Department of Energy, Mines, Industry Regulation and Safety
Energy Policy WA
GOVERNMENT OF WESTERN AUSTRALIA

Meeting Agenda

Meeting Title:	Power System Security and Reliability Standards Working Group
Date:	10 October 2024
Time:	1.00pm – 3.00pm
Location:	Online, via TEAMS.

Item	Item	Responsibility	Type	Duration
1	Welcome and Agenda	Chair	Noting	1 min
2	Meeting Apologies and Attendance	Chair	Noting	2 min
3	Competition Law Statement	Chair	Noting	2 min

GOVERNMENT OF WESTERN AUSTRALIA

Power System Security and Reliability (PSSR) Standards Review

PSSR Standards Working Group

10 October 2024

Working to [illegible] brighter energy future.

Purpose of today's session

To finalise the discussion on:

- **proposed solutions for the SWIS System Strength Framework;**
- **proposed solutions for ride though requirements for network elements; and**
- **previously identified issues by Western Power as part on the Technical Rules Review.**

System strength - Fundamentals

What is system strength?

System strength is an umbrella term to describe a set of complex related phenomena such as:

- Sensitivity of voltages to injections/withdrawals of reactive power, e.g. voltage step changes, the propensity for converter-driven oscillations and adverse interactions, dynamic voltage stability issues like fault

System strength - Fundamentals

How is it measured and remedied?

Assessing System strength

- The use of system strength as an umbrella term without focusing on its constituent parts has led to challenges with defining and managing it.
- Common proxy measures of system strength include:
  - Balanced three-phase fault level (MVA;) and
  - Short-circuit ratio (SCR)

Remediation options

- There are a diverse array of options (not only focusing on increasing fault level) to tackle the individual phenomena under the system strength umbrella.

Responsibility for providing solutions

- Some system strength issues like protection system operation and voltage stability are the responsibility of the network operator.
- It can be argued that other issues are a joint responsibility with the network operator and generation/storage proponents, such as post disturbance PLL stability, convertor driven voltage oscillations and dynamic voltage stability.

System strength - Fundamentals

Wholesale Electricity Market (WEM) Rules Framework

WEM Rules definitions

- **System Strength** is a measure of how resilient the voltage waveform is to disturbances such as those caused by a sudden change in Load or an Energy Producing System, the switching of a Network element, tapping of transformers and other types of faults.
- **System Strength Requirements:** Means, the requirements identified to maintain sufficient System Strength on the SWIS, as determined by the processes specified in the WEM Procedure referred to in clause 3.2.7.

Other related WEM Rules

- 3.2.5(f), 3.2.7(e), 3.4.3(d).
- Transmission System Plan (TSP) and Non-Co-optimised Essential System Services (NCESS) provisions contemplate system strength services indirectly.

WEM Procedures

- WEM Procedure - Power System Security (aemo.com.au)
- Power System Stability Guideline (aemo.com.au)

System strength - Fundamentals

National Electricity Market (NEM) Framework

- “System Strength” is not a stand-alone defined term in the National Electricity Rules (NER) Glossary, although there are several related definitions.
- The intent of the recently revised framework (following the Australian Energy Market Commission (AEMC) 2021 and 2024 system strength rule changes) is fundamentally economic – to facilitate the coordinated central procurement of system strength services and provide efficient long-term price signals to allow proponents to make more informed investment decisions.

Key elements of the NEM Framework include:

- **Forecast system strength requirements:** AEMO’s annual System Strength Report defines the minimum fault level at key nodes, identifies system strength shortfalls, and projects inverter-based resources (IBR) capacity over the next 10 years.
- **Centralised system strength planning and investment:** The System Strength Service Provider (SSSP), currently the prevailing Transmission network service providers (TNSP), in each region is responsible for procuring system strength services to meet minimum fault levels and plan additional investments based on AEMO’s IBR capacity projections at each node.
- **System strength charge:** As an alternative to the “do no harm” principle, generation proponents can elect to pay an annual charge to the SSSP to provide enough system strength services to host their IBR capacity.

System strength - Issues

Why does it need to be managed?

- System strength is one determinant of how well the power system can return to normal operation following a disturbance or fault. In practical terms, power systems with system strength can maintain more stable voltages following changes in power flows.

- Synchronous machines, which have traditionally dominated the power system, are a source of system strength. The current generation of grid-following IBR provide a significantly lower and different contribution towards fault level, which means that the lowest system strength on a power system is likely to be in a part where generation is dominated by IBR and electrically remote from synchronous machines.

