeking justification for any increased requirements. ElectraNet and Energy Queensland made a number of specific comments with regard to revenue regulation for NSPs to fund additional investment in their facilities, including the need to identify mandatory or discretionary requirements, and the need to accommodate approval of relevant expenditure within the regulatory reset cycle.

4.45.2. AEMO's assessment

Increased requirements generally

As regards justifications for increasing requirements under the Standard, AEMO's approach to this review and consultation on the Standard is explained at the start of Section 4, to frame the discussion of all material issues.

As regards adopting a long-term view, AEMO agrees this would be ideal, but considers it inevitable that the Standard will need to evolve further in coming years due to longer term uncertainties about the development of the market and technological change at the level of detail required for the Standard. That

said, the key proposed changes to the Standard seek to establish a topology that will be more readily adaptable to ongoing changes in the market and power system.

As regards the issue raised on distinguishing between mandatory and discretionary requirements, AEMO believes that all requirements should be mandatory, although in some cases the Standard will provide options to satisfy these requirements. This in consistent with the existing Standard in section 1.1.

Transitional provisions

Where the outcome of this consultation is an additional or more onerous requirement under the Standard, the impact on an individual DCP could vary considerably depending on its current equipment and operational plans. Thus, what constitutes a reasonable period for transition in many cases may need to be determined on a case by case basis within a reasonable maximum timeframe.

AEMO invites submissions from affected DCPs on the aspects of the amended Standard proposed in this Draft Report that they reasonably expect will require a significant implementation cost or delay. AEMO will consider this feedback in finalising appropriate, workable transitional provisions, with the objective of balancing anticipated system security priorities with manageable individual and overall cost impacts.

At this draft stage, AEMO is proposing a process by which increased or additional requirements may be implemented in accordance with a schedule agreed with AEMO, reflecting the implementation effort. To provide a level of certainty, the Standard would set out maximum implementation periods for DCPs, proposed as follows:

- for regulated NSPs, 12 months after the start of the next regulatory reset period after the amended Standard comes into effect; and
- for other DCPs, 2 years after the amended Standard comes into effect unless the DCP is reliant on implementation of enhanced capabilities by an NSP. If this is the case, then this DCP will be required to meet the increased requirement within 12 months of the commissioning of the necessary enhancements by the NSP.

Within the specified maximum periods, the proposed process to determine the actual implementation schedule for a given requirement and DCP would be similar to that used to manage GPS remediation requirements, including the following steps:

1. DCPs must advise AEMO if they are unable to comply with a new or more onerous requirement by the amended Standard effective date.
2. DCP and AEMO will agree a plan (including a target completion date and target dates for key milestones) to achieve compliance. These will take into account, on an objectively reasonable basis:
    - the implications of not meeting the requirement
    - the work required by all relevant parties to address the issue
    - reasonable cost and resourcing constraints.
3. In the meantime, the DCP will still be required to comply with each such requirement to the extent stated in the previous version of the Standard.
4. The DCP will report on progress against the agreed plan at least every six months, or for identified milestones.
5. If a target date for a key milestone in the plan is not met, then AEMO and the DCP will seek to agree further action to improve progress.
6. If DCP and AEMO fail to agree upon a plan or progress against an agreed plan is consistently unsatisfactory, the DCP would be deemed non-compliant with the Standard and AEMO will advise the AER of the situation.

4.45.3. AEMO's conclusion

AEMO proposes to include transitional provisions in the Standard (new section 9) to allow a suitable extended period for compliance with new or more onerous requirements introduced as a result of the current consultation, as described in Section 4.45.2.

4.46. Inclusion of PMU and HSM data

4.46.1. Issue summary and submissions

AEMO's NEM control centres currently use limited real time data from PMUs. In the near future the availability of this real time data from PMUs and HSMs will greatly increase and requirements for the communication of these data types may need to be included in the Standard.

Submissions suggested that the Standard should cover PMU and HSM data if this data is needed by AEMO.

ElectraNet suggested that the Standard should document PMU specifications for use in the NEM, which could be based on the specification provided to ElectraNet by AEMO for the South Australia PMU specification.

Energy Queensland suggested including PMU and HSM requirements in the overall data points list covered by the Standard. It also added that AEMO should contribute towards funding for PMU and HSM data capability.

4.46.2. AEMO's assessment

AEMO agrees that the transmission of PMU and HSM data should be covered by the Standard. This would apply to any PMU or HSM data that is telemetered for real-time operational use as distinct to offline analysis. AEMO considered the inclusion of a new data category within the standard but proposes to include both PMU and HSM data in the definition of High Resolution Data.

When AEMO determines the possible need for PMU and HSM data to be provided, then AEMO will issue a notice to the relevant NSP under NER 4.11.1(d), which will specify the data to be provided and the required specifications for communication of that data. Currently AEMO does not consider it practical in the short term to specify a common set of requirements in the Standard with confidence that they will be suitable for all real-time PMU and HSM data communications. However, this is something that should be considered in the medium term with the benefit of additional experience.

As regards the comment by Energy Queensland that AEMO should contribute towards the funding of PMUs, AEMO notes that the NER require an NSP to comply with any request by AEMO to install or upgrade RME in their networks. Accordingly, NSPs should have the ability to recover their efficient costs of complying with any such requirements through their regulated revenue.

4.46.3. AEMO's conclusion

AEMO proposes to amend the definition of High Resolution Data to include real-time telemetry of PMU and HSM data. The Standard will confirm that the relevant notice issued to the relevant NSP under NER 4.11.1(d), or a subsequent protocol or similar operating document, will specify the minimum requirements for the data to be relayed to AEMO.

4.47. Application of Standard to Small Generation Aggregators

4.47.1. Issue summary and submissions

Some stakeholders noted that the Integrating Energy Storage Systems rule change will enable Small Generation Aggregators (SGAs) to provide FCAS and that the Standard may need to accommodate this change.

CS Energy and Energy Queensland supported coverage of SGAs under the Standard if they are participating in central dispatch. CS Energy added that the coverage must reconcile with the MASS and other relevant specifications to ensure consistency.

Enel X agreed that SGAs will be able to provide FCAS from March 2023 but queried whether changes to the Standard are required.

4.47.2. AEMO's assessment

NER 4.11.1 requires telemetry to be provided by any ancillary service providers in accordance with the Standard, and Dispatch Data includes the status and amount of market ancillary services. Accordingly there is no need to specifically reference SGAs in the Standard where they provide FCAS.

4.47.3. AEMO's conclusion

No change is proposed to the Standard on this issue.

4.48. Changes to accommodate Scheduled Lite

4.48.1. Issue summary and submissions

Some stakeholders identified that the Scheduled Lite Visibility Model to provide visibility to AEMO of the output in the form of five-minute data may be required in the next year and this may need to be accommodated in the Standard.

It was also noted that the Scheduled Lite Dispatchability Model is expected in 2024-25 to enable distribution connected aggregated DER to participate in central dispatch.

Only Enel X commented on Scheduled Lite issues, and its observations related to the visibility and dispatch model. Whilst Enel X agrees that the Scheduled lite rule (if made) would have implications for the Standard, it understands the model is still in development and believes it is too early to be discussing what changes to the Standard might be required.

4.48.2. AEMO's assessment

Any future telemetry options associated with Scheduled Lite must comply with the security and reliability requirements defined in the Standard. The current Standard has been developed around the use of Intervening Facilities which can provide robust telemetry services even in the event of a loss of supply in one or more NEM regions. For instance in recent major events data communications have been maintained for about ten hours despite loss of supply. It is desired that all telemetry of *Operational Data* should meet this requirement, whether using an Intervening Facility or alternate telemetry options.

However, it is appreciated that setting such a requirement for some non-NSP Intervening Facilities may be unreasonable. Thus it is proposed that in such cases the Standard will allow an option for transmission of data directly to AEMO via the public internet. AEMO considers that these provisions can be established in the Standard now, as the outcome of the Scheduled Lite model and eventual rule will not affect them.

Transmission of data via the public internet has certain risks:

1. Reliability of connection for a single participant is likely to be lower.

2. Loss of an internet service provider may lead to loss of communication with multiple participants.
3. Widespread loss of supply may also lead to loss of communication with multiple participants at a time when such communication may be most important.

To manage these risks AEMO proposes to limit the ability of non-NSP DCPs to establish a connection to AEMO over the public internet by reference to:

- the type of data and size of an individual participant in a given category which can provide data via the public internet (due to risk 1 above); and
- the regional aggregate of capacity in a given category which depends upon data communication over the public internet (due to risks 2 and 3 above).

These will be determined by AEMO separately for each relevant participation type and are expected to be similar in form to those already in place for aggregate level of Wholesale Demand Response for which telemetry is currently not required[17].

4.48.3. AEMO's conclusion

AEMO proposes to specify a process in the Standard to establish an Intervening Facility with a connection to AEMO over the public internet, and therefore with lesser reliability. This may be available in limited cases where no alternative transmission path is feasible and subject to review by AEMO including consideration of compliance with required cyber security measures and individual size limits and aggregation limitations in each region.

4.49. Future requirements for provision of real time data from AEMO to participants beyond current control signals

4.49.1. Issue summary and submissions

One stakeholder suggested that in the future there may be a requirement for AEMO to also provide real time data to participants beyond current control signals.

CS Energy supported regular review of the Standard that reflects a proactive rather than a reactive approach.

Energy Queensland submitted that If AEMO is providing real time data to participants, then it should be included in the detailed points list.

4.49.2. AEMO's assessment

The telemetry of real-time Operational Data back to participants, in accordance with the Standard, should only include remote control or monitoring equipment under the direct or indirect control of that organisation. This capability already exists via ICCP.

4.49.3. AEMO's conclusion

AEMO does not propose any amendments to the Standard for this issue.

4.50. Requirements for provision of real time power system data to NSPs

4.50.1. Issue summary and submissions

Whilst provision of real time data to NSPs from generators and others is not within the scope of the Standard, it remains part of the overall data communications process in the NEM. For instance, even where

[17] Refer WDR Guidelines Sect 3.2 Wholesale Demand Response Guidelines - draft - Jan 2021 (aemo.com.au)

a generator is required to provide real time data directly to AEMO, its NSP will almost certainly require provision of the same data.

ElectraNet is supportive of including this requirement in the Standard. ElectraNet added that this data is required in order for TNSPs to perform their functions in ensuring system stability. It is unlikely that the latency of receiving this data via AEMO will be adequate for real time power system management needs.

Energy Queensland's view is that this requirement should be covered by connection standards and connection agreements between participants and NSPs. Energy Queensland's DNSPs are already doing this.

4.50.2. AEMO's assessment

AEMO considers that the real-time telemetry of Operational Data from between NSPs and connected participants can be managed through arrangements in their connection agreements. It is AEMO's preference that the NSP obtain the data directly from the relevant participant, which reduces data latency for the NSP's purposes and also has the benefit of enhancing the overall resilience of the data communications system. However, in the absence of a direct connection to the NSP as the Intervening Facility, or any requirement to provide Operational Data in accordance with a connection agreement, AEMO can be requested to provide telemetry via ICCP for generators within the area of direct or indirect operational oversight. This capability already exists where required, subject to approval from the connected party.

4.50.3. AEMO's conclusion

No changes are proposed to the Standard for this issue.

4.51. Factors to take into account in assessing the costs and benefits of enhancements to the Standard

4.51.1. Issue summary and submissions

Enhancements to the Standard will bring benefits but also may result in increased costs to the industry and ultimately consumers. It is possible that costs may be disproportionate in the case of enhanced requirements for smaller participants. However, the necessity for those requirements may increase as the relative numbers of smaller participants increase.

CS Energy suggested that the national electricity objective (NEO) principles should be applied to ensure that the costs and benefits are appropriate. Energy Queensland suggested that AEMO should take the following factors into consideration:

- Resource availability.
- Timeframes for implementation.
- Multiple Intervening Facilities - the participant may not only be required to pay their own costs, but also those of the DNSP and TNSP.

ElectraNet saw this topic as requiring further consultation based on the options being proposed.

4.51.2. AEMO's assessment

AEMO's approach to this review of the Standard is described at the start of Section 4, including principles and considerations for any changes in the requirements applied to DCPs.

AEMO considers that the Standard should reflect good engineering practice in relation to the communication links that it regulates, and good electricity industry practice in power system operation, as applied to the current and reasonably anticipated system and market conditions in the NEM. Requirements

that do not meet these benchmarks will compromise power system security in the longer term and would be inconsistent with the NEO. Participants are best placed to meet the Standard as efficiently as possible, noting that changes may also facilitate medium and longer term efficiencies and lower barriers to entry for the NEM.

4.51.3. AEMO's conclusion

AEMO welcomes information from DCPs on the implementation costs and benefits of the amendments proposed in this Draft Report.

4.52. Required changes to the current NEM power system data communications structure?

4.52.1. Issue summary and submissions

The current architecture for NEM power system data communications is a hierarchical structure:

1. Embedded scheduled generator communicates to DNSP via DNSP SCADA system
2. DNSP transfers data to its TNSP via dedicated data communication links
3. Transmission connected generators communicates to TNSP via TNSP SCADA system
4. TNSP transfers data to AEMO via dedicated communication links.

In the near future, a growing number of embedded battery generation, aggregated DER and VPP connections will need to be accommodated. Some stakeholders believe that this will mean that the current data communications structure will be no longer be fit for purpose.

