RIT-D Project Assessment Report

Complying with the Voltage Management &Under Frequency Load Shedding Emergency Standards

2 September 2022

SA Power Networks

www.sapowernetworks.com.au

Disclaimer

This Draft Project Assessment Report (DPAR) has been prepared in accordance with and is limited to the requirements of Clause 5.17.4 of the National Electricity Rules for the purpose of publicly announcing the provisional outcome of SA Power Networks evaluation of options in response to a specific set of identified needs. The DPAR is a summary or general description only of the matters considered by SA Power Networks when evaluating the various options. It is not intended to be used for other purposes, such as making decisions to invest in generation, transmission or distribution capacity. This document has been prepared using information provided by, and reports prepared by, a number of third parties. It contains assumptions regarding, among other things, economic growth and load forecasts that, by their nature, may or may not prove to be correct. SA Power Networks recommends and advises that anyone proposing to use this information should verify its reliability, accuracy and completeness before committing to any course of action or expenditure. SA Power Networks accepts no responsibility or liability of any nature whatsoever for any loss or damage that may be incurred by any person acting in reliance on the information or assumptions contained in this document. Any use of or reliance upon the information or assumptions contained in this report is at the sole risk of the user. SA Power Networks makes no warranties or representations whatsoever as to the reliability, accuracy and completeness of any information contained in this document. SA Power Networks specifically disclaims any liability or responsibility for any errors or omissions in any of the information contained in this document

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Contents

Executive summary

This report investigates the most economic option for complying with the VM&UFLS Emergency Standards

SA Power Networks is undertaking the Regulatory Investment Test – Distribution (RIT-D) for investment to comply with the requirements of the *Voltage Management and Under Frequency Load Shedding* (VM&UFLS) Emergency Standards, published by the Office of the Technical Regulator in December 2021. This Draft Project Assessment Report (DPAR) represents the second stage of the formal consultation process set out in the National Electricity Rules (NER) in relation to applying the RIT-D.

SA Power Networks considers the identified need for this investment to be a 'reliability corrective action' under the RIT-D

The lack of control at the distribution network level of DER generation, in combination with a power network originally developed for dispatchable generation, means that systems and controls are insufficient to ensure system security in the absence of tools to manage network flows from DER loads responsively.

The VM&UFLS Emergency Standards prescribe network investment by SA Power Networks targeted at addressing the power issues associated with DER, i.e., implementing enhanced voltage management and installing or amending relays to provide required functionality at specific substations and trip points within the SA Power Networks distribution network. SA Power Networks therefore considers the identified need for this investment to be a 'reliability corrective action' under the RIT-D because investment is required to comply with an applicable regulatory instrument.[1]

In particular, SA Power Networks is required to:

- implement and maintain a scheme of last resort that enables the effective curtailment of DER via management of distribution network voltage levels; and
- amend or install relays at various locations and levels in the distribution network with at least the following minimum functional characteristics:
  - are able to measure the power system frequency;
  - have the ability to measure the direction of power flow with a minimum sampling rate of not less than one measurement every five minutes;
  - are programmable such that they will only automatically disconnect a circuit in an under-frequency event if the circuit is a net load with respect to the overall power system; and
  - can disconnect feeders at such frequency as determined in consultation between SA Power Networks, the Technical Regulator and AEMO.

These investments will provide a firm foundation for enabling non-network solutions to address future system security issues.

One credible option has been assessed

SA Power Networks has identified one credible base case network option to meet the identified need. SA Power Networks acknowledges that it is uncommon to assess one credible option as part of a RIT-D. However, the prescriptive nature of the requirements set out in the VM&UFLS Emergency Standards provides limited scope to consider multiple credible options.

Further, the VM&UFLS Emergency Standards are the outcome of an extensive process of research, modelling and industry consultation between SA Power Networks, the Australian Energy Market Operator (AEMO) and representatives from the South Australian Government. This process itself

[1] Reliability corrective action is defined in clause 5.10.2 of the NER, while applicable regulatory instrument is defined in chapter 10 of the NER.

encompassed detailed consideration of investment options to provide the required capabilities at each substation site.

SA Power Networks has adopted a credible base case option because its existing network infrastructure does not meet the VM&UFLS Emergency Standards requirements, meaning a 'do-nothing' base case would result in non-compliance and so is not appropriate for this RIT-D.

The credible base case option involves the implementation of voltage management services and amendment or installation of prescriptive Under Frequency Load Shed (UFLS) protection infrastructure. In particular it comprises two stages:

- stage one – implementation of advanced voltage management capabilities, with the program of works sequenced to maximise the amount of voltage control as soon as possible. SA Power Networks recently completed this stage in July 2021 for $10.06 million (in June 2020 dollars);[2] and
- stage two – amendment or installation of UFLS infrastructure. This element of the credible base case option is estimated to cost $24.97 million, with the program of investments being delivered between 2022/23 and 2024/25.

A single scenario has been assessed and no categories of market benefit are considered material

The RIT-D is required to be based on a cost-benefit analysis that includes an assessment of reasonable scenarios of future supply and demand.[3] The AER's RIT-D application guidelines clarify that, in the context of a reliability corrective action, development of reasonable scenarios should seek to capture any variables or parameters that are likely to affect the ranking of the credible options.[4]

Due to there being only one credible option to meet the identified need, SA Power Networks has only modelled a single scenario for this RIT-D because there are no variables or parameters that will affect the ranking of the credible options. SA Power Networks considers this is a proportionate approach, consistent with the requirements of the RIT-D and the unique nature of this RIT-D application.