- Therefore, it is becoming increasingly important to forecast and manage system strength issues to maintain a secure power system.

System strength - Issues

What does a good framework look like?

A robust system strength framework should promote:

- **Efficient planning and investment:** by both the network service provider (NSP) and generation/storage proponents as it pertains to the forecasting / identification and resolution of system strength issues.
- **Clear demarcation of responsibility:** between relevant parties for resolving system strength issues.
- **Appropriate cost allocation:** between the relevant parties that is reflective of the system strength needs that are being addressed.
- **Appropriate risk allocation**: between the NSP and proponents, trading off the risk of over-investment by the NSP and the risk of excessive curtailment affecting proponent returns.
- **Transparency:** to allow informed investment decisions to be made and risks to be appropriately priced.
- **Solution-agnostic:** the framework should be compatible with the range of remediation options available, e.g. network investment, contracts with market generators, collective re-tuning, etc.
- **Fairness for incumbent facilities:** who have often done nothing wrong and are adversely affected by new facilities connecting and/or changes to the power system.

System Strength - Issues

SWIS context - Lack of guidance on efficient planning and investment

There is no single source of “truth” for forecasting the future demand and generation mix in the SWIS over a 10-year period to inform any system strength related investments.

- **AEMO WEM Electricity Statement of Opportunities (ESOO)** – Only assumes existing and committed generation
- **AEMO Gas Statement of Opportunities (GSOO)** – Assumes least-cost expansion
- **EPWA Whole of System Plan (WOSP) and ad hoc studies like the SWIS Demand Assessment** – Assumes least-cost expansion but no expected scenario
- **Western Power TSP** –must “take into account” power system security and reliability standards and requirements under the WEM Rules and the TR (4.5B.5), with consideration of scheduled connection of new loads or generators (4.5B.6). No clear guidance is included in relation to uncommitted loads, generation or retirements which may impact System Strength needs.

System Strength - Issues

SWIS context - Lack of clearly defined responsibilities

- No obligations for Western Power (or any entity) to determine, maintain and publish minimum threephase fault levels (in MVA) in the transmission network.
- There is an existing obligation in the Technical Rules (5.5.1) for Western Power to publish maximum fault levels at each transmission node.
- In practice, Western Power also publish current and future (+5 years) minimum three-phase and single-phase fault currents (in kA) at each transmission node in the annual TSP, which is intended to convey information to network users for facility design and protection purposes.
- However, the methodology for determining the generation fleet is not specified, nor are the generator dispatch, outage and/or demand scenarios articulated, i.e. without any formal obligations, this process can be (and currently is) very opaque.
- Moreover, the current requirement is simply to publish the fault levels, without determining and maintaining minimum levels. While this may be done implicitly behind the scenes as part of BAU transmission planning, it is not transparent what the minimum fault levels are and how they were determined.
- Proponents may enter into negotiations using the framework under the Electricity Networks Access Code (ENAC) if they want to request a service from Western Power as part of the connection process. This provision does not explicitly mention system strength services but could be used for this purpose.

System Strength - Issues

SWIS context – Other issues

Cost allocation

- There is no cost allocation framework between Western Power and proponents if Western Power is investing to maintain system strength

- There is no guidance for Western Power (or proponents) to plan or make proactive system strength investments, nor is there explicit guidance on the market benefits of alleviating system strength constraints.
- For new proponents, system strength issues are expected to be captured during the grid connection process, though rectification of issues identified that involve third-party facilities is not defined (i.e. ad-

System strength – proposed framework

Components

System Strength definition

- 10- year generation outlook
- Minimum fault level requirements
- A 10-year forecast of fault level by transmission node

System strength – proposed framework

Amended System Strength definition

Proposed Electricity System and Market Rules (ESMR) definition

- ***System Strength*** relates to the ability of the power system to resist changes to the voltage waveform in a particular location, both during steady state operation and following a disturbance, including, but not limited to, a sudden change in a Load or an Energy Producing System, the switching of a Network element, tapping of transformers and faults.

Rationale

The definition of system strength has evolved considerably over time and the proposed definition harmonises the current WEM definition with the proposed AEMC definition, to capture both locational considerations, and the need to capture steady state operation and disturbances.