Submissions noted the challenge of keeping up with the evolving technology. This may require changes in the Standard in areas such as:

- Accommodating growing participation of DER/VPPs and data exchanges with these assets (already a real issue in the NEM) requires new architecture and protocols. It was noted the anticipated Schedule Lite rule change may be the appropriate forum to discuss these changes.
- There should be a focus be on proper implementation of the demand side response mechanism.
- DNSPs are introducing Distributed Energy Resources Management Systems (DERMS) as an independent system to their DMS/SCADA systems. Consideration should therefore be given as to whether AEMO should be communicating directly with the DNSPs' DERMS (and those of other NSPs) in addition to the current connection to AEMO via TNSPs.
- Further clarification is needed on how different parties will connect to AEMO, e.g. where to connect the DER, DNSP or TNSP or AEMO, and whether this is size or capacity dependant.
- If generators are able to connect directly to AEMO, the Standard should ensure that the data is still delivered to the relevant NSP.

4.52.2. AEMO's assessment

It is clear that changes to the current hierarchical architecture of the NEM power system data communications system are necessary to address the changing nature of the power system. However, in considering appropriate changes it is necessary to balance:

- the need to ensure that costs of these changes are minimised by avoiding unnecessary duplication and allowing use of the latest technology, and
- the need to enhance the resilience of the data communications system during events such as major equipment failures or interruption of external ac supply to communications facilities.

The changes proposed to the Standard in this Draft Report attempt to achieve an appropriate balance between these two factors. AEMO also recognises that the Standard should facilitate, or at least not be inconsistent with, the achievement of relevant regulatory requirements set in the NER or other instruments.

The major proposed changes in architecture in this Draft Report are described below.

- DNSPs will be required to:
  - Provide the services of an Intervening Facility to connections within their network.
  - As an Intervening Facility, collect and relay data from RME and relay control commands to RCE.
- A DNSP Intervening Facility to have the option to directly connect to AEMO via secure ICCP, noting in some cases this might be necessary to be able to meet the performance requirements in the Standard.
- The Standard will also facilitate arrangements where, if practical and agreed by all relevant parties, the DNSP Intervening Facility directly connects to one AEMO control centre and connects to the other AEMO control centre via the TNSP Intervening Facility. This arrangement has the benefit of efficiently maintaining data flows between NSPs and enhancing resilience of the data communications network.
- For other DCPs, such as aggregators, that do not have obligations or options to provide telemetry to an NSP through connection agreements or other arrangements, AEMO will provide the ability for the DCP to connect directly. The DCP would be expected to concentrate all data from remote equipment to deliver the aggregated data required by AEMO control centres, in a facility which will be defined in the Standard as a non-NSP Intervening Facility. For further details refer to Section 4.12.3.

For further details on these proposals refer to Sections 4.11 to 4.15, 4.52 and 4.53.

These changes are intended to better accommodate changes likely to occur in the medium term (such as expecting to facilitate initial stages of Scheduled Lite[18]). Longer-term changes are anticipated and likely to arise through reforms being considered in the Energy Security Board | Post 2025 electricity market design project and informed through industry trials such as, but not limited to, Project Edith , Project Edge and the Integrating Energy Storage Systems Project[19].

However the nature of these longer-term changes is not yet known at the level of detail required for this Standard. Thus the Standard will need to continue to evolve. For this reason, as discussed in Section 4.57, AEMO proposes to hold annual workshops to address the performance of the Standard and the need for further change.

4.52.3. AEMO's conclusion

AEMO will amend the Standard to include the provisions described in Section 4.52.2.

4.53. Preferred data protocols for direct communication with AEMO by generators and other participants

4.53.1. Issue summary and submissions

It was noted that under the current architecture, the only communication protocol supported for connection to AEMO is the ICCP protocol. If a change in the data communications structure is required, then it may be necessary for the Standard to accommodate alternative protocols for connection to AEMO. This is because the ICCP protocol is designed for data communication between control centres and would not be suitable if a generating unit were to communicate directly with AEMO.

[18] Refer also Section 4.48

[19] Forming part of the Energy Security Board's (ESB) National Electricity Market (NEM) 2025 reform portfolio, the Integrating Energy Storage Systems rule seeks to better integrate storage into the NEM. This rule change will come into effect on 3 June 2024 but the proposed changes to the standard are expected to accommodate this. Refer also AEMO | Integrating Energy Storage Systems project

There was support in submissions for utilisation of proven standard industry protocols subject to the requirements. Protocols suggested for consideration were MODBUS/MMS/DNP3/Routed GOOSE. Consideration of other emerging protocols such as IEC61850 and IEEE2030.5/CSIP was also recommended. Enel X and others indicated the preferred protocol is DNP3.

CIGRE AU noted that a change in protocol could impact existing security solutions, e.g. IPS/application scanning. Enel X added that any new protocol must be something that AEMO itself can support (from both a technical and resourcing perspective) and ideally something that can be implemented in a timely and cost-effective manner and meets future needs.

4.53.2. AEMO's assessment

Direct connection of DCPs such as aggregators is discussed in Section 4.13. For clarity, the connection to AEMO will be via a suitable Intervening Facility, not directly to individual RME/RCE in the field.

AEMO understands that DCPs wish to connect to AEMO directly using protocol/s other than secure ICCP due to technical and cost factors. While AEMO does not currently support other protocols, it acknowledges the likely cost advantages across industry of a protocol for smaller data connections. Of the protocols suggested in submissions AEMO believes that the secure version of DNP3) would functionally meet the requirements and be the most cost effective at AEMOs end to support at this stage.

Noting the enhancements to the DNP3 Secure Authentication protocol over time, only versions of DNP3-SAv5 and above would be supported and configuration of algorithms and protocols should be aligned to recommendations from the Australian Signals Directorate (ASD) approved protocols and algorithms as detailed in their Guidelines for Cryptography advice.

It is appreciated that, as protocols evolve, additional protocols might become more effective and feasible for AEMO to support. It is proposed that the Standard should include sufficient flexibility for AEMO to support additional protocols in future without the need to amend the Standard itself.

4.53.3. AEMO's conclusion

AEMO proposes that the Standard include the option for use of the DNP3 Secure Authentication protocol (versions of DNP3-SAv5 and above) as an option where the Standard allows for direct connection to AEMO control centres and the ICCP protocol is not suitable.

This direct connection would be a single connection for each such participant with the participant expected to concentrate all required data in a facility which will be defined in the Standard as a non-NSP Intervening Facility. For further details refer to Section 4.12.3.

AEMO proposes to include in the Standard a provision which allows AEMO to maintain an information resource that may specify additional protocols that will be supported for direct connection of non-NSP Intervening Facilities to AEMO control centres.

4.54. Criteria for determining a single communication protocol in addition to secure ICCP

4.54.1. Issue summary and submissions

AEMO asked what criteria it should use to determine the most suitable protocol if, for cyber security or other reasons, only one could be accommodated in addition to secure ICCP.

Submissions suggested that any new protocol must be available to and accessible by all participants, allow DCPs to fulfill their respective obligations, is cost effective to implement and meets future needs including those that may result from Schedule Lite. DNP3 was generally cited to be a preferred option overall,

although Energy Queensland suggested a protocol like IEEE2030.5/CSIP is most likely the best suited for future requirements.

4.54.2. AEMO's assessment

As noted in Section 4.15.2, ICCP was designed to standardise communications between control centres, although ICCP applications now also include communication between control centres and power plants and substations. However, it is understandable that technical and other considerations may favour a different protocol where there is a need for smaller DCPs to connect to AEMO control centres directly.

Section 4.13 discussed the offering of a direct connection and Section 4.54. discussed offering a secure DNP3 protocol as an alternative to ICCP, based on current usage and feasibility for AEMO to support. AEMO believes at this stage a secure DNP3 protocol represents an appropriate extension to the Standard to support the provision of Operational Data to AEMO by aggregators and generators where the DNSP does not support the data transmission service.

The IEEE2030.5/CSIP protocol is emerging and actively being considered in standards for interoperability between DERs, aggregators and networks, however, at this stage there is limited adoption by industry.

On the hand the DNP3 protocol is well established and commonly used between components in process automation systems, including for electric utilities. The DNP3 protocol is considered to have significant features that make it more robust, efficient, and interoperable than older protocols such as Modbus.

AEMO thus proposes at this stage to support a secure version of DNP3 as an alternative to the ICCP protocol for direct connections to AEMO from equipment that is not suitable for the ICCP protocol.

4.54.3. AEMO's conclusion

AEMO proposes to include in the Standard an option for use of the DNP3 Secure Authentication protocol (versions of DNP3-SAv5 and above) as an option where non-NSP Intervening Facilities are permitted, and their equipment is not suitable for the secure ICCP. For further details refer to Section 4.12.3.

Additional issues from submissions

4.55. Definition of analogue value

4.55.1. Issue summary and submissions

Energy Queensland submitted that use of the term 'digital representation' implies a Digital or Status indication, which is different to the intent. Energy Queensland suggested replacing the word 'digital' with 'numeric' in the Standard's definition of Analogue Value.

4.55.2. AEMO's assessment

The term 'digital representation' was intended to indicate a value that had been converted to digital form for transmission via a SCADA protocol. AEMO agrees that 'numeric' also conveys that intent and may be a clearer term, avoiding any potential ambiguity.

4.55.3. AEMO's conclusion

AEMO proposes changing the definition of Analogue Value in the Standard to replace 'digital' with 'numeric'.

4.56. Data quality

4.56.1. Issue summary and submissions

Hydro Tasmania suggested that, as well as the use of data quality flags, a clear definition is required on what good data quality entails. More specifically, it suggested a definition of the point in the data stream at which data quality standards would apply.

4.56.2. AEMO's assessment

The Standard requires the provision of data quality indications in accordance with communications protocols. AEMO agrees the Standard would benefit from more detail specifying data quality requirements contributing to availability.

AEMO considers that provision of poor quality data has the similar effects on operations of AEMO's systems as the failure to receive data as all. For this reason the outage definition should treat delivery of poor quality data in the same manner as failure to deliver.

4.56.3. AEMO's conclusion

AEMO proposes that loss of good quality data will constitute an outage event and current outage monitoring provisions will apply. AEMO also proposes that the outage definition will be updated, and 'Good Quality' defined in the Standard. Refer also to Section 4.20.

4.57. Ongoing review of Standard

4.57.1. Issue summary and submissions

Hydro Tasmania suggested that due to the rapid change of the electrical power industry, it may be necessary to introduce a more responsive consideration of the Standard, such as six-monthly forums to identify developing issues.

4.57.2. AEMO's assessment

AEMO agrees that a more responsive consideration of the Standard is necessary. However, precisely due to the quantity and rate of change that both AEMO and participants need to consider and implement, six-monthly forums at present are unlikely to be manageable. AEMO considers that an annual cycle is more appropriate.

4.57.3. AEMO's conclusion

AEMO proposes to organise annual forums to identify developing issues and help determine whether a formal review of the Standard should be initiated[20].

4.58. Data for power system modelling

4.58.1. Issue summary and submissions

ElectraNet suggested that the future complexity of network and inter-relationships between wider NEM and transmission and distribution networks will require a greater level of widespread modelling by all participants. ElectraNet considered it would be more efficient to minimise duplication of this modelling effort and align the assumptions made about device status and ratings by entities sharing their models, the device status, ratings, power flow, voltage levels etc. They proposed that the Standard should also

[20] A formal review of the Standard requires significant resources and thus, whilst the workshops are intended to be held annually, formal reviews are likely to be conducted no more frequently than every two years unless there are significant relevant reforms.

contemplate whether that sharing is facilitated directly between participants or whether AEMO has a role to play to provide a centralised repository and access and how that would work through appropriate protocols.

4.58.2. AEMO's assessment

Power system modelling is important across a wide range of power system planning and operational activities beyond provision of real time data. For this reason the quality and sharing of power system models must continue to be managed by more centralised processes outside of the Standard.

4.58.3. AEMO's conclusion

As power system modelling and issues of model sharing, have significantly wider implications beyond data communication, AEMO considers it is not within the scope of the Standard to address the issue.

4.59. Specific NSP obligations

4.59.1. Issue summary and submissions

SA Water submitted that, due to the security and investment efficiency advantages (for all network users) of having fully functional (and Standard compliant) ICCP data links in place between TNSPs, DNSPs and AEMO, and the likely increase in the number of NEM connected generation and BESS facilities looking to participate in FCAS and other ancillary markets, the Standard should be amended to place a clear, regulatory obligation on all NSPs (TNSPs and DNSPs alike) to ensure that:

- they have a Standard compliant ICCP link between their network and AEMO at all times (to ensure generators, BESS facilities and load facilities (including demand response providers) connecting to their network have access to a reliable, secure, and cost effective AEMO data link at all times;
- in order to be Standard compliant, the ICCP data link between AEMO and each NSP is able to exchange all AGC and all other generator/BESS and load (including demand response) signals as per Chapter 4, 5 and any applicable AEMO guidelines from time to time (including the Standard);
- adequate information about these data links is provided to each connecting party at the connection enquiry phase, together with information relating to the kinds of data which needs to be communicated between the generator/BESS/load and AEMO for access to different markets; and
- access is granted to the data links on reasonable (and commercial) market-based terms and conditions.

4.59.2. AEMO's assessment

AEMO's consideration of the issues and suggestions made by SA Water is set out in Sections 4.11 and 4.17.

4.59.3. AEMO's conclusion

Refer to Sections 4.11 and 4.17.

5. OTHER MATTERS AND FURTHER WORK

5.1. Drafting improvements

In the course of amending the draft Standard to reflect AEMO's conclusions on the material issues discussed in Section 4, AEMO has undertaken a broader review of the Standard, resulting in several drafting changes for improved clarity, consistency, and readability. These include updates to reflect NER

changes, re-ordering of some provisions and additional explanatory text. Examples of some of the more substantial changes are:

- Inclusion of a section-by-section overview of the Standard's content and application (section 1.7).
- Redefining force majeure to be more certain and fit-for-purpose, removing it as an exclusion from the definition of critical outages and instead explaining the consequences of force majeure events in section 3.1.
- Addressing High Resolution Data in each data-specific requirement of section 2, with section 2.1(c) explicitly excluding real-time PMU and HSM data.
- Removing 6.2(e), which implied planned outages did not require notification unless they were critical, noting inconsistencies with the exclusions already the definition of critical outages.