Further, SA Power Networks considers no categories of market benefit to be material to the outcome of this RIT-D because they will not change the ranking of the credible option. No categories of market benefit have therefore been quantified for this RIT-D.

Option 1 is the preferred option at this draft stage

The credible base case option (implementation of voltage management services and amendment or installation of prescriptive UFLS infrastructure) is the preferred option which satisfies the RIT-D.

It represents the outcome of an extensive process of research, modelling and industry consultation between SA Power Networks, the Australian Energy Market Operator (AEMO) and representatives from the South Australian Government. This process itself encompassed detailed consideration of investment options to provide the required capabilities at each substation site.

The table below provides a summary of the net market benefit in NPV terms for the credible option for the single scenario assessed. In particular, it shows that Option 1 has negative net market benefits (noting no benefits have been quantified) of $35 million. SA Power Networks notes that the preferred option is permitted to have a negative net market benefit due to the identified need being reliability corrective action.

[2] This expenditure is currently subject to a cost pass through application to the AER. It has been included in this RIT-D to demonstrate that the EVM component comprises part of the preferred solution and that a RIT-D has been applied to it – consistent with the requirement to apply the RIT-D to all investments above the current threshold of $6 million. Taken together, the cost pass through and RIT-D are complementary regulatory measures that form the most appropriate regulatory mechanism for implementing the final recommendations under the VM&UFLS Emergency Standards.

[3] Clause 5.17.1(c)(1) of the NER.

[4] AER, *Application guidelines | Regulatory investment test for distribution,* December 2018, page 42.

Table E 1: Capital expenditure and NPV results for the credible option

	2020/21	2021/22	2022/23	2023/24
VM&UFLS emergency work	-10.06	-		
DUFLS&UFLS		-1.554	-12.16	-11.25
NPV	-27.74			

Submissions requested to the DPAR

SA Power Networks seeks written submissions from market participants and interested parties in relation to the preferred option outlined in this document. The consultation period is 6 weeks and submissions are due on or before 17 October 2022. Submissions and any subsequent response by SA Power Networks may be published.

If you have any comments or enquiries regarding this report please make a submission to the following email: requestforproposals@sapowernetworks.com.au.

1 Introduction

SA Power Networks is undertaking the Regulatory Investment Test – Distribution (RIT-D) for investment to comply with the requirements of the *Voltage Management and Under Frequency Load Shedding* (VM&UFLS) Emergency Standards, published by the Office of the Technical Regulator in December 2021.

The lack of control at the distribution network level of Distributed Energy Resources (DER), in combination with a power network originally developed for dispatchable generation, means that existing systems and controls are insufficient to ensure system security in the absence of tools to manage network flows from DER generation responsively. The VM&UFLS Emergency Standards prescribe network investment by SA Power Networks targeted at addressing the immediate system security issues associated with DER, i.e., implementing voltage management and installing or amending relays to provide specific functionality at specific substations and trip points within the SA Power Networks distribution network.

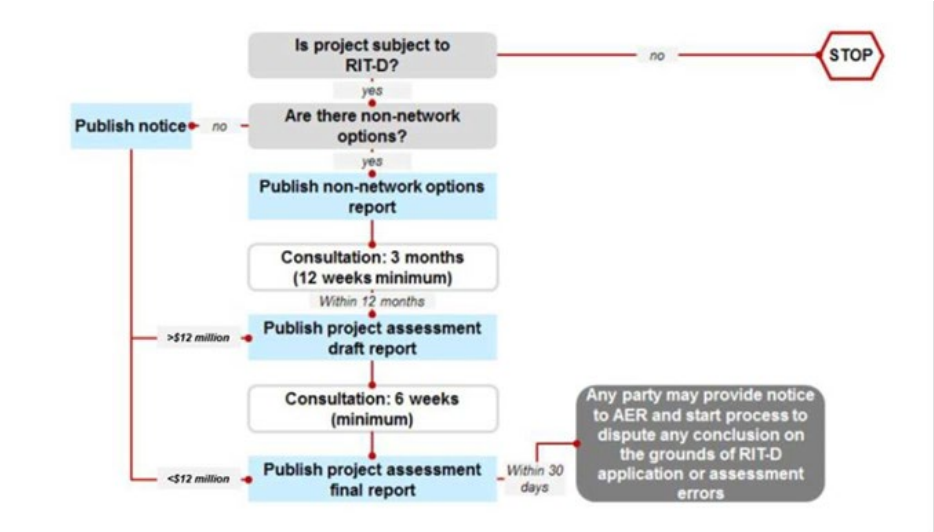
SA Power Networks has initiated this RIT-D to investigate and consult on options to comply with the VM&UFLS Emergency Standards.

1.1 Role of this Draft Project Assessment Report

SA Power Networks has prepared this Draft Project Assessment Report (DPAR) in accordance with the requirements of clause 5.17.4 of the National Electricity Rules (NER). It is the second stage of the formal consultation process set out in the NER in relation to applying the RIT-D – figure 1.1 below.

