Government of South Australia
Department of the Premier and Cabinet

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Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

System Security Market Frameworks Review – Draft Rule Determinations

Dear Mr Pierce

The Energy and Technical Regulation Division of the Department of the Premier and Cabinet, South Australia (Division) congratulates the Australian Energy Market Commission (Commission) for completing the System Security Market Frameworks Review (SSMF) Review's Final Report, which takes a holistic view of the most suitable regulatory framework to address power system security and also covers the rule change proposals raised by the South Australian Government in July 2016. The Division takes this opportunity to provide feedback on the draft rule determinations as an outcome of the SSMF Review.

The Division is still concerned about placing obligations on TNSPs for the provision of inertia or other services through building assets or procurement of long-term contracts that may lead to inefficient investment, which may be locked in for a long time. It is the opinion of the Division that, in the absence of an open market, AEMO is better placed to procure such services (as it currently manages similar contracted services), which are better dynamically coordinated with changing system conditions.

The attached submission focusses on how the Division sees the draft rule determinations resolve the issues raised in the related components of the package of rule changes proposed by the South Australian Government in July 2016 and provides some feedback, where appropriate, on alternative solutions for consideration by the Commission.

The Division will offer feedback on other issues raised in the SSMF Review's Final Report during the relevant future work streams on the issues.

Should you wish to discuss any of the content of the submission, please feel free to call Ms Rebecca Knights, Director - Energy and Technical Regulation Division, on (08) 8226 5500.

Yours sincerely

Vince Duffy
EXECUTIVE DIRECTOR
14 August 2017

System Security Market Frameworks Review

Submission to Draft Rule Determinations

Energy and Technical Regulation Division
Department of the Premier and Cabinet, South Australia

August 2017

ERC0214 – Managing The Rate Of Change Of Power System Frequency

Within a package of rule change requests submitted to the Australian Energy Market Commission (Commission) in July 2016, the South Australian Government addressed the management of high rates of change of frequency (RoCoF) so that RoCoF stays within acceptable limits, beyond which power system security may be compromised. The component relevant to high RoCoF in the rule change request proposed amending the National Electricity Rules (Rules) to:

- Give the Australian Energy Market Operator (AEMO) the flexibility to manage emerging security challenges as a result of high RoCoF by enabling it to procure the necessary ancillary services when required in a competitive and efficient procurement mechanism.
- Enable AEMO to develop guidelines for the acquisition of these services, similar to the System Restart Ancillary Service (SRAS) guidelines, which would provide the technical and contractual information as guidance to registered participants on the factors AEMO is taking into account when contracting for the service.
- Prescribe a process for the Reliability Panel to develop and maintain a system standard for RoCoF to guide the procurement of the services and to clarify responsibilities of AEMO, Transmission Network Service Providers (TNSPs) and market participants.

As stated in the draft rule determination (Determination), the Commission has decided to make an alternative draft rule that it sees as more preferable and is justified to contribute to the achievement of the National Electricity Objective (NEO).

The draft rule charges the TNSPs with the provision of a minimum threshold level of inertia in a sub-network, where a shortfall in inertia is identified by AEMO, through a prescribed process. The absolute minimum threshold of inertia will ensure that the post-disturbance islanded system is in a satisfactory operating state[1] and represents a lower bound on the level of inertia required to maintain system security parameters within normal operating limits, but not likely to withstand a subsequent contingency event.

The draft rule also obliges TNSPs to provide inertia or contract with third-party providers of services, such as fast frequency response (FFR), as a secondary measure, to obtain a minimum secure operating level of inertia. The minimum secure operating level of inertia will ensure that the post-disturbance islanded system is in a secure operating state[2] and that the system returns to a satisfactory operating state following the occurrence of a credible contingency event or protected event.[3]

As stated in the South Australian Government's rule change proposal,[4] there are no current rules to define limits for how fast the frequency may change or regulatory means to acquire services to

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[1] A power system *satisfactory operating state* has the meaning given in clause 4.2.2 of the Rules.
[2] A power system *secure operating state* has the meaning given in clause 4.2.4 of the Rules.
[3] A protected event is a low likelihood, high consequence non-credible contingency event and can be requested by AEMO (following the conditions prescribed in clause 5.20A.4) to the Reliability Panel, which determines the declaration of protected events according to the provisions in clause 8.8.4. No protected events have been consulted on or declared so far by the Reliability Panel at the time of writing this paper.
[4] South Australian Minister for Mineral Resources and Energy, *Managing the rate of change of power system frequency rule change request - attachment A,* 12 July 2016, p. 2.

maintain that rate of change within any acceptable limits. In this context, the Energy and Technical Regulation Division (Division) acknowledges that the meaning of 'managing' high RoCoF has very wide interpretations and accepts that the purpose of the proposed rule change is to resist or possibly arrest the fast frequency change within acceptable limits. The Division looks forward to inter-related work by the Commission to further address frequency control recommendations from the SSMF Review that will find the best means to control frequency starting by the containment of the initial high RoCoF (from the time a contingency occurs) until the rebalance of supply and demand by frequency control services. The Division is still of the view that the purpose of the rule change request is best defined as the management of high RoCoF, rather than levels of any particular service to control high RoCoF.