5.2. Further work

In considering a number of the issues raised in Section 4, AEMO has committed to further work outside of this consultation. This includes the following:

- AEMO will consider the development of an industry guideline to provide more specific details on the data requirements for different types of DCP and types of data depending on use (refer Section 4.1).
- Review of the information currently provided to new connections regarding data communication requirements to see where it could be improved (refer Section 4.12).
- Engagement with stakeholders with regard to the proposed way forward with clamping of SCADA MW values (refer Section Error! Reference source not found.).
- Examination of the issues raised by CS Energy on the dispatch conformance alert system and detailed aspects of operation of the AGC, considered outside of the scope of the Standard (refer Section 4.27).
- Investigation of options to improve monitoring and reporting to provide increased assurance that requirements of the Standard are being met (refer Section 4.35).
- Development of a "Real-time data equipment measurement guide" (refer Section 4.37).
- As required, development of guidelines and restrictions on use of the public internet for relevant DCPs (refer Section 4.48).
- Organisation of annual forums to identify developing issues and help determine whether a further formal review of the Standard should be initiated (refer Section 4.57).

6. DRAFT DETERMINATION

Having considered the matters raised in submissions, AEMO's draft determination is to amend the Power System Data Communications Standard in the form published with this Draft Report, in accordance with clause **4.11.2(c)** of the NER.

A marked-up copy of the draft Standard is also available, noting that there are a significant number of changes both in relation to the material issues and the general drafting review undertaken by AEMO.

AEMO proposes that the amended Standard will take effect from 3 April 2023, subject to the proposed transitional arrangements where applicable.

APPENDIX A. GLOSSARY

Term or acronym	Meaning
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AESCSF	Australian Energy Sector Cyber Security Framework
AEST	Australian Eastern Standard Time
AGC	Automatic Generation Control
ASD	Australian Signals Directorate
BESS	Battery Energy Storage System
CB	Circuit Breaker
Consulted Persons	Registered Participants and interested parties
DCF	Data Communication Facility
DCP	Data Communication Provider
DER	Distributed Energy Resource
DERMS	Distributed Energy Resource Management System
DLR	Dynamic Line Ratings
DNP3	Distributed Network Protocol 3
DNSP	Distribution Network Service Provider
Draft Report	Draft Report and Determination
DRSP	Demand Response Service Provider
DSCP	Double Sided Causer Pays
DTR	Dynamic Transformer Rating
EMS	Energy Management System
FCAS	Frequency Control Ancillary Service
FFR	Fast Frequency Response
GPS	Generator Performance Standards / Global Positioning System
HSM	High Speed Monitor
ICCP	Inter-Control Centre Protocol
IF	Intervening Facility
kV	kilovolts
LOLS	Line Overload Load Shedding
MASS	Market Ancillary Service Specification
MW	megawatt
NEM	National Electricity Market
NER	National Electricity Rules
NSP	Network Service Provider
PFR	Primary Frequency Response
PMU	Phasor Measurement Unit
PTP	Permission to Proceed

Term or acronym	Meaning
QoS	Quality of Service
RAS	Remedial Action Scheme
RCE	Remote Control Equipment
RME	Remote Monitoring Equipment
RPC	Reactive Plant Control
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SGA	Small Generation Aggregator
SML	SCADA Minutes Lost
SOCI	Security of Critical Infrastructure Act
SPS	Special Protection Scheme
Standard	Power System Data Communications Standard
TI	Trading Interval
TNSP	Transmission Network Service Provider
UFLS	Under Frequency Load Shedding
UTC	Coordinated Universal Time
VPP	Virtual Power Plant
WAN	Wide Area Network
WDR	Wholesale Demand Response
WDRM	Wholesale Demand Response Market

APPENDIX B. SUMMARY OF SUBMISSIONS AND AEMO RESPONSES

No.	Issue	Submissions	AEMO response
1.	Does the Standard need to be more specific on the range of data covered by the Standard?	AGL: No comment. CIGRE AU: "The standard needs to be more specific on emerging connections, for example the standards specifically for generators or DNSPs, and how these differ (if they do) from exiting connections. The standard should remain broad so that it doesn't create adverse limitations based on technology changes. A guideline document that outlines how the standard applies to a specific DCPs with some example scenarios for different types and levels of DCPs would provide greater clarification for consumers of the standard." CS Energy: "CS Energy notes that currently the Standard does not itself set obligations as to the data that must be provided to AEMO. Consideration should be given to the inclusion of data requirements that are in addition to obligations set by other provisions in the National Electricity Rules (NER), such as access standards." Delta Electricity: "The standard only needs changing if it is failing, for all participants, in any specific area required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. Having a wish list of improvements is understandable but if the standard is functional and the improvements will cost the NEM, best avoid the improvements. Improvements that have demonstrable (by AEMO or participants) need must be substantiated in the final determination including the comparisons of the potential costs versus the benefit." ElectraNet: "No comment, ElectraNet is comfortable with the existing mechanisms used in determining the measurements that need to be provided." Enel X: No comment. EQL: "Energy Queensland agrees that the Standard needs to provide a definitive points list, rather than just "Operational Data required by AEMO" to provide greater certainty for participants. It may be appropriate to include a points list as an Appendix or in a separate document. (It is noted that this may already be covered under the ABC and AGC Interface Requirements Technical Specification.)" Hydro Tasmania: "As an existing and established generator, Hydro Tasmania supports the aim of ensuring that the standards maintain a high quality, safe, reliable, and secure data transmission system." SA Water: SA Water notes that the type of data covered by the Standard and the relevant definitions are quite broad. Whilst this enables maximum flexibility, wherever possible, SA Water view is that greater clarity should be provided to ensure that all parties reading the Standard fully understand their obligations. Standard should: (a) clearly specify that the Standard separately covers data exchanges: (1) between DNSPs and AEMO; (2) between TNSPs and AEMO; (3) between connecting (or connected parties) and AEMO (including AEMO direct link);	*Refer to Sections 4.1, 4.11 to 4.13, 4.52*

No.	Issue	Submissions	AEMO response
		(4) between connecting (or connected) parties and DNSPs; and (5) between connecting (or connected) parties and TNSPs; (b) expressly require that all DCFs of all DNSPs and TNSPs (located anywhere in the communication path) have the capability to exchange all: (1) (Generator/BESS signals): generator/BESS signals, including AGC signals and all other generator signals as required by r 4.11.1(a), r 4.11.1(b) and S5.2.6 of the NER (Generator Signals); and (2) (Load signals): load signals, including demand response signals as required by r 4.11.1(a), r 4.11.1(c1), and S5.3.9 of the NER (Load Signals), with AEMO for the purpose of assisting and facilitating "Operational Data" exchanges between AEMO and the parties which are connected to the NSP's networks. It should also be drafted in such a manner to provide that such capability must be in place at all times for the NSP to be compliant with its obligations in r 4.11.2. Powerlink: No comment.	
2.	Does the definition of power system data need to be extended?	AGL: No comment. CIGRE AU: "Seek better clarification as to whether both conditions need to be true to be identified as a Power System Data or whether it is an and/or. Are DNSPs that connect to AEMO covered by this standard even if less than the voltage stipulated? Are small generators that connect to AEMO either via DNSPs or directly also covered by this standard even if they don't meet the definition for a Power System? Are Virtual Power Plants covered by this standard? All require clarification in the standard." CS Energy: "The definition should be extended to include identified requirements reflecting current gaps and anticipated requirements arising from the changing dynamics of the NEM with regular reviews to capture evolving requirements not yet identified." Delta Electricity: "If the application of the standard is desired (by AEMO and/or proposed applicants) to occur to generators, NSPs or large loads where the standards don't apply because of the restrictions implied by points 1. and 2. of the existing standard it would seem to be a necessity. Wouldn't power system data simply be any data that is necessary for the secure operation of the power system and therefore include some AEMO control and indication data not defined in the present definition?" ElectraNet: "In the case that the definition changes and additional data points are to be onboarded the costs for the design and implementation of this need to be considered." Enel X: No comment. EQL: "Energy Queensland questions whether there is a need for separate definitions for 'Power System Data', 'Dispatch Data', 'Other Data' and 'Operational Data' or whether they could all be grouped under one extended definition. Alternatively, it may be appropriate to consider using terms like 'DER Data', 'Transmission Data' and 'Distribution Data'."	Refer to Sections 4.1, 4.2, 4.57

No.	Issue	Submissions	AEMO response
		Hydro Tasmania: No comment. SA Water: (a) There does appear to be some circularity with the definition of "Power System Data" and "Other Data" which needs to be clarified (see in particular the reference to Power System Data within the definition of Other Data). (b) In addition, the definition of "Power System Data" needs to be amended to specify (or at least provide examples) the types of data which are intended to fall within this definition, rather than simply referring to 'data concerning plant'. (c) The issue raised in the Issues Paper around this definition not extending to embedded generators seems to be inconsequential in that 'power system data' for plant operating at 220kV or less is covered in the definition of "Other Data". It also seems to be the intent that this includes the same type of data as the definition of Power System Data (and therefore included in the definition of "Operational Data"). (d) Regardless, if the intent of the "Power System Data" definition is intended to delineate between TNSP and DNSP, it is noted that the transmission network in South Australia operates at below 132kV in certain locations. Powerlink: No comment.	
3.	Does the definition of control commands need to be extended?	AGL: No comment. CIGRE AU: "We wouldn't want to lock ourselves into specific commands here either." CS Energy: "CS Energy supports the development of an updated definition with AEMO initially producing a list of current and expected control commands to be reflected in the updated definition." Delta Electricity: "The wording of the definition seems obscure. The work control means something as does the word command. Neither mean "representation" but rather that word is attempting to describe how the commands are converted to signals and transmitted to the object for the control. It is also confusing when used with Analogue value above it because some control commands will be analogue values so neither definition is adequate at present. Follow some control system definitions for analogue signals (which can be still relevant in this standard), analogue to digital converter, digital to analogue converter and these sorts of terms commonly known to control and instrumentation technicians." ElectraNet: "No comment, ElectraNet is comfortable with the current definition." Enel X: No comment. EQL: "As the term 'control commands' and what it encompasses is well understood within the industry, Energy Queensland does not consider that the definition requires amendment." Hydro Tasmania: No comment. SA Water: (a) From SA Water's perspective, this definition is already quite clear. (b) However as mentioned above, wherever possible, greater specificity should be provided to ensure the responsibilities of all DCPs are fully understood and not 'open to interpretation'. As such, to avoid doubt, we believe this definition should be amended	Refer to Section 4.3

No.	Issue	Submissions	AEMO response
		to make it clear that this covers all control commands that fall into the "Generator Signals" and "Load Signals" categories mentioned above as a minimum. Powerlink: No comment.	
4.	Do the definitions of RCE and RME need to be extended?	AGL: No comment. CIGRE AU: "Very broad – consider clarification. Consider including overview of the functions of the equipment." CS Energy: "As AEMO stated on page 5 of the Consultation Paper, the definitions do not adequately describe the new technology for data acquisition. The new technology for data acquisition should be reconciled with the identified requirements prior to finalising the updated definition." Delta Electricity: "Aren't these terms Rules Defined? Better make sure the definitions in the Standard do not contradict with the Rules definition which take precedence in a full application and if a different definition is needed a rule change is required. (Rules v177: remote control equipment - Equipment used to control the operation of elements of a power station or substation from a control centre. remote monitoring equipment - Equipment installed to enable monitoring of a facility from a control centre.)" ElectraNet: "The definition may need to be extended in the instance where differentiation is required for Performance and/or Reliability requirements for different types of RCE/RME. Where requirements are consistent across the RCE/RME space further definition is unnecessary." Enel X: No comment. EQL: "Energy Queensland does not treat RCE and RME as separate devices but rather as two functions of the one device. Therefore we do not consider there is a requirement for separate definitions. Energy Queensland refers to the device that performs the RCE and RME functions as a Remote Terminal Unit (RTU) and therefore considers 'RTU' should be considered as a replacement term." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer to Section 4.4
5.	Other than changes required to accommodate additional participant categories identified in clause 4.11.1 of the	AGL: No comment. CIGRE AU: "The ancillary service providers cover this. These groups are sufficient." CS Energy: "The range of Participants must be reconciled and updated with the requirements of the data communications process and reflect the evolving needs of the NEM power system to ensure the integrity of power system operations."	Refer to Section 4.5

No.	Issue	Submissions	AEMO response
	NER, does the Standard need to extend or specify other participants or subgroups within a category?	Delta Electricity: "The standard only needs changing if it is failing, for all participants, in any specific area required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it will cost the NEM for no valid purpose." ElectraNet: "The Standard may need to be extended to include additional categories of data e.g. • Load available on UFLS in a region or sub-region • DER available to shed in a region or sub-region • FFR availability (from BESSs and VPPs). The above parameters assist in the management of Power System Security. There may be additional parameters that may need to be added as the energy transformation progresses." Enel X: No comment. EQL: "Rather than changing the Standard to specify each participant individually, Energy Queensland considers inclusion of a generic statement, such as 'The Standard applies to Participants, including but not limited to:…', would be more appropriate." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	
6.	Should requirements under the Standard be varied according to how critical the data is?	AGL: "AGL believes that the requirements under the Standard should be varied according to how critical the data is. The data should be classified as critical if a non-conformance is required to be submitted after an unplanned outage." CIGRE AU: "No. Data applicability as per power system data definition." CS Energy: "AEMO should consider the development of priorities for the data and group the data accordingly with associated specifications including the management of data outages analogous to outages of primary protection." Delta Electricity: "Data necessary for the automatic control of the system should have a higher standard and a redundancy than data that only provides indication of conditions to human controllers. However, if the latter are heavily relied on by the human controller to manage the system then they have a higher criticality than other data that is not relied on or not relied on often." ElectraNet: "ElectraNet note differentiation of requirements based on different classes of data may introduce unnecessary complication. In this manner it is suggested that any differentiation be done at a high level for instance real time (protection) vs near real time data (control)." Enel X: No comment. EQL: "In Energy Queensland's view, the data requirements set under the Standard should only be varied if the actual requirement is different and the actual requirement should determine the criteria the data must meet. In our view, there may be potential to reduce the classes of data to two or three classes."	Refer to Section 4.6