This DPAR follows the publication by SA Power Networks of the options screening notice. SA Power Networks has concluded that there will not be a non-network option, or stand alone power system (SAPS) option, that could form a potential credible option on a standalone basis, or that could form a significant part of a potential credible option for this RIT-D. This is due to the specific nature of the VM&UFLS Emergency Standard, which mandates specific network functionality at specific locations in the network.

Figure 1.1: Overview of the RIT-D process



The purpose of this DPAR is to:

- describe the identified need SA Power Networks is seeking to address, together with the assumptions used in identifying it;
- provide a description of each credible option assessed;
- quantify relevant costs and market benefits for each credible option;
- describe the methodologies used in quantifying each class of cost and market benefit;
- explain why SA Power Networks has determined that classes of market benefits or costs do not apply to the credible options;
- present the results of a net present value analysis of each credible option, including an explanation of the results; and
- identify the proposed preferred option.

The next step of this RIT-D involves publication of a Final Project Assessment Report (FPAR). The FPAR will update the assessment in light of any submissions received on this DPAR. SA Power Networks intends to publish the FPAR as soon as practicable after submissions are received on this DPAR.

SA Power Networks notes that the investments required to comply with the VM&UFLS Emergency Standards represent the foundational infrastructure required to address the issues being caused by DER – they will not solve the issues in isolation. Rather, these investments will provide a firm foundation for enabling non-network solutions to address future system security issues. By way of example, SA Power Networks is currently collaborating with the Australian Energy Market Operator (AEMO) to define a new Emergency Under Frequency Response (EUFR) service that would enable non-network options to offer this service to help support the network.[5] SA Power Networks is keen to engage with potential non-network proponents going forward, in addressing future network issues.

1.2 Submissions requested to the DPAR

SA Power Networks seeks written submissions from market participants and interested parties in relation to the preferred option outlined in this document. The consultation period is 6 weeks and submissions are due on or before 17 October 2022. Submissions and any subsequent response by SA Power Networks may be published.

If you have any comments or enquiries regarding this report please make a submission to the following email: requestforproposals@sapowernetworks.com.au.

1.3 Relationship to emergency standards cost pass through application

On 7 April 2022 SA Power Networks submitted an application under clause 6.6.1 of the NER to the Australian Energy Regulator (AER) for a positive pass through of costs associated with the new regulatory obligations stemming from the VM&UFLS Emergency Standards.[6]

The focus of the cost pass through process is to seek an increase in SA Power Networks' allowed revenue for the current 2020-25 regulatory control period, to account for the unforeseen expenditure associated with these new obligations. In particular, SA Power Networks estimates it will incur $35 million in capital expenditure during the regulatory control period in order to meet and satisfy the requirements of the VM&UFLS Emergency Standards. This comprises:

- $10.06 million of capital expenditure on enhanced voltage management (EVM) expenditure; and
- $24.97 million (June 2020) of capital expenditure on dynamic under frequency load shedding and under frequency load shedding (DUFLS/UFLS).

[5] More details of this initiative are available at: https://www.sapowernetworks.com.au/industry/tenders/.
[6] Available at: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/cost-pass-throughs/sa-power-networks-cost-pass-through-emergency-standards-2021%E2%80%9322

SA Power Networks has already incurred the expenditure relating to EVM (with investment completed in July 2021). It was not possible or appropriate at that time to proceed to determine and implement the most appropriate regulatory mechanism for implementing the final recommendations from the investigation and modelling processes. However, the potential consequences of delaying the commencement of the initial EVM work pending the enactment of a regulatory mechanism for implementing the final recommendations, were so serious that SA Power Networks was prepared to agree to undertake this initial EVM work prior to finalisation and enactment of the emergency standards regulatory mechanisms.

That expenditure has been included in this RIT-D to demonstrate that the EVM component comprises part of the preferred solution and that a RIT-D has been applied to it – consistent with the requirement to apply the RIT-D to all investments above the current threshold of $6 million.[7] Taken together, the cost pass through and RIT-D are complementary regulatory measures that form the most appropriate regulatory mechanism for implementing the final recommendations under the VM&UFLS Emergency Standards.

[7] NER Clause 5.17.3. There are some exceptions set out in the NER to this requirement, none of which apply to the investment being considered in this RIT-D.

2 Description of the identified need

SA Power Networks considers the identified need for this investment to be a 'reliability corrective action' under the RIT-D.

In particular, investment is required to comply with an applicable regulatory instrument,[8] namely the *Technical Regulatory Emergency Standards – Voltage Management and Under Frequency Load Shedding"* (VM&UFLS Emergency Standards) published by the Office of the Technical Regulator on 21 December 2021.[9]

The remainder of this section describes the emerging issues relating to increased integration of Distributed Energy Resources (DER) in the SA Power Networks distribution network that led to the development of the VM&UFLS Emergency Standards, before outlining the relevant requirements under those standards.

2.1 DER are causing system security issues for the South Australian electricity grid

South Australia is at the forefront of the integration of DER in the National Electricity Market (NEM). There has been significant uptake in the extent of DER connected to SA Power Networks' distribution network, including significant growth in embedded generation such as solar PV connections.

The continued growth of DER will provide benefits for many South Australian consumers. Notwithstanding, high concentrations of DER can present serious power system security and security of supply issues for the South Australian grid if not addressed.