System strength – proposed framework

Future generation outlook

AEMO, EPWA and Western Power to align on a forecasting approach, including assumptions, scenarios and input data. This will be through a Methodology, Inputs, Scenarios and Assumptions (MISA) report, to be updated annually and consulted with industry

Use this to determine an expected 10-year generation and storage capacity outlook on an annual basis

- Fleet mix to assume least cost expansion on basis of MISA assumptions
- Fleet mix should reflect capacity quantities (MW), technologies (e.g. gas/wind/solar) and broad locations (e.g. regions)

Use an existing publication process (e.g. ESOO “expected generation mix”) to convey this outlook to stakehu3 (o)-9d [(.oc)1 (k)7.8 (l)2 (ocru3 (o98 (on)-8 (basi),(st)2 (f-1.7 (k)7.4 0 Td [(et)2 ()-1.7 (i))6.7 ( )-34.8)1

System strength – proposed framework

Minimum fault level and 10-year forecast of fault level by transmission node

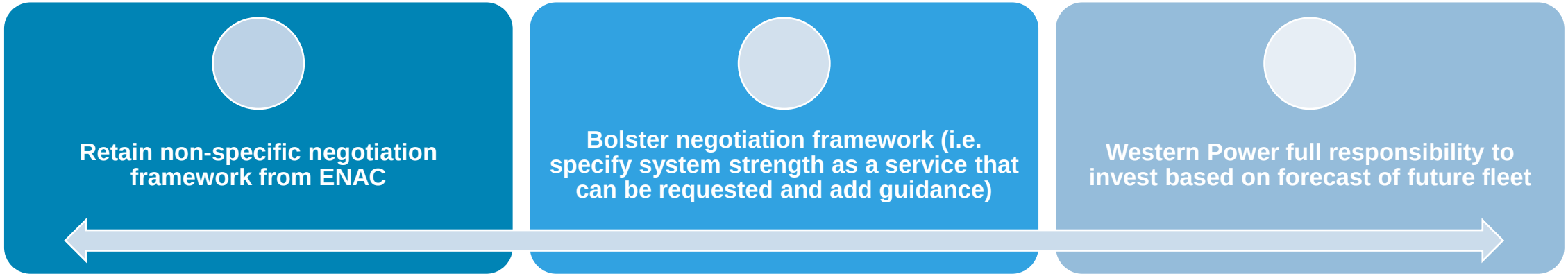
- Western Power (with input from AE-5 (h)-e/lugfand/e/lugoer(i)-1 (dusE)-291 (t)--3.3Artifact <</MC8 ao19ifacy

System strength – proposed framework

Centralised planning/investment for IBR connections

Currently, Western Power is not obliged to make proactive investments in system strength to bolster IBR hosting capacity. There is a continuum of options to consider with regard to how proactive (or otherwise) Western Power should be as shown below.

EPWA is seeking feedback from the PSSRSWG on the options presented.



Questions for discussion

- How to deal with no-fault issues (e.g. as a result of coal retirement)
- Cost allocation where a negotiated outcome results in investment that may benefit future connection applicants?
- Will this approach to 'connect and manage' allow for solutions to be implemented in a timely manner?

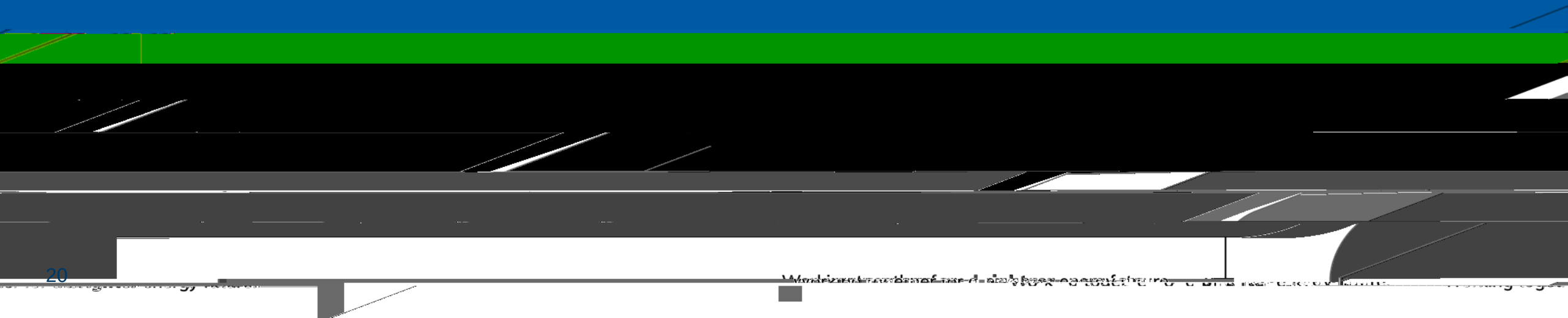
Questions for discussion:

- How far ahead should investment be triggered?
- What threshold should be applied to trigger investment to avoid the risk of stranded assets?
- How should costs be allocated?
- Will the administrative burden of this be warranted in the 'new normal' (post 2030 coal retirements)?