No.	Issue	Submissions	AEMO response
		Hydro Tasmania: "Hydro Tasmania currently treats all data with the same level of criticality. Whilst we do not oppose changes to data prioritisation, any changes should be considered in the light of ensuring minimal disturbance to the existing system. In the future we can see value in prioritising high frequency data to save bandwidth." SA Water: No comment. Powerlink: No comment.	
7.	Are there examples where AEMO has specified requirements beyond those set in the Standard and how can any potential inconsistencies best be reconciled?	AGL: No comment. CIGRE AU: No comment. CS Energy: "CS Energy would support the inclusion of identified legitimate requirements beyond those set in the Standard to ensure that it remains fit for purpose. Refer to comments above." Delta Electricity: "The MASS is supposed to be more detailed because it is a specification. If there is meant to be a Data Communications Specification, that is a separate question. A Standard should be brief and describe expected performance criteria not specify how data communications is supposed to be constructed." ElectraNet: "No comment, ElectraNet do not recall an event as described." Enel X: No comment. EQL: "Any specific requirements could be itemised in the detailed points list." Hydro Tasmania: "We are of the opinion that standards relevant to the Market Ancillary Service Specification should make reference to the existing standards and documentation, to avoid overlap and discrepancies that can occur across multiple standards, and thus reduce any current inconsistencies." SA Water: No comment. Powerlink: No comment.	Refer to Sections 4.1, 4.7
8.	Are there examples where the Standard has not kept pace with developments in data communications technology?	AGL: No comment. CIGRE AU: "The drawing in section 1.3 implies that an intervening data centre is available and that all connections require primary and backup communications. The drawing is just one example of how DCPs connect to AEMO. Either a guidelines document with examples of different configurations is required and/or the drawing in the document needs to be updated to include more information on the architecture requirements based on current specs. It is confusing as to what redundancy is required within the DCP e.g. from Data Concentrator to RME/RCE, does this require redundancy of only the comms link, redundancy of both the comms link and the RME/RCE – or does the standard need to only define the link to AEMO and the reliability and availability standards are used by the DCPs to make their own decisions on this. e.g. It is unclear if dual RTUs is required by all parties (e.g. a small generator)." CS Energy: "This is a key challenge for both AEMO and Participants to ensure the Standard is reconciled with developments in data communications technology and the requirements keeping pace with evolving NEM developments."	Refer to Section 4.8

No.	Issue	Submissions	AEMO response
		Delta Electricity: "No comment". ElectraNet: "Refer to response under Architectural Requirements". Enel X: No comment. EQL: "In our view, the diagram in section 1.3 of the Standard (General structure of DCFs) is ambiguous and does not reflect current state. For example, the diagram implies that each substation has a primary and backup communications path, which is not correct for most DNSPs." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	
9.	Is there an opportunity for the Standard to encourage enhancement of resilience through design?	AGL: No comment. CIGRE AU: No comment. CS Energy: "CS Energy supports the proactive approach proposed by AEMO. Security and resilience are arguably non-negotiable risks." Delta Electricity: "Design requirements are not the place of a standard but belong in a construction specification. The standard should describe only as much as is needed to guide designers in expectations of the outcome of a design. The outcomes should only be such that are required to meet the objective of data communications required for AEMO to achieve secure operational control of the NEM. If the standard is missing some outcomes necessary for this they should be added but the necessity should also be fully explained. Data communications has appeared to function adequately for 20 years." ElectraNet: "Yes, it could be reasonable to specify maturity expectations within existing frameworks such as AESCSF or ASD Essential Eight Maturity model. The latter may be more appropriate for a standard document such as the PSDCS as the measures specified are technical controls." Enel X: No comment. EQL: "Energy Queensland considers there is an opportunity to encourage enhancement of resilience through design. This could be achieved by amendments to section 4 of the Standard (Security). In our view, the requirements specified in this section are non-negotiable and the language used should reflect this (for example, by amending '... should use reasonable endeavours to address...' to 'must address' in the second paragraph). Consideration should also be given to providing further specification of cyber security requirements." Hydro Tasmania: "In response to the proposition of including resilience-through-design to design security into future systems, Hydro Tasmania would recommend a Standard, as opposed to a generic design. We believe that this would create less disturbance to current participants, as well reducing the potential of a singular security breach to eliminate the entire communication system."	Refer Section 4.9

No.	Issue	Submissions	AEMO response
		SA Water: No comment. Powerlink: No comment.	
10.	Should the Standard set out the consequences for a participant failing to meet its requirements?	AGL: "AGL has been making efforts to submit non-conformances where there have been issues with transmission of SCADA data. It would be appreciated if the obligations were defined/explained more clearly." CIGRE AU: "This should be outlined in the regulations. A guideline document could be useful here – reference to point DCPs in the right direction to get more information on what happens if the requirements are not met." CS Energy: No comment. Delta Electricity: "No. A standard is not the place for such information and neither is a specification. The Law, Regulations and Rules are the place for such information and in fact the words and penalties are already adequate in the Rules for this." ElectraNet: "No, consequences are to be outlined in the NER." Enel X: No comment. EQL: "Energy Queensland agrees that it may be beneficial for the Standard to clearly set out the consequences for participants if they fail to meet requirements. There may also be value in considering a compliance and enforcement regime to ensure participants comply with the requirements of the Standard." Hydro Tasmania: "Hydro Tasmania would encourage a multi-stage response. This would allow a participant to correct any initial breaches to the standard, rather than being immediately deemed non-compliant. We would, however, support consequences to continual, prolonged, or intentional breaches to the standard, to ensure a reliable, safe, and secure data communication system." SA Water: No comment. Powerlink: No comment.	Refer Section 4.10, 4.45
11.	What changes to the current Standard are required to clarify the requirements for DNSPs?	AGL: No comment. CIGRE AU: "It is unclear whether a generator needs to connect via a DNSP / directly with AEMO / or via another means. There are no standards between the generator and DNSP listed. No definitions of lines of responsibility. Who is responsible for upgrade of equipment as required and standards around obsolescence? The performance and the reliability sections should drive this. Is this implied through these sections? If not, it should be more well defined. Agree, the diagram in Section 1.3 does not reflect topologies for DNSP and other. The architecture needs to be more well defined and updated. Agreed – extend the architecture to account for the possibility of more than 1 Intervening Facility." CS Energy: "CS Energy recognises the integral role of the Distributed Network Service Provider (DNSP) in the NEM. AEMO has highlighted the key relevant points. The key will be developing a consistent approach across the NEM for all Participants and update the Standard accordingly."	Refer Sections 4.8 4.11, 4.34

No.	Issue	Submissions	AEMO response
		Delta Electricity: No comment. ElectraNet: "The diagram and text in section 1.3 should be updated to show the end-to-end architecture from generating facility through to AEMO control centre. Inclusion of DER, VPP and ancillary services should be illustrated to show interconnection at appropriate layers based on generating capacity." Enel X: No comment. EQL: Energy Queensland provides the following comments regarding requirements for DNSPs that may require clarification or amendment: • Update diagram in Section 1.3, its ambiguous and it implies each substation has primary and backup communications path which is not correct for most DNSPs. • Furthermore, there is a potential contradiction between Section 1.3 and Section 3.2 (redundant elements), redundant communications paths are not required if reliability requirements in Section 3.1 can be met. • The Critical outage timeframes set out in Table 4, for RME/RCE over a 12-month period, may not always be achievable due to failures in remote locations • Tables 4 and 5 (Total period of Critical outages of Intervening Facility over a 12- month period) do not take into account where there are multiple Intervening Facilities (for example, a solar farm passes data to the DNSP who passes the data to the TNSP who passes the data to AEMO). • DNSPs, and potentially other participants, should be permitted to directly connect to AEMO rather than going through the TNSP. This capability would reduce ambiguity around reliability where there are presently multiple Intervening Facilities. Hydro Tasmania: No comment. SA Water: Standard should include requirement that TNSPs and DNSPs (separately): (1) have their own Standard compliant ICCP link (capable of exchanging all "Generator Signals" and "Load Signals" as defined in previous questions) in place between their network and AEMO at all times (regardless of the number of connecting parties which are using such link); and (2) grant access to such ICCP link to connecting (or connected) parties to enable them to satisfy their obligations in the NER to exchange all such "Operational Data" with AEMO on reasonable, market benchmarked terms and conditions upon request. A DNSP may choose to establish such a link through the relevant TNSP in certain instances in order to be more cost effective, however, this doesn't necessarily need to be addressed in the Standard (provided that it is clear the DNSP must have the required AEMO link in place). The embedded connecting party should only have 1 contractual interface for access to an AEMO data link (with the NSP whose network they are connecting into) and that it does not need to deal with the DNSP and TNSP separately in order to establish its required ICCP link with AEMO.	

No.	Issue	Submissions	AEMO response
		This approach is efficient because TNSPs and DNSPs leverage existing telco assets and promote efficient investment in the NEM, by removing the need for all connecting parties to individually install the DCFs required to establish direct ICCP links with AEMO. This also promotes power system security, by ensuring that connecting parties have access to an established, reliable and secure dual path ICCP link with AEMO at all times. All NSPs must provide a connection party with information (at the connection enquiry response phase) regarding: (1) the types of Generator Signals and Load Signals which may need to be exchanged with AEMO by the connecting party's facility; (2) the NSP's capability to assist the connecting party with the exchange of Generator Signals and Load Signals as a DCP; and (3) the rates and terms upon which the relevant NSP will provide access to its ICCP link to enable the connecting party to satisfy its obligations under the NER. If it is not appropriate for such requirement/s (i.e., regarding the type of information to be provided at connection enquiry phase and the rates and terms on which access is to be granted) to be inserted into the Standard, SA Water suggests this should be considered as part of a separate rule change process. Providing more information at the time of connection is important, as we understand numerous connecting parties assume that the required ICCP link will be established by the NSP under their relevant connection agreement (which seems logical), and this often causes connection delays and unexpected costs to be incurred late in the connection process. It would also have a positive impact if the charges proposed to be charged by the NSP for access, to the extent that they were recoverable by the NSP as an unregulated service, are able to be referred to an independent expert (for market review on a relatively informal basis) to provide the connecting party with comfort that the rates proposed are market based/reasonable. Powerlink: No comment.	
12.	Are there specific examples where the current data communications structure is making it difficult for new connections or embedded participants?	AGL: No comment. CIGRE AU: "New connections from DNSPs – finding it difficult. Challenges around resourcing, no experience connecting in this way and there is no consistent messaging from AEMO around how to connect. This could be more defined in the standard or appropriate guideline document." CS Energy: "Refer to comments above. The key is to avoid surprises arising from the requirements in the Standard or where the Standard is silent on a matter, not imposing additional requirements on the connecting party." Delta Electricity: No comment. ElectraNet: "Whilst there are difficulties in the connection process, in ElectraNet's experience (i.e. transmission level connections) these are overcome." Enel X: "The standard is already not fit for purpose and must be updated to accommodate a new architecture and data protocol as soon as possible. DRSPs have no clarity on the telemetry obligations that would apply to them and	Refer Sections 4.12,4.48 4.52, 4.53,

No.	Issue	Submissions	AEMO response
		thus it would be difficult for DRSPs to assess the costs of participation in the WDRM. The delay in considering this issue by AEMO has driven significant regulatory and investment uncertainty for Enel X over the past 12 months." EQL: "By not allowing participants to directly connect to AEMO, they have no other option than to go through an Intervening Facility that may not be able to prioritise connections to suit the participant. The participant is also then subject to costs charged by the Intervening Facility with little ability to negotiate or seek alternative solutions." Hydro Tasmania: No comment. SA Water: Refer to Issue 11. Powerlink: No comment.	
13.	What difficulties are wholesale demand response providers finding to arranging to be connected for data communications under current arrangements?	AGL: No comment. CIGRE AU: "Clarification of where the connection should come from- is it to DNSP, straight to AEMO, to TNSP? Is this dependant on the capacity? If so this delineation between DCPs connecting to AEMO should be defined. Unclear if there are different arrangements for different types of DCPs." CS Energy: "At this stage, CS Energy offers no comments as it has no meaningful exposure to the area." Delta Electricity: No comment. ElectraNet: No comment. Enel X: "The standard is already not fit for purpose and must be updated to accommodate a new architecture and data protocol as soon as possible. DRSPs have no clarity on the telemetry obligations that would apply to them and thus it would be difficult for DRSPs to assess the costs of participation in the WDRM. The delay in considering this issue by AEMO has driven significant regulatory and investment uncertainty for Enel X over the past 12 months." EQL: "Energy Queensland's understanding is that difficulties may be occurring because connection agreements are finalised without technical and data communication requirements being fully understood. It is important that participants are equipped with a sound understanding of the technical requirements of their project at an early stage." Hydro Tasmania: No comment. SA Water: Refer to Issue 11. Powerlink: No comment.	Refer Sections 4.11 to 4.13, 4.48
14.	What difficulties do DNSPs have in communicating AGC control signals?	AGL: No comment. CIGRE AU: "May be a legacy equipment / system issue." CS Energy: "The Standard is required to be fit for purpose to enable the DNSP to either modify or to ensure the inclusion of requirements in upgraded DNSP Energy Management System (EMS). Based on the current assessment of some DNSPs, there may have to be a transitionary period to enable DNSPs to meet the requirements of an updated Standard."	Refer Sections 4.14, 4.29