Determination of the necessary services

It is widely acknowledged in the literature that the two means currently available by which to slow down or arrest a high RoCoF is either by increasing the system inertia or mitigating the effect of the contingency that caused the high RoCoF via a very fast injection of power into the grid or withdrawal of load from the grid following a falling frequency disturbance within the affected region.

It is evident that the Commission has based the draft rules on the premise of the level of system inertia determining the size of the initial RoCoF that would result immediately following a separation of the sub-network from the NEM.[5] The initial RoCoF will also be determined by the interconnector flow at the time of separation, or otherwise generally termed as the contingency size.

It is also important to consider the operation of the sub-network as an island after separation and the effect of the initial RoCoF resulting immediately after the loss of the largest generating unit or cluster of units, largest load or a significant transmission line. Of particular concern is the situation of a loss of the bulk source of inertia in the sub-network from the same large synchronous generator that tripped causing the contingency, as mentioned in the Determination.

The Division supports the draft rules in giving AEMO the responsibility of determining the boundaries of inertia sub-networks, the requirements of minimum inertia for each sub-network and any shortfall in inertia from these requirements.

The Division acknowledges that there is no substitute for the inherent characteristic of synchronous machines to immediately resist the change in frequency and make the initial RoCoF more manageable for all assets connected to the grid. However, it is also more efficient to make the best use of resources in slowing down or resisting the initial RoCoF. These resources are roughly divided into two categories: inertia from rotating plant and FFR services, also known as 'synthetic' inertia.

It is worth noting here that special protection schemes (SPSs), mentioned as a form of FFR in the Determination, should be treated as a separate resource as it prevents a high RoCoF in the first place by shedding generation or load in response to event signals other than frequency change. Nevertheless, SPSs represent another form of reducing contingency size, just as FFR services do. The same could be said for other services that pre-empt high RoCoF, such as schemes for curtailing or

[5] Australian Energy Market Commission, *Draft Rule Determination - Managing the rate of change of power system frequency*, 27 June 2017, p. 24.

constraining off generation, albeit probably at a higher cost as they would operate in anticipation of disturbances at certain periods of time rather than in response to a signal when they are needed.

All types of other services to reduce contingency size should also be taken into account. Recent studies by AEMO suggested that SPS-enabled pre-emptive load shedding is effective in preventing the islanding conditions of South Australia due to non-credible loss of generation. On the other hand, a much larger amount of load needs to be shed post-separation from the rest of the NEM to compensate for the lost Heywood Interconnector infeed and, even with very rapid shedding of load, a viable island cannot be formed due to high temporary over voltages across the State.[6]

As previously stated in the South Australian Government rule change proposal, AEMO is best placed in its responsibility for maintaining the security of power system operation to co-optimise all the available ancillary services and determine the best combination of resources to manage high RoCoF, based on the results of AEMO's contingency planning system studies. The Commission's decision in the Determination (see page 55) of confining any additional activities (other than inertia) to only meet the secure operating level of inertia – but not the minimum threshold level of inertia – may not produce the most efficient outcome.

To demonstrate the effectiveness of the use of resources other than inertia, a steady decline in frequency at 3 Hz/sec would reach 47 Hz from the nominal frequency of 50 Hz in 1 second in the absence of any system inertia. Within this first second, connected generation is required to stay online for 250 milliseconds for a RoCoF up to 4 Hz/sec, as per the automatic access standard in the Rules. As demonstrated by potential providers, it is not inconceivable for current technologies (especially battery storage) to inject power into the grid or interrupt load within 250 milliseconds. It is well-known that even faster response times are plausible in current technologies, which can significantly reduce the amount of power injection required or the amount of inertia needed to maintain a manageable RoCoF.

As reiterated in the submissions by other stakeholders, the Division is still of the view that guidelines for a system standard for RoCoF should be established by the Reliability Panel when reviewing the Frequency Operating Standards instead of an explicit requirement for synchronous inertia only, even for the minimum threshold. Given the nature of the current generation mix and the gradual withdrawal of synchronous resources from the power system, scarce synchronous inertia may only play a supporting role in regions such as South Australia. Considering the maximum allowable RoCoF alongside the traditional parameters of frequency bands and timeframes to restore frequency following events will be a prudent measure to provide certainty to the market. Adhering to a RoCoF standard will provide guidance for AEMO and subsequently market participants on setting the optimum mix of inertia and quantity and speed of FFR (or SPS) on a dynamic basis. In the absence of any standard there will be always a question on what maximum level of RoCoF should be allowed for each credible contingency or protected event.

Procurement of the necessary services

The Division acknowledges the Commission's main reasons behind choosing TNSPs to procure the required levels of inertia; being the discipline provided by the existing economic regulatory

[6] AEMO, *Black System South Australia 28 September 2016 – Final Report*, March 2017, pp. 61, 254, 261

framework for TNSPs' expenditure and the ability to coordinate the levels of inertia with other localised network support services such as system strength or voltage control requirements.