System strength – proposed framework

Summary analysis/rationale

Proposed solution to Issue 3: Network ride through



Network ride through - Issues

Network elements are not required to operate continuously through credible system disturbances

- There are clear requirements in WEM Rules A12.7 – A12.8 for transmission connected generation facilities defining what disturbances these facilities are required to remain in continuous uninterrupted operation through.
- There is no specific requirement for the network service provider to design, install or operate the network in a manner that will not trip elements for the same system disturbances that generators and loads are required to remain connected for.

Considerations

- Network elements can have a large impact on system security if they trip during system disturbances.
- During the fault, network elements that are required to remain in services are electrically closer to each other than large generating facilities. That makes the requirement on network elements to ride through important for PSSR.

Network ride-through

Proposal

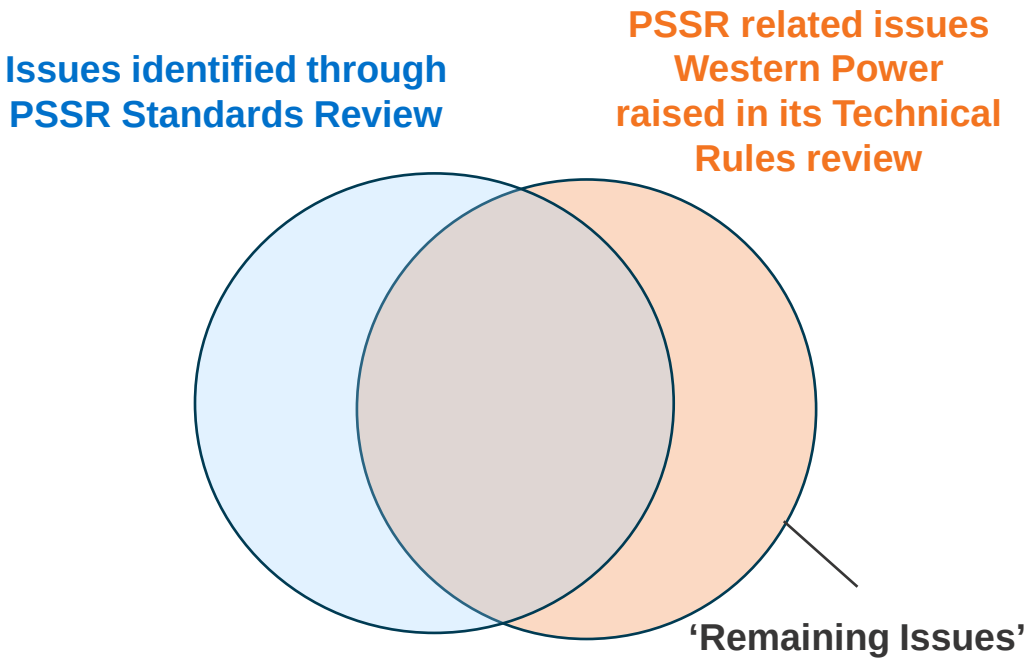
- Network elements to be required to ride through similar disturbances that generators are required to ride through, unless the element itself is already faulted, or there is a requirement for the network element to trip as part of a considered load shedding scheme.
- Apply the facility ride through requirements of WEMR A12.7- A12.8 as an obligation on network elements with appropriate supporting text to clarify that this standard does not apply to:
    - Faulted primary equipment disconnected under the requirements of the current TR 2.9
    - The operation of the Load Shedding requirements (the current TR 2.3.2 and TR 2.4).

Rationale: No basis for a different definition of disturbances than that which is currently applied to generators has been identified. Increasing alignment between network and facility ride through requirements provide pre-emptive mitigation of PSSR risks.