No.	Issue	Submissions	AEMO response
		Delta Electricity: No comment. ElectraNet: No comment. Enel X: EQL: "Issues may be experienced with timing / data latency requirements, especially via an Intervening Facility." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	
15.	Is the current ICCP Protocol specified in the current Standard still appropriate?	AGL: No comment. CIGRE AU: "ICCP is for inter-control centre by design. Distributed energy systems need faster communications (DNP3/MODBUS/MMS). This should also be covered in emerging technologies section. The security architecture should be considered as a whole, rather than protocol specific." CS Energy: "Arguably the Standard is appropriate and AEMO needs to answer the above statement regarding security of protocol and how it contributes to the resilience delivered by the Standard. However, it would be beneficial for AEMO to provide definitive guidelines for the implementation of Inter-Control Centre Communications Protocol (ICCP) / secure ICCP." Delta Electricity: "If the standard is meeting the objective of data communication as necessary for AEMO to achieve secure operational control of the NEM no change is required. If not, AEMO must clearly demonstrate how the protocol is not appropriate especially if changing it will cost the NEM." ElectraNet: "Secure ICCP is appropriate for securing data in transit and to some degree for authentication. However, adding additional security to this to verify the integrity of the data (signing of some form) is required to make it truly secure. Further, the security architecture should be considered as a whole, rather than protocol specific." Enel X: Enel X referred to the wholesale demand response mechanism rule made by AEMC in June 2020. Enel X noted that the final rule required AEMO to develop guidelines that, among other things, set out the obligations on DRSPs with respect to the communication of data to AEMO. As pointed out by Enel X, AEMO then commenced consultation on the WDR guidelines and determined that WDR guidelines would reference the Power System Data Communications Standard (which AEMO intended to review and finalise by mid-2021, prior to WDR market start in October 2021). Through this consultation on WDR guidelines Enel X highlighted its concerns that DRSPs have no clarity on telemetry obligations and are expected to implement costly ICCP connection until AEMO completes the review of the communications standard. AEMO then re-iterated its intention to review the communications standard in 2021 which would allow additional lower cost interfaces. Due to the fact that the review did not commence in 2021 DRSPs wanting to participate in the WDRM could either invest to meet existing standard or seek exemption from telemetry obligations and this remains the case today.	Refer Sections 4.15, 4.52, 4.53

No.	Issue	Submissions	AEMO response
		"The delays in the review of the Standard and lack of direction of telemetry requirements have driven significant regulatory and investment uncertainty for Enel X over the past 12 months. "We assume that it is also hindering broader participation in the WDRM, as no prudent DRSP will invest in secure ICCP capability when AEMO has flagged its intention to introduce alternative, lower-cost protocols. This regulatory uncertainty will persist for as long as AEMO delays consideration of this issue. Further, the longer AEMO delays consideration of this issue the more untelemetered WDR MW there will be in the market." EQL: "It is our understanding that the current ICCP with Digital Certificate Management uses encryption and authentication on the transport layer. Energy Queensland considers this is appropriate and secure." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: "Yes it is, however, it would be beneficial for AEMO to provide definitive guidelines for the implementation of ICCP / secure ICCP."	
16.	What protocols should apply for connections to AEMO WAN?	AGL: No comment. CIGRE AU: "We are not sure what more could be listed here. It is likely more of a matter of being unclear on how that connection is made and the architecture not being defined fully." CS Energy: "The protocols should be consistent and applicable to all parties connecting to the AEMO Wide Area Network (WAN). A compelling case would have to be presented to deviate from the protocols including an assessment of the risk arising from the deviation." Delta Electricity: No comment. ElectraNet: "ElectraNet find the current Ethernet, TCP/IP and ICCP via section 5.2 sufficient detail for a standard document. If dynamic routing or virtual containers (MPLS/802.1q) are to be used supported protocols could be included as details will need to be sorted during design." Enel X: No comment. EQL: "The ICCP is a protocol developed between control centres. Therefore, if a participant is connecting directly and not via an Intervening Facility (control centre), they may not have ready access to the ICCP protocol. In this situation AEMO should consider other standard industry protocols, such as DNP3 and Modbus, and potentially other emerging protocols and standards, such as IEC61850 and IEEE2030.5/CSIP. If the ICCP is required, smaller participants may incur additional costs to implement via a protocol converter." Hydro Tasmania: "Hydro Tasmania notes that it's main data connection with AEMO is made via the TNSP (Transmission Network Services Provider). In AEMO's consideration of any future changes recognising data transmission between other participants as well as with AEMO should be factored in." SA Water: No comment. Powerlink: No comment.	Refer Sections 4.11 to 4.13, 4.16, ,4.18, 4.45, 4.52, 4.53

No.	Issue	Submissions	AEMO response
17.	What additional detail is required in the Standard to provide more clarity on boundary of both operational and financial responsibilities?	AGL: No comment. CIGRE AU: "More clarity of the responsibilities of each party. E.g. one party could be forced by a second party to maintain legacy equipment. This might be a regulation issue rather than in the standard. This section 3.1.5 is most important for Generator / NSP." CS Energy: "CS Energy agrees with the requirement for clarity as proposed. The framework should include the protocols for the boundaries and should be overlayed with revised Standard. The key is to ensure that the operational and financial responsibilities are applied consistently across all boundaries and parties. It should be clear what is the responsibility of the generator, and what is the responsibility of the Transmission Network Service Provider (TNSP). Many new generators are unclear on what it is they need to do to connect to AEMO, and the TNSP has been guiding them through the process." Delta Electricity: "In isolation, this point is less important than when considered in combination with the next question. It is inappropriate to imply in Generator Performance Standards S5.2.6.1 and/or S5.2.6.2 that a participant has obligations for equipment performance outside of their control." ElectraNet: "Focus on coordination of interoperability of RCE & RME and the requirement to maintain reliability aligned with the standard. Should the NSP need to make changes to equipment due to obsolescence or other market pressures a means is required to coordinate this undertaking." Enel X: No comment. EQL: "The Standard should emphasise that it is the generator's responsibility to ensure required data is provided to AEMO, whether via a direct connection or an Intervening Facility. Issues relating to responsibilities could be addressed by removing the need for Intervening Facilities and permitting generators to directly connect to AEMO." Hydro Tasmania: No comment. SA Water: (a) SA Water submits that when a connecting party connects its facility to an NSP's network, the NSP should provide appropriate points of interface for secondary systems, including systems capable of exchanging "Operational Data" signals between the connecting party and AEMO at the point where the connecting party's facility connects with the regulated network (Telco Interface). (b) The Standard should provide that the NSP is financially and operationally responsible for all DCF assets located on the network site of the Telco Interface, all the way through to AEMO as a regulatory obligation which must be complied with by all NSPs to enable the costs associated with such assets to be incurred by the NSP as a regulated expense (i.e., for the benefit of all regulated network users). (c) The Standard should also provide that the NSP may charge connected or connecting parties reasonable and market benchmarked rates for access to its ICCP link, provided that all relevant information regarding its ICCP link and access to such link (as mentioned above, is provided to the connecting party at the connection enquiry phase of their connection, so they have ample time to consider all available options). (d) The connecting party should have financial and operational responsibility on their facility side of such Interface Point.	Refer Sections 4.11 to 4.13, 4.17, 4.18

No.	Issue	Submissions	AEMO response
		Powerlink: "It should be clear what is the responsibility of the generator, and what is the responsibility of the TNSP. Many new generators are unclear on what it is they need to do to connect to AEMO, and the TNSP is the one that ends up guiding them through the process as they connect to AEMO via the TNSP."	
18.	Should an obligation for parties to work together be added to the Standard?	AGL: No comment. CIGRE AU: "There is implicit obligation to meet reliability and availability requirements. However could still be disagreements – need to have a mechanism to resolve. This could be via state based regulator?" CS Energy: "CS Energy supports the formalisation of the obligation of parties to work together to resolve any problems to ensure a requirement is met however would not support a heavily rigid dispute resolution framework." Delta Electricity: "The standard should not assign these obligations at all. The Rules do this. However, as the standard is necessary for AEMO to achieve secure operational control of the NEM, AEMO should manage the performance issues including coordinating rectification of detected performance issues either found by AEMO or reported to AEMO by other participants." ElectraNet: "Yes, clear obligations needs to be spelt out, (including operational and financial responsibility). Lack of clear requirements/governance here can cost the consumer. In addition, ElectraNet suggests an escalation framework be set out to provide a means of dispute resolution." Enel X: No comment. EQL: "Energy Queensland supports a high-level obligation for parties to work together to resolve issues." Hydro Tasmania: No comment. SA Water: Refer to Issue 17. Powerlink: No comment.	Refer Sections 4.17, 4.18
19.	Does the Standard need to clarify that connection is required to both AEMO control room sites?	AGL: No comment. CIGRE AU: "Covered in reliability and availability." CS Energy: "Yes. CS Energy queries whether it should also include backup sites." Delta Electricity: "If connection to both AEMO control room sites is necessary for AEMO to achieve secure operational control of the NEM then yes but AEMO should demonstrate why it is so." ElectraNet: "No comment, this is governed by the reliability requirements and aligns with the need to update/patch systems and test, discussed elsewhere in the issues paper." Enel X: No comment. EQL: "Intervening facilities are already well aware of AEMO's connection requirements. However, further clarification may be required if direct connections to AEMO are permitted."	Refer Section 4.19

No.	Issue	Submissions	AEMO response
		Hydro Tasmania: "Regarding the issue of detailing clear connections to both AEMO control rooms, Hydro Tasmania believes it would be beneficial for the standards to clarify both in words and visually, the requirement to communicate with multiple AEMO control room sites." SA Water: No comment. Powerlink: No comment.	
20.	Should the Standard include a specific requirement that data sent should be of good quality?	AGL: "AGL does not support this change. AGL believes this would require logic changes to be implemented at multiple sites to prevent data being sent if quality flags are set to bad. AGL would prefer AEMO, TNSP and DNSP systems discard bad quality data on an individual use basis. AGL understands this is the current practise." CIGRE AU: No comment. CS Energy: "Yes. The impact of poor-quality data may under certain circumstances lead to system security concerns and in the worst-case scenario lead to Market Suspension. The key will be to ensure the standard is set so as to avoid outcomes detailed in AEMO procedure SO_OP3706 MARKET SUSPENSION AND SYSTEMS FAILURE. Accountability for ensuring the data quality between generators and TNSPs should also be clarified." Delta Electricity: "The standard only needs changing if the lack of this specific requirement is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it will cost the NEM for no valid purpose. Has it been demonstrated that such quality is needed by AEMO? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: No comment. Enel X: No comment. EQL: "Data Quality flags are implied in the use of the ICCP protocol, and briefly mentioned in Section 2.2(e) of the Standard. However, to avoid doubt, it may be beneficial to provide further clarity in that section." Hydro Tasmania: "Hydro Tasmania suggests that as well as the use of data quality flags, a clear definition is required on what good data quality entails. More specifically (noting that our data is sent to AEMO via the TNSP), at what point in the data stream, would measuring data quality and the use of data quality flags apply to. This would determine the cost of implementation, and the time frame that would be required to implement any changes necessary to meet the standard. For example, not all remote monitoring equipment sends quality flags, and this would be a considerable expense to implement. Hydro Tasmania requests a clear specification on the data quality standard intended to be set, to allow considered analysis of any proposed changes and consequent costs that this may incur." SA Water: No comment.	Refer Section 4.20

No.	Issue	Submissions	AEMO response
		Powerlink: "Who is accountable for ensuring the data quality? The generator or the TNSP that passes it to AEMO? Furthermore, when the quality is not acceptable, who is accountable for resolution? Powerlink experience has been that when issues arise AEMO will contact Powerlink about an issue, which is 9 times out of 10 not a Powerlink issue, but a generator issue and that Powerlink ends up needing to troubleshoot with the generator. I can see this going the same way, which would cost Powerlink money to support."	
21.	Should all data be sent with quality flags?	AGL: "AGL believes data should be sent with quality flags. If quality flags are not available from a source device, the quality flag should be artificially set to 'good'." CIGRE AU: No comment. CS Energy: "Yes, and those quality flags should reconcile with AEMO quality flags. This may require a transitionary period to allow sufficient time to implement the requirements." Delta Electricity: "The standard only needs changing if the lack of this specific requirement is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it will cost the NEM for no valid purpose. Has it been demonstrated that such quality flags are needed by AEMO? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: "No comment, ElectraNet acknowledge not all metering communication implementations support the use of quality flags." Enel X: No comment. EQL: "In our view, Data Quality flags are essential and should be a requirement for stakeholders to include in their design. Most SCADA protocols include some form of data quality." Hydro Tasmania: "….not all remote monitoring equipment sends quality flags, and this would be a considerable expense to implement. Hydro Tasmania requests a clear specification on the data quality standard intended to be set, to allow considered analysis of any proposed changes and consequent costs that this may incur." SA Water: No comment Powerlink: No comment.	Refer Section 4.21
22.	Should the Standard include a more specific requirement regarding data accuracy?	AGL: No comment. CIGRE AU: No comment. CS Energy: "Yes. There is need to develop a standard regarding the data accuracy that reflects the requirement and risk. This may require a transitionary period to allow sufficient time to implement the requirements." Delta Electricity: "The standard only needs changing if the lack of this specific requirement is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it will cost the NEM for no valid purpose. Has it been	Refer Section 4.22