However, the Division's view, shared by many stakeholders, is that placing obligations on TNSPs in the Rules would likely lead to investments that are locked in for long periods of time for providing services that may vary considerably with changing system conditions.

As requested by the South Australian Government in its rule change proposal, a set of guidelines should be developed for AEMO to procure the necessary services, similar to the existing guidelines for SRAS. Upon consultation with market participants, the guidelines will have all the technical information that AEMO will be seeking for procuring the services, the contracting process (or ultimately a market-based process) for procuring the services and the criteria by which AEMO will be selecting and enabling the ancillary services when required in real-time.

With regards to other services, such as managing system strength, AEMO should be able to accommodate localised network requirements when designing a scheme to manage high RoCoF. A feasible solution would be expected to account for network support services already in place or required by the TNSP. Managing high RoCoF should not be contradictory, but rather complementary, to other localised operational planning schemes, such as Voltage Control.

Additional reasons for the preference for AEMO to procure the necessary services are:

- If inertia sub-networks encompass two or more NEM regions, AEMO has oversight of the entire affected sub-network and has more flexibility to develop solutions across regional boundaries.
- As mentioned in the Determination, the obligation on the TNSP to meet an inertia shortfall may require the TNSP to procure more than the shortfall if a synchronous generator dispatched in the market, which is also providing inertia, gets pushed out of the merit order because of the TNSP procurement, resulting in no extra inertia added. Apart from the fact that the use of a FFR service may resolve this situation to some extent, AEMO as the system and market operator should be in a better position to determine the most feasible quantity of inertia or FFR required, taking into account market outcomes.
- Negotiation for contracts by the TNSP for inertia or FFR will be challenged by having incomplete information on the frequency (and possibly the quantity) with which the service would be enabled by AEMO. Naturally, any potential service provider will need to know how often the service will be required to be able to negotiate a price and contract terms. AEMO is in a better position to provide this vital information with a higher degree of accuracy that would result in a robust and a fast process.
- Last but not least, AEMO is responsible for maintaining the power system in a secure operating state. As frequency deviation is a continuous measure from the start of a disturbance until frequency recovery, AEMO, as the system operator, is best placed to have full control of all available resources to manage system frequency. As the process of arresting, stabilising and restoring frequency is managed through the contingency FCAS market, it is logical to add the *resisting* frequency change as the initial phase of the FCAS process. Although, all those phases operate in succession, they cannot be separated by distinct boundaries.

Based on the above analysis, The Division is still of the view that the Rules should be amended to enable AEMO to procure the necessary ancillary services to manage high RoCoF. A proposed alternative process is described in broad terms as follows:

1. AEMO to determine sub-networks likely to have high RoCoF, requirements of inertia for each sub-network and shortfall in inertia in each sub-network. This point is not different from the proposed approach by the Commission, but it would be more straightforward and transparent to have a desired RoCoF to meet for each sub-network in order to facilitate AEMO's task and provide clarity for service providers on how their resources can provide the service.
2. AEMO to develop a set of technical specifications for the desired services. It is envisaged that such specifications, although technology neutral, will need to differentiate between inertia from synchronous plant (generators, condensers or load) and 'synthetic' inertia by fast injection or withdrawal of power from the grid.
3. Potential service providers to register their interest in providing the service with an initial proof of capability to provide the service.
4. AEMO to enter into negotiations with suitable candidates to assess price, timetable for implementation, measures to ensure availability and reliability of the service and any matters that AEMO sees of concern in consideration of the offered services.
5. AEMO to follow a set of evaluation criteria agreed by the industry stakeholders, and in coordination with the affected TNSPs for accommodating network support services, to select successful providers and enter into (preferably short-term) contractual arrangements with the necessary binding commitments. An ideal implementation of this step in the future is to have an open market for provision of the service in conjunction with the dispatch process for the co-optimised energy and ancillary service market. It is, however, acknowledged that a minimum level of inertia may have to be procured on a long-term basis from synchronous plant for security purposes of a region in case of islanding and for ensuring localised issues, such as system strength, are covered at all times.
6. AEMO to enable the services from a ranked schedule based on an optimised process taking into account operational cost, availability, reliability and any other operational constraints.

The Division urges the Commission to consider the above conceptual model as a viable option to satisfy the purpose of the rule change request by the South Australian Government. A key point in this model is that it gives AEMO the flexibility to use all available and potential resources more efficiently to meet the requirement of avoiding or resisting a high RoCoF. This also has the benefit of giving market participants the commercial incentive to commit resources and harness available technologies to provide the necessary services. Considered to be a forerunner to a fully open market in the future, this model can also accelerate the deployment of new technologies to accommodate the shift to new forms of generation in the power system rather than relying only on traditional synchronous resources. By openly specifying the necessary capabilities to provide the service, an emerging opportunity is created to direct the investment by new generation technologies to deliver the services at the outset rather than as a retrofit. Nevertheless, the Division accepts that further refinements or finer details will need to be considered if the proposed concept above is implemented as the preferred solution.