Western Power Technical Rules Review identified issues

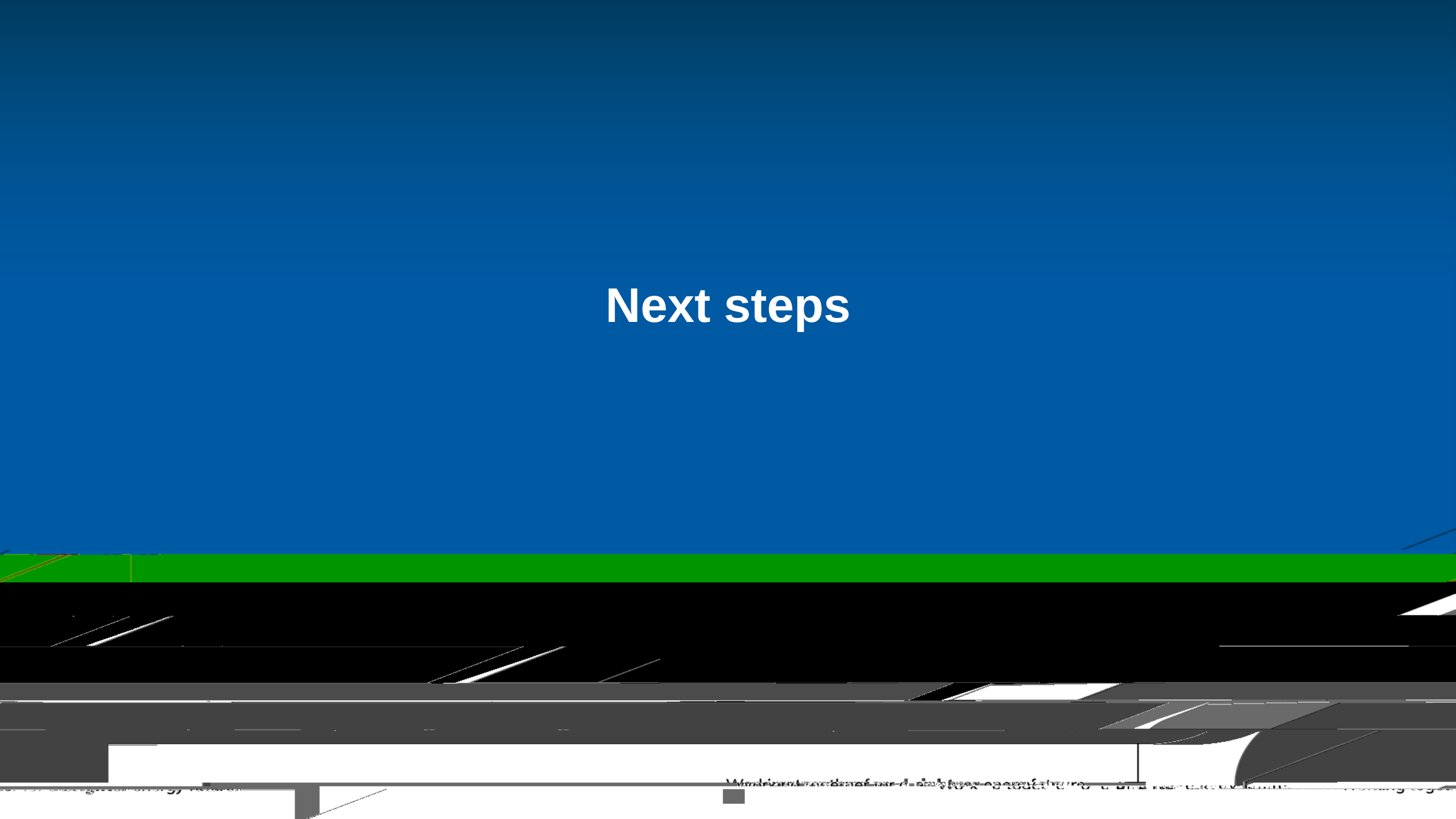
Proposed Approach

- Western Power identified issues with the current PSSR framework in its September 2023 Technical Rule Change submission to the ERA.*
- Some of Western Power's identified issues are covered by the broader issues identified in the PSSR Standards Review under stage 2.
- Some issues remain and Western Power and AEMO, as part of the PSSR Standards Technical Working Group, have reviewed and provided further feedback on the issues for consideration.
- EPWA proposes to consult Western Power's preferred approach to the remaining issues through the consultation paper, and these issues are set out in the spreadsheet circulated with these slides.
- EPWA is seeking feedback from the PSSRSWG on the matters contained within that spreadsheet.



*** Western Power's submission to the ERA and Western Power's proposed amended Technical Rules**

Next steps



Next steps

- The draft Consultation Paper will be presented at the 28 November MAC meeting.
- EPWA anticipates the PSSR Standards Working Group to meet two more times prior to finalising the draft Consultation Paper.
- The User Facility Standards framework, related issues and governance of the standards remains to be discussed.