No.	Issue	Submissions	AEMO response
		demonstrated by AEMO that accuracy issues exist? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: "Where necessary, calibration cycles should be specified, noting this will come at a cost." Enel X: No comment. EQL: "DNSPs and TNSPs will have their own data accuracy requirements, so more specific requirements are not necessary for those participants. Generators should be designing to a certain level of metering accuracy. If accuracy is a problem that AEMO is experiencing, calibration requirements at appropriate intervals should be specified in the Standard. However, additional participant costs will need to be taken into consideration when determining these requirements." Hydro Tasmania: Hydro Tasmania comments on data quality also relate to accuracy. SA Water: No comment. Powerlink: No comment.	
23.	How material is the issue regarding clamping of values for semi-scheduled units?	AGL: "AGL would support a change for telemetered MW values to allow negative values. Many of AGL's wind farms consume energy from the grid during very low wind times (i.e. 0MW TOTALCLEARED). Often sites are at -4MW for significant periods, resulting in unavoidable impacts to causer pays factors." CIGRE AU: No comment. CS Energy: No comment. Delta Electricity: No comment. ElectraNet: No comment. Enel X: No comment. EQL: "Energy Queensland does not consider that clamping is appropriate for two-way power flows as it is important for AEMO to see both negative and positive values, particularly as great volumes of batteries are deployed." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Section Error! Reference source not found.
24.	Should the Standard include a specific requirement regarding data latency?	AGL: No comment. CIGRE AU: No comment. CS Energy: "Yes, as data latency compromises the requirements and the purpose of the data function. This may require a transitionary period to allow sufficient time to implement the requirements." Delta Electricity: "The standard only needs changing if the lack of this specific requirement is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure	Refer Sections 4.24, 4.45

No.	Issue	Submissions	AEMO response
		operational control of the NEM. If it is not a necessity it will cost the NEM for no valid purpose. Has it been demonstrated by AEMO that issues of data latency exist? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: "Latency requirements should be aligned to protocol operation. As with 3.1.9 ElectraNet questions if ICCP continues to be a suitable protocol for near real time operations." Enel X: No comment. EQL: "While data latency is addressed in section 2.3 (Age of Data, Table 2 (Time intervals for data to be available for transmission to AEMO) is difficult to interpret and does not account for multiple Intervening Facilities. Energy Queensland also questions the need for a separate time interval for data transmitted through a data concentrator. In our view, only one time interval should be specified and clarity provided that the time interval should include any time within an Intervening Facility." Hydro Tasmania: "Hydro Tasmania recommends that, for consistency any changes that the standard sets regarding data latency be applied to all participants in the communication system." SA Water: "This needs to be defined and be a realistic value for generators / market participants to achieve, and needs to separately cover ICCP links between connecting/connected parties to AEMO via: (a) direct AEMO link; (b) TNSPs only; (c) DNSPs only; (d) two NSPs i.e., DNSP to TNSP to AEMO, so that all options are available and not excluded due to unachievable data latency." Powerlink: No comment.	
25.	How material is the issue regarding timing differences due to RME?	AGL: No comment. CIGRE AU: No comment. CS Energy: "The conversion time may contribute to latency outcomes and should be addressed and standardised. This may require a transitionary period to allow sufficient time to implement the requirements." Delta Electricity: "The standard only needs changing if the lack of this specific requirement is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it will cost the NEM for no valid purpose. Has it been demonstrated by AEMO that issues requiring more calibrations, testing, validation and maintenance of time-stamping exist? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: "Timing differences across RME may create significant delays in outage restoration. Although it might mean a complete retune of timing devices across the NEM ElectraNet support the standard to be updated to stipulate the use of market time across all in scope equipment." Enel X: No comment.	Refer Section 4.25

No.	Issue	Submissions	AEMO response
		EQL: "There may be value in adding a section regarding time-stamping requirements. These requirements may include a GPS clock signal or time via a network protocol and would also need to include the expected timestamp resolution, e.g. minute, second, millisecond, etc. However, depending on the specific requirement, this could be a significant overhead for the participant, particularly if installation of a GPS clock is required. Notwithstanding, accurate time should be available within the participant's design." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	
26.	Should an additional requirement be included in the Standard to allow ongoing monitoring of end-to-end response times?	AGL: "AGL would support an end-to-end monitoring scheme. AGL hopes such monitoring would allow DNP3 interfaces to be recognised as suitable to be used as the "primary interface for energy dispatch". AGL would support this as a mandatory signal if the TNSP and DNSP costs to implement were not passed onto the generator." CIGRE AU: No comment. CS Energy: "An assessment of the risk and a cost benefit analysis will need to be conducted to understand the implications and the requirements arising from an updated Standard. CS Energy supports in principle the proposal but seeks to have access to the out workings arising from the above." Delta Electricity: "The standard only needs changing if the lack of this specific requirements is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it will cost the NEM for no valid purpose. Has it been demonstrated by AEMO that issues with end-to-end update times exist? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: No comment. Enel X: No comment. EQL: "Ongoing monitoring of end-to-end response times would be very difficult and onerous to undertake, and several factors would need to be considered. For example, the time of day testing is performed may impact round-trip time due to network congestion. Further, issues such as responsibility for paying testing costs and whether Intervening Facilities will also need to be involved will need to be considered." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Section 4.26
27.	What would the implications be if the specification of	AGL: "AGL supports a specification of a maximum delay for control commands but does not offer a suggested maximum value." CIGRE AU: No comment.	Refer Sections 4.27, 4.45

No.	Issue	Submissions	AEMO response
	maximum delay for control commands was tightened to 2 seconds?	CS Energy: CS Energy provided input to the Primary Frequency Response (PFR) and associated processes that details concerns with the current AGC process and the flow on effects, these include: • AEMO's dispatch conformance alert system is yet to align with the Primary Frequency Response (PFR) rule changes intended to clearly legitimise being off target to help correct frequency. Traders continue to receive "Off Target" alerts despite PFR contributing to a significant portion of the "MW Error" in AEMO's dispatch compliance system due to: (a) the discrepancy between the "Total Cleared" in AEMO's Automatic Generation Control (AGC) system and the actual AGC setpoints seen by generators when PFR provides a head start to load ramping, and (b) PFR itself still being included in the "MW Error", which is simply "Total Cleared" minus "Actual MW" (supporting charts provided as part of the submission). This then potentially impacts subsequent decisions. • Participants do not receive a linear AGC setpoint ramp. This appears to be principally due to resetting the "Total Cleared MW" to "Actual MW" at the start of each Dispatch Interval (DI). The resultant flat spots in AGC ramps at DI boundaries if "Actual MW" is lagging an AGC setpoint ramp before the start of the DI, and the inconsistent ramp rate between DIs is directly responsible for degrading the ramping response of generators. • The AGC setpoint ramping should not be reset to Actual MW every DI, rather it should just continue from the AGC setpoint at the end of the previous DI with no pause. In this way, it would be decoupled from any PFR influence. Unlike AGC setpoint changes, PFR is not rate limited and should not be allowed to alter the base AGC setpoint ramping. If the reason for resetting "Total Cleared MW" to "Actual MW" at the start of each DI is because the energy market dispatch engine does not account for the influence of frequency deviations on system load, then AEMO needs to model the frequency influence on load and generation and factor into the dispatch an estimate of the change in generation needed to correct frequency. • The non-linearities in AEMO's AGC setpoint ramping distort the legitimacy of any causer-pays framework. Causer pays performance factors are judged by comparing actual MWs against a linear trajectory between dispatch targets, whereas they should be judged against the AGC set points as received by the generator and that are sent back to AEMO with the actual MWs. There is strong push for the DSCP response to be measured against each unit's rate limited AGC target, which is send back to AEMO together with the actual load. This would also avoid timing discrepancies between the two principal values being compared, which could otherwise be another significant source of error. Why assume a linear trajectory when the trajectory is precisely known at the same time as each load measurement? Using the unit's AGC setpoint may incentivise AEMO to update its AGC system to include a linear ramp as the non-linear AGC setpoint ramping causes sub-optimal unit control by pushing rate of change feed-forward influences in and out. For units that are dispatched for Regulation FCAS, measuring against the unit's AGC setpoint would measure their PFR response independently from their regulation AGC response, thus decoupling DSCP payments for PFR from	

No.	Issue	Submissions	AEMO response
		existing payments for Regulation FCAS. That would remove any objection around 'double dipping'. At present, good or bad Regulation FCAS response is neither rewarded nor penalised." Delta Electricity: "No issues". ElectraNet: "As mentioned in 3.1.8 ElectraNet does not believe poll-based communications is appropriate for near real time operations. Reduction in the poll time for ICCP may not be conducive to the problem and furthermore the migration to SICCP will introduce additional delay." Enel X: No comment. EQL: "In our view, a review of the entire communications network would be required to meet the proposed 2 second timeframe, particularly where Intervening Facilities are involved. Significant costs may be involved in changing the communications infrastructure to meet tightened timeframes." Hydro Tasmania: "Hydro Tasmania currently has an 8 second response time to control commands that is specific to Tasmania. We request clarification on how any proposed changes to the standard with regards to response time would be specifically applied to Tasmania, noting the current arrangement. We would invite further communication regarding this proposal and its relevance for Hydro Tasmania more specifically, as any change would have a substantial cost and take considerable time to implement." SA Water: No comment. Powerlink: No comment.	
28.	How material is the issue of unreliability of connection to AEMO's market portal?	AGL: "AGL has not had material issue with reliability of the connection to the AEMO market portal. AGL has had material issues with the reliability of the remote networks, provided by 3rd parties, to remote locations. Whether dispatch instructions are received by SCADA or Market Portal, without highly available network connections, there is a risk of not being able to comply with dispatch instructions. AGL would welcome the ability to leverage the highly available, highly secure, highly managed TNSP and DNSP SCADA networks." CIGRE AU: No comment. CS Energy: Yes this is a material issue and "CS Energy is supportive of addressing the identified concerns around reliability of the connection to AEMO's market portal." Delta Electricity: "No issues". ElectraNet: No comment. Enel X: No comment. EQL: "Responsibility for reliability of the Market Portal rests with AEMO and any performance issues should therefore be addressed by AEMO. Dispatch signals through the NSP should only be used as a last resort or backup option, not as an alternative to a poorly performing system." Hydro Tasmania: No comment.	Refer Section 4.28

No.	Issue	Submissions	AEMO response
		SA Water: No comment. Powerlink: No comment.	
29.	Should the specification of control command delays in the Standard take into account the number of Intervening Facilities?	AGL: "AGL supports a specification of a maximum delay for control commands but does not offer a suggested maximum value. If, due to location and the necessity to have multiple Intervening Facilities, the delay exceeds the maximum specified by the standard, an exemption should be formally raised and reviewed periodically to ensure the exemption is still valid with regards to improvements to technology." CIGRE AU: No comment. CS Energy: "Any requirements regarding maximum delays would ideally take into account the number of Intervening Facilities through which the command signal needs to be relayed and the final requirement in the Standard would ideally be reflective of rigorous cost benefit analysis." Delta Electricity: No comment. ElectraNet: "No, the communication of control commands should be reviewed to transition from a queue and dispatch model to one that leverages unsolicited dispatch. This should be done with a view to eliminate the amount of time data spends idle across Intervening Facilities (in both directions). It is expected that this would require the introduction of significant change but one that will allow the control commands to keep pace with emerging technology and market opportunities." Enel X: No comment. EQL: "In our view, the best option is to specify one time interval. That time interval should take into consideration the involvement of any Intervening Facilities." Hydro Tasmania: Refer to Issue 24. SA Water: Refer to Issue 24. Powerlink: No comment.	Refer Sections 4.27, 4.29
30.	What specific obligations regarding maintenance of security should be included in the Standard?	AGL: No comment. CIGRE AU: "The security section needs to be in alignment with AESCSF or reference AESCSF – it could also reference a particular Maturity Level – though there would need to be time allowed for DCPs to get to this level. Also noting that smaller companies may not have the resources to fully comply." CS Energy: "Clarity on obligations of the parties about the security of the data (physical, personnel and cyber) and of control protocols at the level required for critical infrastructure is required and would ideally be captured in the Standard." Delta Electricity: "No issues. If the AEMO or TNSP system were demonstrably in-secure, the power station can operate on local control. Are there security risks? If so, what are they and how have they propagated and what is required to address them. If there are none, no change is needed."	Refer Sections 4.15, 4.30

No.	Issue	Submissions	AEMO response
		ElectraNet: "Obligations are already in place as part of the SOCI legislation. Given SOCI is concerned with adherence to frameworks and is not technical in nature, it may be appropriate for AEMO to specify some specific technical obligations where these are required to secure others connected to the network. It should be clear that these only enhance the existing obligations and should not contradict them in any form. Use of (or reference to) the ASD Essential Eight maturity model would provide a concise mechanism for specification of these controls." Enel X: No comment. EQL: "In our view, there is no requirement for these obligations to be covered in detail in the Standard. Rather, the Standard should reference the Australian Energy Sector Cyber Security Framework and Security of Critical Infrastructure Act." Hydro Tasmania: "Hydro Tasmania is of the belief that in terms of security the Standard should specifically refer to the 'Security of Critical Infrastructure Rules' (SOCI), to prevent overlap or confusion that can be caused by having multiple standards. Noting the detail in these rules and that many organisations are already investing significant effort in addressing these, it would be undesirable to have requirements in the Standard that may potentially confuse or differ from SOCI." SA Water: "Security requirements for any ICCP direct link between AEMO and connecting/connected parties needs to be defined." Powerlink: No comment.	
31.	Does the legislation adequately cover security obligations and requirements or is there a need for more detailed obligations in the Standard?	AGL: No comment. CIGRE AU: No comment. CS Energy: "CS Energy supports the principles being codified in the regulations and the detailed security obligations and requirements being specified in detail in the Standard." Delta Electricity: No comment. ElectraNet: "See response to previous question." Enel X: No comment. EQL: No comment. Hydro Tasmania: "With regards to all changes to the security standards, Hydro Tasmania supports the setting of standards by AEMO, that maintain the quality of existing security systems." SA Water: Refer to Issue 30. Powerlink: "Whilst the legislation is currently broad and principles based, it is the minimum standard that we must adhere to and it is clear what it requires of organisations. If AEMO want to take it further, then that is up to AEMO, but there may be cost implications of doing more than what is legislatively required."	Refer Section 4.31