There are two separate but related issues currently facing the South Australian electricity grid due to high penetration of uncontrolled DER.

First, the high uptake of DER in South Australia has decreased minimum load demand, with zero operational demand conditions occurring multiple times over the last three years. A minimum amount of operational load demand is required for AEMO to maintain a secure electricity system when South Australia is operated islanded from the rest of the NEM. This lack of operational demand imposes operational risks on the system when there is a credible risk of separation of South Australia from the NEM. To continue to operate the system in a secure state it is necessary to curtail renewable generation with South Australia and place operational limits on the South Australia to Victoria interconnector flows. Without these controls the system faces stability challenges for both credible and 'non-credible' events such as interconnector separation.

SA Power Networks, along with other distribution network service providers (DNSPs) in the NEM, currently has no control over embedded generation installed at the household and small business levels. An emergency control scheme is therefore required to disconnect these rooftop solar inverters in a controlled manner when directed by AEMO. This issue is particularly pertinent in South Australia due to the NEM-leading levels of DER penetration in the distribution network.

Second, there are significant issues with the current implementation of the under-frequency load shedding (UFLS) mechanism used for managing system security. UFLS is an emergency frequency control scheme that operates as the last line of defence to managing severe frequency disturbances. It enables the disconnection of load to correct large supply-demand imbalances and reduces the likelihood of cascading failures when severe disturbances do occur.

[8] Reliability corrective action is defined in clause 5.10.2 of the NER, while applicable regulatory instrument is defined in chapter 10 of the NER.

[9] Regulation 55H(1) of Division 1A of the *South Australian Electricity (General) Regulations 2012* empowers the Technical Regulator to publish technical and operational standards that must be applied so that electricity infrastructure and electrical installations are installed, maintained and operated in a manner that facilities the taking of effective emergency action. These are referred to as emergency standards.

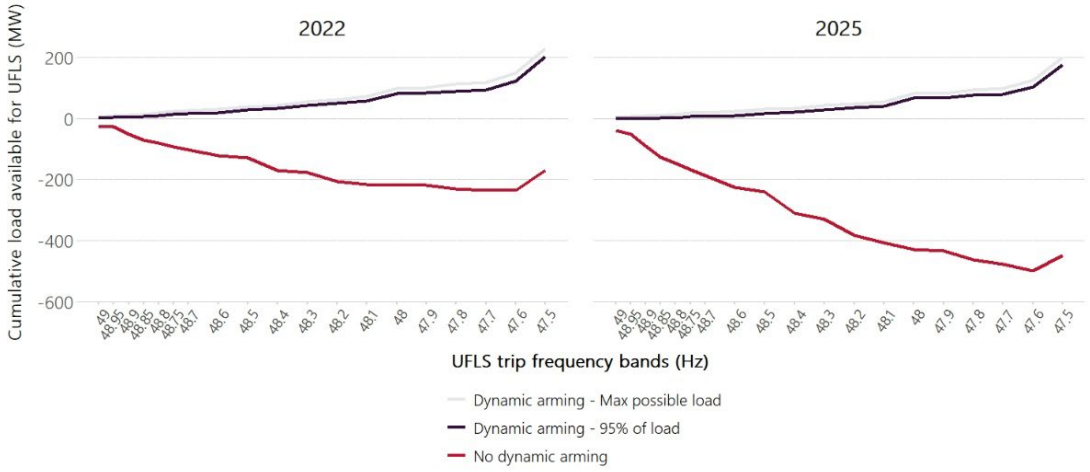
Traditional UFLS schemes are not effective in the presence of high levels of DER generation for two key reasons:

- to be effective UFLS requires a net load available to shed to restore network frequency. However, significant growth of distributed PV has reduced the net load on the South Australia UFLS scheme, thereby reducing the load available to be shed; and
- UFLS schemes may exacerbate frequency decline when circuits are operating in reverse flows (i.e., where net load on the UFLS scheme is negative), because conventional UFLS schemes trip circuits without discrimination during frequency disturbances, where that load may be a net generator to the system – only serving to increase the prevailing load imbalance.

A consequence of these shortcomings of traditional UFLS schemes in the context of a high prevalence of DER is that they may escalate frequency disturbances and lead to system black events. Importantly, this risk is likely to grow because reverse flow conditions are increasing in incidence. SA Power Networks notes that over half of UFLS load blocks operated in reverse flow in some periods in 2020.

Figure 2.1 presents the cumulative load available for UFLS with and without the ability to selectively trip only those circuits that are operating as net loads, i.e. to dynamically enable and disable UFLS depending on the direction of energy flow. This ability to enable and disable UFLS protection based on energy flow is referred to as Dynamic Arming.