No.	Issue	Submissions	AEMO response
32.	What would be the implications of including a specific obligation for DCPs to advise on cyber security risks?	AGL: No comment. CIGRE AU: "Does this exist in regulations? If not, then this should be included in the standard." CS Energy: "CS Energy considers that the obligations imposed on Participants in Rule 4.8.1 (Registered Participants advice) already requires Registered Participants to provide advice to AEMO on cyber security risks and incidents." Delta Electricity: "The standard should not assign obligations. It should describe conditions expected for data communications." ElectraNet: "It may be appropriate to require some form of reporting in the event of a cyber incident, particularly where this could have a flow on effect to others connected to the network. It needs to be explicitly stated the conditions this would need to be done, the method that needs to be used to report, the allowable time frame for this to be done, and what AEMO or others would be allowed to do with this information. This is needed to provide clarity for incident response plans." Enel X: No comment. EQL: "It is Energy Queensland's expectation that DNSPs would notify AEMO of a cyber security risk. It is not clear that there would be any value in including a specific requirement in the Standard." Hydro Tasmania: "Hydro Tasmania supports the onus on participants to advise on cyber security incidents and suggests that there needs to be a clear path of communication in which to provide notifications on cyber security risks." SA Water: No comment. Powerlink: No comment.	Refer Section 4.32
33.	Should the Standard be enhanced to better identify and support the protection of the confidentiality of data?	AGL: No comment. CIGRE AU: "Specific to generation. There should be clarification of who has the rights to and owns the data." CS Energy: "CS Energy supports the protection of the confidentiality of data where appropriate." Delta Electricity: "The standard only needs changing if the lack of this specific requirement is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it will cost the NEM for no valid purpose. Has it been demonstrated by or to AEMO that issues with confidentiality of data exist? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: No comment. Enel X: No comment. EQL: "Confidentiality of information requirements are made clear in section 4.1(d) and note 3 of the Standard. However, there may be a need to add further detail with some commentary regarding ring-fencing obligations." Hydro Tasmania: No comment.	Refer Sections 4.32, 4.33

No.	Issue	Submissions	AEMO response
		SA Water: No comment. Powerlink: No comment.	
34.	What changes would be required to clarify reliability requirements in the Standard?	AGL: No comment. CIGRE AU: "A guidance document would be good here, how do different DCPs meet the redundancy. Clarify what is required – are multiple RTUs required at Generator sites and DNSPs- is this covered by this standard? Agree that the definition of critical outage needs to be defined. Do different data sets require different outage times depending on data criticality? This needs further clarification in the standard." CS Energy: No comment. Delta Electricity: These questions should be considered with regards to criticality and interfacing arrangements. "The standards should describe the highest performance on signals necessary for automatic control, lesser performance for signals relied on for human control and lower performance for all others. The tables should also consider importance from the perspective of individual point error at the source compared to errors of all points due to failure of a RTU or Data concentrator and failures of both primary and secondary systems where redundancy has been included. Failures on elements that carry risk of affecting a group of signals require a separate focus and priority as can be interpreted in the present standard but some clarification could achieve a more effective common understanding." ElectraNet: "The standard needs to be explicit and unambiguous (e.g. if redundancy is required, it needs to be stated) in order to justify the cost of implementation." Enel X: No comment. EQL: "The following changes are suggested for consideration: • Replace tables 4 and 5 with an availability figure. • In practice, the three categories in Table 4 will most likely always have the same outage timeframes. Similarly, with respect to Table 5, if the Intervening Facility has an outage for Power System Data, there will likely be an outage for Dispatch Data as well. • The timeframes specified in Table 5 for Intervening Facilities need to be fair and reasonable given Intervening Facilities are merely facilitating data transfer between the generator and AEMO. Otherwise, there is a risk that the Intervening Facility will need to build in reliability requirements that are greater than their own needs. • Energy Queensland agrees clarity is required about loss of some points, total loss of points, or loss of redundancy (if applicable) in the definition of Critical Outage. • Clarity is required with respect to responsibility for notifying AEMO of a planned outage (i.e. the generator, DNSP or TNSP) and the circumstances in which AEMO must be notified."	Refer Sections 4.1, 4.8, 4.34

No.	Issue	Submissions	AEMO response
		Hydro Tasmania: "As an existing and established generator, Hydro Tasmania supports the aim of ensuring standards maintain a high quality, safe, reliable, and secure data transmission system." SA Water: No comment. Powerlink: "None. It is up to the entity to meet the requirements, not for AEMO to mandate how the entity runs its business."	
35.	Does the Standard need to set enhanced expectations regarding monitoring and reporting of availability?	AGL: No comment. CIGRE AU: No comment. CS Energy: No comment. Delta Electricity: "The standard is not the place for maintenance requirements and obligations. That is the arena of good electricity industry practice and is best left out of the standard which should be providing the criteria for further on-reporting of detected performance issues. Performance Standard Compliance programs should be where maintenance objectives are supervised for relevant signals and otherwise as maintained under good electricity industry practice." ElectraNet: "Yes. Heartbeat facility already exists between ElectraNet and AEMO, an provides useful quality feedback. This should be mandated based the criticality of the connection." Enel X: No comment. EQL: "As participants will incur additional costs to meet enhanced expectations, changes should only be made to the Standard where AEMO is experiencing issues with data reliability." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: "No".	Refer Section 4.35
36.	Does any lack of redundancy currently restrict the ability of participants to apply software security patches in a timely manner?	AGL: No comment. CIGRE AU: "This should be implicit from availability and reliability requirements. The redundancy of different types of NSPs needs to be clarified to answer this question. E.g. at multiple comms nodes / firewalls/ RTUs required at all sites to allow for software updates." CS Energy: "The requirement and subsequent obligation should reflect good operating practice and current best practice." Delta Electricity: "No comment". ElectraNet: "This should be implicit from availability and reliability requirements. The redundancy (and therefore availability) requirements of different types of NSPs needs to be clarified to answer this question. E.g. at multiple comms nodes / firewalls/ RTUs required at all sites to allow for software updates." Enel X: No comment.	Refer Section 4.36

No.	Issue	Submissions	AEMO response
		EQL: "Software patching should be managed by each individual participant as required. For instance, DNSPs already have redundancy built into their systems such that patching does not affect their day-to-day operations." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: "No, it's up to the entity to architect their systems to factor this in. If they haven't, then they need to redesign their system to be able to perform this function."	
37.	What change to Section 2.2 of the Standard would be required to clarify the requirement for adequate notice?	AGL: No comment. CIGRE AU: No comment. CS Energy: "An assessment of the risk that the requirement is managing in addition to clarification of changes that require notification is required to determine what is adequate notice." Delta Electricity: No comment. ElectraNet: No Comment. Enel X: No comment. EQL: "In Energy Queensland's view, greater emphasis should be placed on the sign convention in the Standard. In our view, the sign convention should be the same for all participants and not subject to change. Further clarification on the sign convention could be provided in the Standard, e.g. that power direction is relative to the DER source, such that if a generator is exporting it is negative, or if a battery is charging it is positive." Hydro Tasmania: No Comment. SA Water: No comment. Powerlink: No comment.	Refer Section 4.37
38.	What issues have arisen that would justify including in the Standard a specific requirement regarding response time to forced outages?	AGL: No comment. CIGRE AU: No comment. CS Energy: "CS Energy proposes that a process reflecting the requirements detailed in the Rule 4.6.5 (Partial outage of partial protection systems) with the details required to give effect to the requirements in AEMO procedure SO_OP 3715 Power system security guidelines." Delta Electricity: "The standard only needs changing if the lack of this specific requirement is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it may cost the NEM for no valid purpose. Has it been demonstrated by or to AEMO that issues with return to service times exist? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: "No comment, upon failure, restoration is already of the highest priority to meet reliability requirements as far as practically possible."	Refer Section 4.38

No.	Issue	Submissions	AEMO response
		Enel X: No comment. EQL: "Unless AEMO is dependent on the service, Energy Queensland does not see the need for setting response times for forced outages." Hydro Tasmania: "Hydro Tasmania awaits further information on these matters as part of this consultation to allow a more considered response." SA Water: No comment. Powerlink: "There are too many types of issues that can occur, and setting a timeframe would be arbitrary. At best it should simply state that the service should be returned to service as soon as possible."	
39.	What issues have arisen that would justify expanding the scope of testing specified in the Standard?	AGL: No comment. CIGRE AU: No comment. CS Energy: "In addition to the 'quality flags' discussed previously, testing is a key risk management measure and is required for maintenance of the integrity of the process and Standard." Delta Electricity: "The standard only needs changing if the lack of this specific requirement is agreed, by all participants, required to achieve the overall objective of data communications as necessary for AEMOs secure operational control of the NEM. If it is not a necessity it may cost the NEM for no valid purpose. Has it been demonstrated by or to AEMO that expanded testing is required? If so, the statistics supporting the change need to be reported in any final determination that upholds making a change." ElectraNet: "No specific issues identified, but as a matter of principal, ElectraNet support more comprehensive testing of data correctness as well as comms path open." Enel X: No comment. EQL: "In Energy Queensland's view, participants should be responsible for testing their own assets. The Standard should not need to address the level of testing required for the actual plant. The Standard should assume that data points have been appropriately tested and commissioned to a control system, and that data flowing to AEMO is commissioned data. Basic checks should only be required, such as: • for digitals - check the status (no need to re-field test); and • for analogues - check the current value (no need to test at 0, 50% and 100%). It may be worth considering full end-to-end testing of controls." Hydro Tasmania: "Hydro Tasmania awaits further information on these matters as part of this consultation to allow a more considered response." SA Water: No comment. Powerlink: No comment.	Refer Section 4.39

No.	Issue	Submissions	AEMO response
40.	What are examples of testing requirements that are considered too onerous for new generators?	AGL: No comment. CIGRE AU: No comment. CS Energy: No comment. Delta Electricity: "The standard only needs to describe conditions of data communications as necessary for AEMOs secure operational control of the NEM. If it goes beyond that it is a burden to participants in the NEM for no valid purpose. If it can be simplified to reduce the testing burden for all generators it should be." ElectraNet: No comment. Enel X: No comment. EQL: "As per the above, if points have already been fully tested and commissioned to a control system, then they should not need to be fully retested to AEMO." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Section 4.40
41.	What changes to the definition of an "upgrade" is required?	AGL: No comment. CIGRE AU: No comment. CS Energy: "There is need to define a material change with an appropriate threshold." Delta Electricity: "Reference to Rule 5.3.9 may be relevant here and the Standard need not mention it if so." ElectraNet: "No comment. ElectraNet are comfortable with the current wording" Enel X: No comment. EQL: "Energy Queensland considers that the intent of the term 'upgrade' is clear and that a definition is not required." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Section 4.41
42.	Should section 6.4(c) of the current Standard be amended to encourage use of standard test procedures?	AGL: No comment. CIGRE AU: No comment. CS Energy: "Standardisation of test plans is an efficient proposal provided that there is an appropriate level of detail so as to avoid any ambiguity." Delta Electricity: "Section 6 should not be in the standard. It belongs in the Performance Standard Compliance template instead or some other industry guide on Data Communication system maintenance."	Refer Section 4.42

No.	Issue	Submissions	AEMO response
		ElectraNet: "Internal standard test processes are used. Having common understanding of good practice through industry common standards makes sense." Enel X: No comment. EQL: "Energy Queensland agrees that standard test procedures and test plans should be available." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	
43.	What issues have arisen that would justify expanding the scope of augmentations required to be advised under the Standard?	AGL: No comment. CIGRE AU: No comment. CS Energy: No comment. Delta Electricity: "Reference to Rule 5.3.9 may be relevant here and the Standard need not mention it if so." ElectraNet: "With an increasing complexity of power system requiring more complex understanding of integration between participants, the need for timely information on changes is becoming more critical – see overarching comment in section 2.1 of the report." Enel X: No comment. EQL: "Data updates regarding network augmentation are typically managed by the TNSP (or DNSP) independent of this Standard." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Section 4.43
44.	What issues have arisen that would justify the Standard specifying the provision of testing environments for data links?	AGL: No comment. CIGRE AU: No comment. CS Energy: "CS Energy considers that it is essential to provide testing environments for data links. The implications will become apparent when the test scope and environment is finalised." Delta Electricity: "Section 6 should not be in the standard. It belongs in the Performance Standard Compliance template instead or some other industry guide on Data Communication system maintenance." ElectraNet: "AEMO needs to have a test environment to allow full testing of systems and changes. Lack of testing environment has created difficulties in adequate and timely testing of EMS implementation at ElectraNet." Enel X: No comment. EQL: "A testing environment may be helpful. However, it is not clear that it should be included in the Standard." Hydro Tasmania: No comment.	Refer Section 4.44

No.	Issue	Submissions	AEMO response
		SA Water: No comment. Powerlink: No comment.	
45.	In what circumstances would transitional provisions be justified for increased requirements in the Standard?	AGL: No comment. CIGRE AU: No comment. CS Energy: "As highlighted in previous responses, a number of the developments will require transitionary periods. The duration will be reflective of the risk." Delta Electricity: "Agreed but changes to the standard should pass through a necessity test such that AEMO demonstrate clearly, referencing statistics of all relevant events, why the change is required. Changes that impact on the entire data communication system will be expensive to all participants and NEM in general and should be avoided if possible." ElectraNet: "Being clear about which elements are mandated and which are discretionary will be important in framing the outputs of the review as businesses need to be able to fund their implementation. Before the outcomes of this consultation and any changes identified are made final, the impact needs to be understood and where they will result in a material investment for participants these need to be made with suitable transition timeframe, considering time for entities to source the funding through the normal revenue period and the time needed to implement the changes. Given that timeframe (multiple years) AEMO needs to take a long-term view of what the requirements will be and not just focus on the needs of communications over the next few years." Enel X: No comment. EQL: "DNSP funding is generally determined in five-yearly regulatory control period cycles. Any major updates (e.g. adding full communications redundancy to all substations) requires significant investment and approval by the AER. If a transitional decision is made at the start of an investment cycle, it could be another four to five years before funding is available, and a further five to ten years to outwork the changes." Hydro Tasmania: "Hydro Tasmania awaits further information on these matters as part of this consultation to allow a more considered response." SA Water: No comment. Powerlink: No comment.	Refer Section 4.45
46.	Does the Standard need to cover PMU and HSM data?	AGL: No comment. CIGRE AU: No comment. CS Energy: "Yes, if deemed integral to power system security." Delta Electricity: No comment.	Refer Section 4.46

No.	Issue	Submissions	AEMO response
		ElectraNet: "Yes, the standard should document phasor measurement unit specification for use in the NEM. This sets a baseline for PMU and HSM across the network. This could be based on the specification provided to ElectraNet by AEMO for "South Australia Phasor Measurement Unit Specification." Enel X: No comment. EQL: "If this data is required by AEMO, it should be included in the detailed points list. In our view, AEMO should also contribute towards funding that capability." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	
47.	Does the Standard need to cover SGAs?	AGL: No comment. CIGRE AU: No comment. CS Energy: "Yes, and it must reconcile with the Market Ancillary Service Specifications (MASS) and other relevant specifications to ensure consistency of approach and avoid the emergence of loopholes." Delta Electricity: No comment. ElectraNet: No comment. Enel X: "The paper is correct in stating that SGAs will be able to provide FCAS from March 2023. However, it's not clear that changes to the standard will be needed to accommodate this change. We ask that AEMO provide further information on why changes might be required." EQL: "If AEMO is dispatching and monitoring SGAs, then the Standard should include the specific requirements determined by AEMO." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Sections 4.7, 4.47
48.	Are changes to Standard required now to accommodate the Scheduled Lite Visibility and Dispatchability Models?	AGL: No comment. CIGRE AU: No comment. CS Energy: No comment. Delta Electricity: No comment. ElectraNet: No comment. Enel X: "The issues paper states that the visibility model being proposed under the Scheduled lite rule change may require the provision of five-minute data to AEMO "by mid-2022". However, this model is still in development and a rule change would be required to implement it. In Enel X's understanding, AEMO will submit the Scheduled lite rule	Refer Section 4.48

No.	Issue	Submissions	AEMO response
		change request (comprising both the visibility and dispatchability models) to the AEMC in mid-2022. A rule change process will follow and the rule, if made, would presumably involve an implementation period. So, while we agree that the Scheduled lite rule (if made) would have implications for the standard, it is too early to be discussing what changes to the standard might be required." EQL: No comment. Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	
49.	Is it likely that future changes to the Standard will be required to also cover provision of real time data from AEMO to participants beyond current control signals?	AGL: No comment. CIGRE AU: No comment. CS Energy: "CS Energy supports the regular review of the Standard that reflects a proactive rather than a reactive approach." Delta Electricity: No comment. ElectraNet: "Refer to comment below." Enel X: No comment. EQL: "If AEMO is providing real time data to participants, then it should be included in the detailed points list." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Sections 4.49, 4.57
50.	Regardless of provision of data to AEMO, does the Standard need to incorporate or reference requirements for generators and others to provide real time power system data to their NSPs?	AGL: No comment. CIGRE AU: No comment. CS Energy: No comment. Delta Electricity: No comment. ElectraNet: "Yes, data is required in order for TNSP to perform its function in ensuring system stability. It is unlikely that the latency of receiving this data via AEMO will be adequate for real time power system management needs." Enel X: No comment. EQL: "In our view, this requirement should be covered by connection standards and connection agreements between participants and NSPs. Energy Queensland's DNSPs are already doing this." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Section 4.50

No.	Issue	Submissions	AEMO response
51.	Are there any specific factors AEMO should take into account in assessing the costs and benefits of a proposed enhancement to the requirements of the Standard?	AGL: No comment. CIGRE AU: No comment. CS Energy: "The NEO principles should be applied to ensure that the costs and benefits are appropriate." Delta Electricity: No comment. ElectraNet: "No comment. – This is a big topic and would need further consultation based on the options being proposed." Enel X: No comment. EQL: "AEMO should take factors such as the following into consideration when undertaking a cost-benefit analysis: • resource availability; • timeframes for implementation; and • the fact that where there are multiple Intervening Facilities, the participant may not only be required to pay their own costs, but also those of the DNSP and TNSP." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	Refer Section 4.51
52.	What changes to the current NEM power system data communications structure are likely to be required?	AGL: No comment. CIGRE AU: "Not necessarily changes to structure – consider broadening the definition to include where to connect the DER e.g. to DNSP or TNSP or AEMO and at what size. TNSP still require the data from the generators – if a generator connects direct to AEMO, the standard should ensure that data is still delivered to the TNSP." CS Energy: No comment. Delta Electricity: No comment. ElectraNet: "Not necessarily changes to structure – consider broadening the definition to include where to connect the DER e.g. to DNSP or TNSP or AEMO. This should be based on size. TNSP still require the data from the generators – if a generator connects direct to AEMO, the standard should ensure that data is still delivered to the TNSP." Enel X: "We agree that changes to the current architecture for NEM power system data communications are likely to be required to accommodate growing participation by VPPs and demand-side assets in the energy market. However, this is not an "emerging issue" as the paper suggests. It is a real issue now that is having significant implications for the success of the wholesale demand response mechanism. The standard is already not fit for purpose and must be updated to accommodate a new architecture and data protocol as soon as possible. Beyond the changes required to support the proper implementation of the wholesale demand response mechanism, we agree that the standard will likely need to evolve to accommodate information exchanges between AEMO and smaller DER assets. At this stage, the Scheduled lite rule change appears to be the most appropriate forum to consider these issues. As noted in our response to the question above (relating to Schedule Lite Visibility Model), changes to the standard should only be	Refer Section 4.52

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		considered once a policy decision has been made through that rule change. We therefore recommend that AEMO focus its immediate attention on addressing the issues in the standard as they relate to DRSPs and the proper implementation of the wholesale demand response mechanism. The decision made by AEMO on these matters can then lay the groundwork for further developments once the policy direction of the Scheduled lite rule change is clearer." EQL: "While it is difficult to predict future requirements, current industry protocols, such as ICCP and DNP3, have stood the test of time. It is likely that NSPs will keep up-to-date with modern protocols (e.g. using a DERMS to communicate directly to inverters), so the solution may need to loop back to mandating . Alternatively, AEMO may need to introduce their own systems rather than relying on . Energy Queensland's DNSPs are introducing a DERMS in the near future as an independent system to their DMS/SCADA systems. Consideration should therefore be given as to whether AEMO should be communicating directly with the DNSPs' DERMS, (and those of other NSPs) in addition to the current connection to AEMO via the TNSP." Hydro Tasmania: No comment. SA Water: "The architecture for AEMO for each type of connecting/connected party ICCP link mentioned above (see our comments in relation to Issue 24) needs to be shown in a separate topology diagram. Powerlink: No comment.	
53.	If generators and other participants were permitted to communicate directly with AEMO, then what types of data protocols would be preferred?	AGL: No comment. CIGRE AU: "There are some discussions on the merit / for / against the current DNP3 plaintext protocol and the use of secure DNP3, which provides integrity only and doesn't really provide confidentiality. Also operational impact on the existing EMS systems in supporting secure DNP3 We would be considering the suite of SCADA protocols (Modbus / MMS / DNP3) as it is hard to change to different protocols from what is natively supported by the existing equipment that connecting parties use. Note that a change to protocols may impact existing security solutions e.g. IPS / application scanning." CS Energy: No comment. Delta Electricity: No comment. ElectraNet: "Direct communication with AEMO from a TNSP for control commands using an unsolicited dispatch lends itself to DNP3v5 and Routed GOOSE." Enel X: "We strongly support the consideration of alternatives to secure ICCP. There are a range of cost-effective and flexible protocols that would support data sharing between AEMO and participants. Enel X's preferred protocol is DNP3. DNP3 provides a complete set of functionalities that we believe is well suited to NEM requirements. It is an open, intelligent, robust, and efficient modern SCADA protocol. It is supported by many SCADA equipment manufacturers, and thus provides interoperability between different vendors' equipment. DNP3 can: • request and respond with multiple data types in single messages • segment messages into multiple frames to ensure excellent	Refer Section 4.53

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		error detection and recovery • include only changed data in response messages • assign priorities to data items and request data items periodically based on their priority • respond without request (unsolicited) • support time synchronisation and a standard time format • allow multiple masters and peer-to-peer operations • allow user definable objects and file transfer. We also note AEMO's comment in the workshop on 18 Nov 2021 that DNP3 is supported by AEMO's existing vendor, so this solution may be the quickest and simplest to implement. This all said, Enel X is capable of implementing a range of different protocols, and we support the exploration of other options. Fundamentally, though, any new protocol must be something that AEMO itself can support (from both a technical and resourcing perspective) and ideally something that can be implemented in a timely and cost-effective manner." EQL: "Ideally, the preferred protocols would be the proven standard industry protocols, such as DNP3 and Modbus, but also other emerging protocols and standards, such as IEC61850 and IEEE2030.5/CSIP. Generally, it will depend on the requirements, e.g. Modbus, though quite robust, does not allow time-stamping of data." Hydro Tasmania: No comment. SA Water: No comment. Powerlink: No comment.	
54.	If for cyber security and other reasons, only a single protocol could be accommodated in addition to secure ICCP, what criteria should AEMO use to determine the most suitable protocol?	AGL: No comment. CIGRE AU: "We would be considering the suite of SCADA protocols (Modbus / MMS / DNP3) as it is hard to change to different protocols from what is natively supported by the existing equipment that connecting parties use. Note that a change to protocols may impact existing security solutions e.g. IPS / application scanning." CS Energy: No comment. Delta Electricity: No comment. ElectraNet: No comment. Enel X: "As noted in our response to earlier questions, an additional protocol is needed as a matter of priority to support the effective implementation of the WDRM. We therefore support a protocol that: 1. enables AEMO and DRSPs to fulfil their respective obligations under the WDRM 2. is cost-effective for both AEMO and DRSPs to implement 3. can be implemented quickly. It is also worth considering whether the chosen protocol is likely to be suitable for future needs, including as a result of the Scheduled lite rule change, and to support the provision of regulating FCAS from distributed, non-scheduled assets." EQL: "If a new protocol is added then it will need to be available to and accessible by all participants. A protocol like 2030.5 is most likely the best suited protocol for future requirements, but not all participants will have access to it in their systems. Therefore, in our view, DNP3 is the best overall option as it is well-known and easy to implement and convert to if it is not a native protocol within a participant's system." Hydro Tasmania: No comment. SA Water: No comment.	Refer Section 4.54

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		Powerlink: No comment.	
55.	Should "digital representation" be renamed "numeric representation"?	EQL: "Energy Queensland considers that use of the term 'Digital representation' at first glance implies a Digital or Status indication, which is different to the intent. We therefore suggest replacing the word 'Digital' with 'Numeric'."	Refer Section 4.55
56.	At what point in the data stream should data quality be measured?	Hydro Tasmania suggests that as well as the use of data quality flags, a clear definition is required on what good data quality entails. More specifically, a definition of the point in the data stream at which data quality standards would apply.	Refer Section 4.56
57.	Should there be six-monthly industry forums on the Standard?	Hydro Tasmania: "Due to the rapid change of the electrical power industry, we feel that it may be necessary to introduce a more responsive consideration of the Power System Data Communication Standards, six-monthly forums, for example, might be useful to convene to identify the state of play of this issue. This would allow for a faster response to changes within the industry, with input for existing participants to consider any changes. The main concern is to avoid the likelihood of having to implement multiple large changes in short time frames, to maintain compliance with any new standards which would have significant impacts in terms of future capital planning and expenditure."	Refer Section 4.57
58.	Should industry participants share network models?	ElectraNet suggests that the future complexity of network and inter-relationships between wider NEM and transmission and distribution networks will require a greater level of widespread modelling by all participants. It would be more efficient to minimise duplication of this modelling effort and align the assumptions made about device status and ratings by entities sharing their models, the device status, ratings, power flow, voltage levels etc. The Standard should also contemplate whether that sharing is facilitated directly between participants or whether AEMO has a role to play to provide a centralised repository and access and how that would work through appropriate protocols.	Refer Section 4.58
59.	Should all NSPs be required to have ICCP-compliant links with AEMO, provide adequate information on those links to connecting parties at the enquiry phase, and grant access to those links on	SA Water submits that the Standard should be amended to place a clear, regulatory obligation on all NSP's (TNSPs and DNSPs alike) to ensure that: (1) they have a Standard compliant ICCP link in place between their network and AEMO at all times (to ensure generators, BESS facilities and load facilities (including demand response providers) connecting to their network have access to a reliable, secure and cost effective AEMO data link at all times);	Refer Sections 4.11,4.12, 4.59

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	reasonable terms and conditions?	(2) in order to be Standard compliant, the ICCP data link in place between AEMO and each NSP is able to exchange all AGC and all other generator/BESS and load (including demand response) signals as per Chapter 4, 5 and any applicable AEMO guidelines from time to time (including the Standard); (3) adequate information regarding such data links is provided to each connecting party at the connection enquiry phase, together with information relating to the kinds of data which needs to be communicated between the generator/BESS/load and AEMO for access to different markets; and (4) access is granted to such data links on reasonable (and commercial) market-based terms and conditions.	