Figure 2.1: Load availability for UFLS with and without dynamic arming

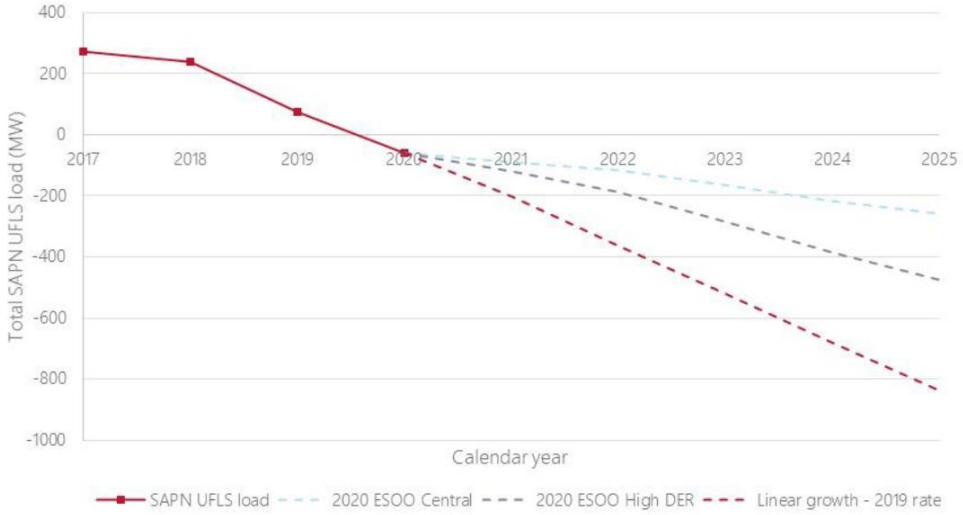


Source: AEMO, *South Australian Under Frequency Load Shedding Dynamic Arming Implementation investigation*, May 2021.

Figure 2.2 shows the total net UFLS load in South Australia on SA Power Networks' distribution network in the period of the lowest UFLS load.

In 2020, SA Power Networks' network experienced a negative net load of 60 MW – significantly hindering the ability of SA Power Networks' UFLS scheme to operate effectively. Under AEMO forecasts, this net load is projected to fall further to an estimated -120 MW to -360 MW in the lowest period in 2022.

Figure 2.2: Total SA Power Networks UFLS load in the lowest UFLS load period



Source: AEMO, *South Australian Under Frequency Load Shedding Dynamic Arming Implementation investigation*, May 2021.

2.2 New emergency standards have been introduced to address these issues

The lack of control at the distribution network level of DER generation, in combination with a power network originally developed for dispatchable generation, means that existing systems and controls are insufficient to ensure system security in the absence of tools to manage network flows from DER loads responsively.

In light of these concerns, the Office of the Technical Regulator in South Australia has prepared the "*Technical Regulatory Emergency Standards – Voltage Management and Under Frequency Load Shedding"* (VM&UFLS Emergency Standards), which were published on 21 December 2021.[10] Although prepared by the Technical Regulator, the VM&UFLS Emergency Standards are the outcome of an extensive process of research, modelling and industry consultation between SA Power Networks, AEMO and representatives from the Office of the Technical Regulator.

The VM&UFLS Emergency standards apply solely to SA Power Networks and have been designed to address two distinct power issues associated with DER. These are:

- the need for capability to disconnect embedded generation including roof top solar quickly during emergency conditions when there is high DER generation coincident with low demand load and a risk of separation, so as to maintain a minimum operational demand on the power system; and
- the need to facilitate load shedding during under-frequency emergency events while also ensuring circuits that are net generators of power are not disconnected.

[10] Regulation 55H(1) of Division 1A of the *South Australian Electricity (General) Regulations 2012* empowers the Technical Regulator to publish technical and operational standards that must be applied so that electricity infrastructure and electrical installations are installed, maintained and operated in a manner that facilities the taking of effective emergency action. These are referred to as emergency standards.

To address these issues, the VM&UFLS Emergency Standards require SA Power Networks to:

- implement and maintain a scheme of last resort that enables the effective curtailment of DER via management of distribution network voltage levels. This scheme of last resort must be available to automatically control network voltages within the SA Power Networks electricity infrastructure listed in Appendix 2 to the VM&UFLS Emergency Standards;
- amend or install relays within the SA Power Networks electricity infrastructure listed in Appendix 3 to the VM&UFLS Emergency Standards, so that the relays have the following characteristics:
  - are able to measure the power system frequency;
  - have the ability to measure the direction of power flow with a minimum sampling rate of not less than one measurement every five minutes; and
  - are programmable such that they will only automatically disconnect a circuit in an under-frequency event if the circuit is a net load with respect to the overall power system; and
- amend or install relays within the specific SA Power Networks electricity infrastructure listed in Appendix 4 to the VM&UFLS Emergency Standards so that the relays have the following characteristics:
  - are able to measure the power system frequency; and
  - can disconnect feeders at such frequency as determined in consultation between SA Power Networks, the Technical Regulator and the Australian Energy Market Operator (AEMO).

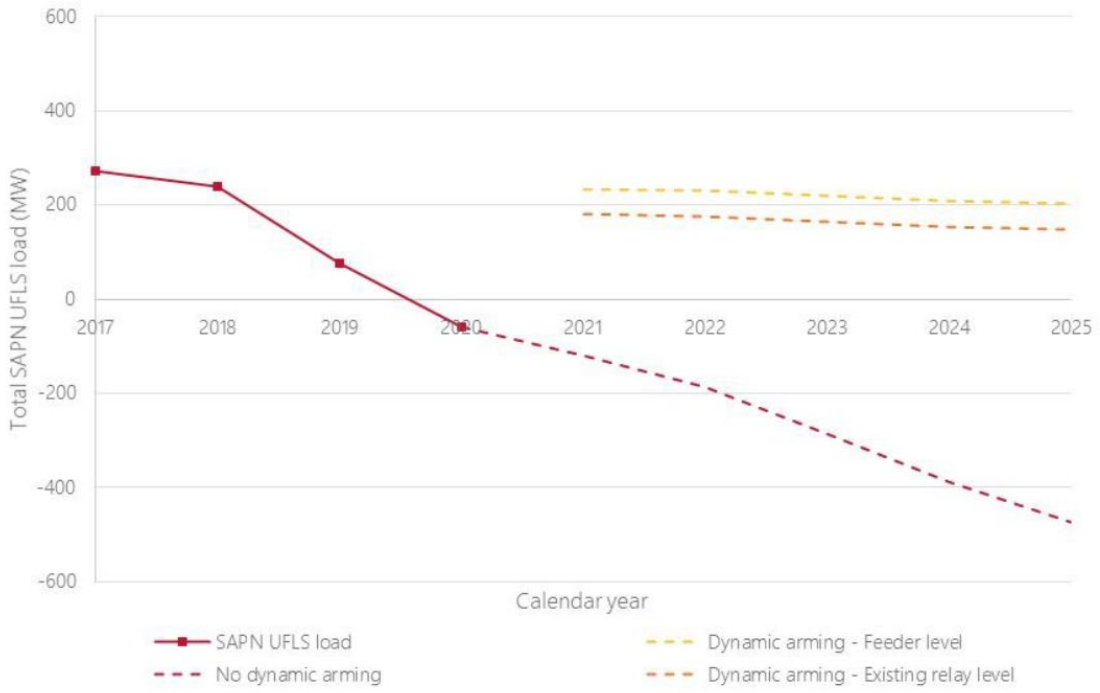
It follows from the above requirements that the VM&UFLS Emergency Standards place prescriptive substation site-specific requirements on SA Power Networks, i.e., they specify the installation or amendment of relays to provide specific functionality at specific substations and trip points within those substations (designated as either the feeder, bus, or line level within that substation site). SA Power Networks' existing network infrastructure does not satisfy these requirements. In particular:

- the substation voltage control relays were principally electromechanical relays that were incapable of receiving a remote controlled setpoint to adjust the substation voltage. These relays have required replacement with modern electronic equivalent relays to provide the necessary voltage control functionality;[11]
- the UFLS scheme currently in service principally uses relays that are incapable of measuring the direction of power flow and cannot be programmed to trip for a given direction of power flow – these relays will need to be replaced with modern electronic equivalent relays to provide the necessary functionality;
- many existing UFLS relays in service only operate at the bus level within the substation, or at the line exit of a transmission connection point, meaning for those substations that require feeder level tripping the existing relays will need to be removed from service and replaced with compliant protection relays on each of the specified feeder exits; and
- for those substation sites where there is an existing protection relay in service that meets the minimum requirements, it will need to be re-configured and re-commissioned to deliver the required functionality.

Figure 2.3 below demonstrates the projected increase in net UFLS load with the addition of relays capable of dynamic-arming, compared to the current and already negative load in the lowest UFLS load period.

[11] Section 1.3 describes the relationship between this RIT-D and the current cost pass through application.

Figure 2.3: SA Power Networks UFLS load in lowest UFLS load period with and without dynamic arming



Source: AEMO, *South Australian Under Frequency Load Shedding Dynamic Arming Implementation investigation*, May 2021.

3 Proposed options to meet the identified need

SA Power Networks has identified one credible network option to meet the identified need. This section provides more information on the scope and cost of this option. It also outlines options considered but not progressed.

SA Power Networks acknowledges that it is uncommon to only assess one credible option as part of a RIT-D. However, the prescriptive nature of the requirements set out in the VM&UFLS Emergency Standards provides limited scope to consider multiple credible options.

Further, as noted earlier, the Standards are the outcome of an extensive process of research, modelling and industry consultation between SA Power Networks, AEMO and representatives from the South Australian Government. This process itself encompassed detailed consideration of investment options to provide the required capabilities at each substation site (discussed further below).

3.1 Base case credible option – implementation of voltage management services and amendment or installation of prescriptive UFLS infrastructure

A credible base case option has been developed for the purposes of this DPAR, as permitted under the RIT-D when the identified need is for a reliability corrective action.[12]

As outlined in section 2.2, SA Power Networks' existing network infrastructure does not meet the VM&UFLS Emergency Standards requirements. A 'do-nothing' base case would therefore result in non-compliance and so is not appropriate for this RIT-D.

The remainder of this section describes the two stages of the base case credible option in detail.

3.1.1 Stage 1: implementation of advanced voltage management capabilities

The first stage of the base option works is the installation of voltage management systems at 138 zone substations in line with the requirements of the VM&UFLS Emergency Standards. These sites are characterised by high levels of DER penetration.

The locations specified in the VM&UFLS Emergency Standards reflect detailed analysis undertaken by SA Power Networks and AEMO to identify those zone substations that can provide the most effective voltage management capability. Underpinning this analysis was the objective of ensuring that the response to the need for increased voltage management capabilities was proportionate to the cost of implementing the solution and the benefits that would accrue from its implementation at the identified zone substations.

The program has been sequenced to ensure that the greatest amount of voltage control can be achieved as soon as possible. In particular, the upgrades have been sequenced in increasing order of complexity and cost – substations with existing modern programmable relays were re-commissioned first, with those requiring more significant augmentation addressed subsequently.

Specifically, the three phases of the program comprise:

- re-commissioning existing relays to support advanced voltage controls;
- upgrading the modules of modern but not technically capable relays, so that the necessary voltage management capability can be achieved; and
- replacing legacy relay schemes with a retrofitted or modern solution to enable necessary voltage controls.

[12] AER, *Application guidelines | Regulatory investment test for distribution,* December 2018, page 21.

SA Power Networks has recently completed this stage of the base case option. Specifically, these works were completed in July 2021 for $10.06 million and should enable up to 250 MW of rooftop solar to be curtailed across South Australia at the direction of AEMO.[13]

3.1.2 Stage 2: amendment or installation of UFLS infrastructure

The second stage of the credible base case option involves the amendment or installation of modern relay equipment at locations identified in the VM&UFLS Emergency Standards. This initiative will, through the replacement of legacy relays, restore up to 400 MW of load-shedding capability to the UFLS scheme that has been eroded by the installations of DER on the network.

In total, SA Power Networks is required under the VM&UFLS Emergency Standards to install more than 350 new protection relays and re-configure an existing further 200 protection relays. The specified locations for the replacement of relays reflect the outcome of extensive and detailed assessment by SA Power Networks and AEMO concerning the locations where the installation of dynamic UFLS relays would deliver the greatest benefit for the associated cost.

As discussed in section 2.2, the extent to which SA Power Networks' existing infrastructure meets the VM&UFLS Emergency Standards differs significantly across the network. SA Power Networks has therefore sequenced the program of works for the amendment and installation of relays to provide the greatest benefit to consumers. Modern relays which only require reprogramming will be re-commissioned first, followed by relays where only minor upgrades are required to meet the Emergency Standards. The final stage of the program will involve the total replacement of legacy relays.

This element of the credible base case option is estimated to cost $24.97 million, with the program of investments being delivered between 2022/23 to 2024/25.

3.1.3 Stage 3: Expansion of UFLS infrastructure

The third stage of the credible base case option involves expanding the UFLS to locations in the network that does not currently have the capability. This element of the credible base case option in estimated to cost $1.57 million, with the program of investments being delivered between 2022/23 and 2024/25.

3.2 Options considered but not progressed

The prescriptive nature of the network investment required to comply with the VM&UFLS Emergency Standards is such that there is limited scope for alternative technical solutions to meet the identified need. However, SA Power Networks has considered the scope to vary the timing of the program of investment.

Importantly, SA Power Networks is required to comply with the VM&UFLS Emergency Standards as soon as possible and the sequencing of the investments in the base option (described above) have been designed to reflect this requirement. Although a faster installation program could be pursued, it would be associated with higher costs (because it would require additional resourcing beyond SA Power Networks' existing contractual relationships) and is unlikely to deliver any additional benefits to the credible base case option. This is because the sequencing of the investments under the credible base case option is targeted at maximising enhanced voltage management and dynamic arming as quickly as possible, to the greatest benefit of network operation and therefore consumers.

[13] This expenditure is currently subject to a cost pass through application to the AER. It has been included in this RIT-D to demonstrate that the EVM component comprises part of the preferred solution and that a RIT-D has been applied to it – consistent with the requirement to apply the RIT-D to all investments above the current threshold of $6 million. Taken together, the cost pass through and RIT-D are complementary regulatory measures that form the most appropriate regulatory mechanism for implementing the final recommendations under the VM&UFLS Emergency Standards.

4 Assessment framework

This section outlines the methodology that SA Power Networks has applied in assessing the market benefits and costs associated with the credible option considered in this RIT-D.

4.1 Overview of the assessment framework

SA Power Networks has developed a base case credible option for this RIT-D whereby network investment is undertaken to establish enhanced voltage management and amend or install relays consistent with the requirements of the VM&UFLS Emergency Standards.

The RIT-D analysis has been undertaken over a 15-year period, from 2021 to 2035 inclusive. SA Power Networks considers that this assessment period best accounts for the expected life of the credible option and therefore captures all investment associated with meeting initial compliance with the VM&UFLS Emergency Standards.

While the capital components of the credible option have asset lives greater than the assessment period (due to the commissioning dates), a terminal value approach is used to incorporate capital costs in the assessment, which ensures that the capital costs of long-lived options is appropriately captured in the 15-year assessment period.

SA Power Networks has adopted a central real, pre-tax discount rate of 2.34 per cent for the purposes of this RIT-D assessment. This corresponds to the average regulated cost of capital in the AER's most recent determination (ie, for the Victorian DNSPs). This discount rate has been adopted because investment to comply with the VM&UFLS Emergency Standards is a clear regulated investment and there are no market benefits incorporated in the NPV assessment.

4.2 No categories of market benefit are considered material

SA Power Networks is required under the RIT-D to consider whether each credible option could deliver the classes of market benefits set out in clause 5.17.1(c)(4) of the NER. However, quantification of these market benefits is not required in the context of an identified need that is a reliability corrective action because such investments are permitted to have negative net economic benefits.[14]

Due to there being only one credible option to meet the identified need, SA Power Networks considers no categories of market benefit to be material to the outcome of this RIT-D because they will not change the ranking of the credible options. No categories of market benefit have therefore been quantified for this RIT-D.

SA Power Networks considers this is a proportionate approach, consistent with the requirements of the RIT-D, and an approach that recognises the unique nature of this RIT-D application.

4.3 A single scenario has been modelled

The RIT-D is required to be based on a cost-benefit analysis that must include an assessment of reasonable scenarios of future supply and demand.[15] The AER's RIT-D application guidelines clarify that, in the context of a reliability corrective action, development of reasonable scenarios should seek to capture any variables or parameters that are likely to affect the ranking of the credible options.[16]

Due to there being only one credible option to meet the identified need, SA Power Networks has only modelled a single scenario for this RIT-D because there are no variables or parameters that will affect the ranking of the credible options. SA Power Networks considers this is a proportionate approach, consistent with the requirements of the RIT-D the unique nature of this RIT-D application.

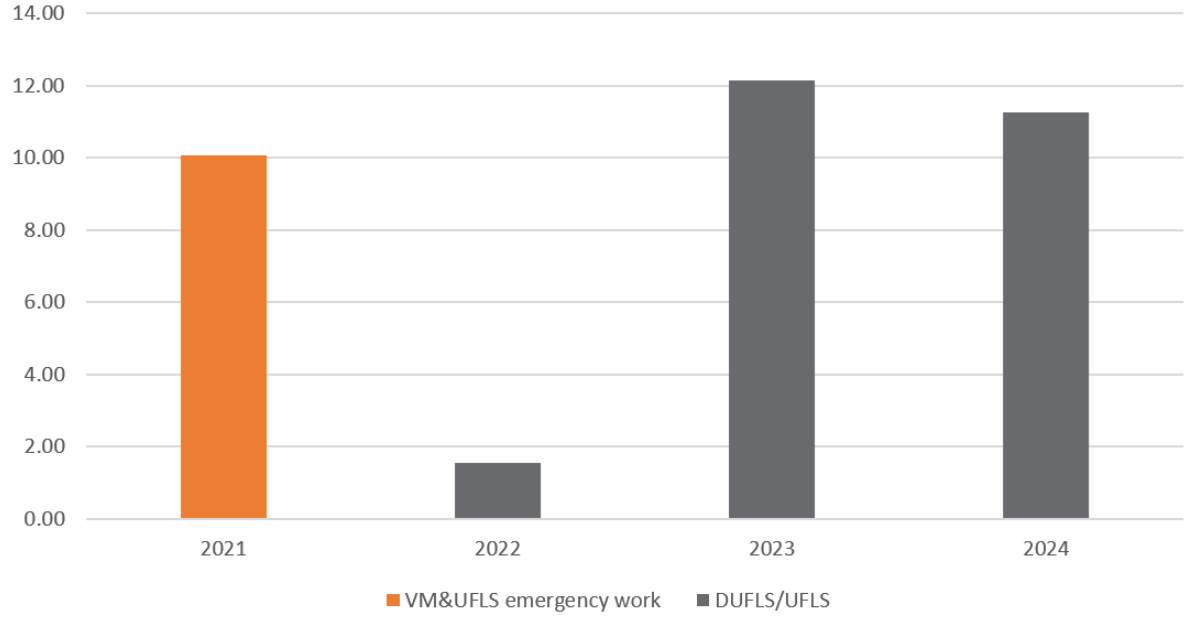
[14] AER, *Application guidelines | Regulatory investment test for distribution,* December 2018, page 33.
[15] Clause 5.17.1(c)(1) of the NER.
[16] AER, *Application guidelines | Regulatory investment test for distribution,* December 2018, page 42.

5 NPV analysis

This section summarises the results of the NPV analysis for the base case credible option assessed as part of this RIT-D.

The figure below provides a breakdown of the costs of the proposed program of works for the base case credible option over the four financial years following FY21/22. Note that costs are presented in June 2020 dollars consistent the previous cost pass-through application.

Figure 5.1: Timing of capital expenditure



5.1 Estimated costs for the credible option

The cost of the base case credible option is $35 million comprising:

- $10.06 million for the first stage of enhanced voltage management works and emergency UFLS commissioning for works completed before 31 March 2021;
- $23.39 million for dynamic arming with upgrades taking place from 2022 to 2024; and
- $1.57 million for expansion of UFLS to areas of the network that did not carry functionality.

After accounting for terminal values associated with varying asset lives, the net present value cost of this option is approximately $27.74 million (June 2020).

6 Conclusion

The credible base case option (Implementation of voltage management services and amendment or installation of prescriptive UFLS infrastructure) is the preferred option which satisfies the RIT-D.

SA Power Networks acknowledges that it is uncommon to assess one credible option as part of a RIT-D. However, the prescriptive nature of the requirements set out in the VM&UFLS Emergency Standards provides limited scope to consider multiple credible options. Further, the preferred option represents the outcome of an extensive process of research, modelling and industry consultation between SA Power Networks, the Australian Energy Market Operator (AEMO) and representatives from the Office of the Technical Regulator. This process itself encompassed detailed consideration of investment options to provide the required capabilities at each substation site.

The estimated capital cost of this option is approximately $35 million, with any operating costs associated with the option not expected to be material.

SA Power Networks considers that this DPAR and accompanying rationale satisfies the RIT-D pursuant to AER guidelines and the NER.