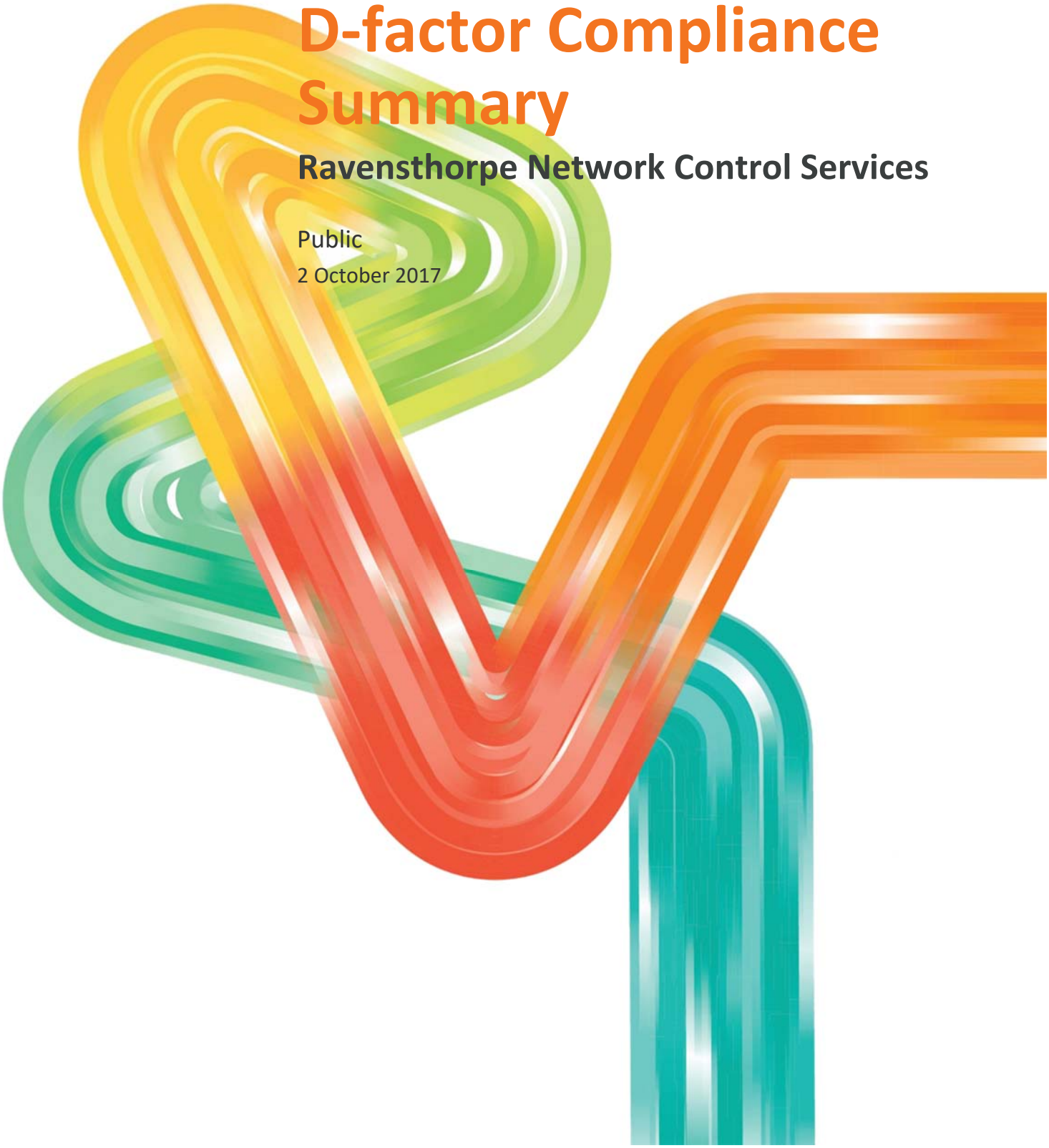
D-factor Compliance Summary

Ravensthorpe Network Control Services

Public

2 October 2017



An appropriate citation for this paper is:

D-factor Compliance Summary

Western Power

363 Wellington Street
Perth WA 6000
GPO Box L921 Perth WA 6842

T: 13 10 87 | Fax: 08 9225 2660
TTY 1800 13 13 51 | TIS 13 14 50

Electricity Networks Corporation
ABN 18 540 492 861

enquiry@westernpower.com.au
westernpower.com.au

Enquiries about this report should be directed to:

AA4 Project Team

Email: AA4@westernpower.com.au

Contents

1. Purpose 1
2. D-factor Compliance 2
3. Compliance with works program governance framework 12
4. Endorsements 13

1. Purpose

This D-factor Compliance Summary has been prepared to support Western Power's proposed D-factor adjustment to target revenue over the fourth Access Arrangement (**AA4**) period. Specifically, this Compliance Summary details the additional non capital costs incurred by Western Power during the third Access Arrangement (**AA3**) period in relation to demand management initiatives or Network Control Services (**NCS**).

Its primary purpose is to:

i. demonstrate that the NCS relates to demand management or a generation solution that would otherwise require network augmentation

ii. demonstrate that the operating expenditure proposed complies with the requirements of Sections 6.40 and 6.41 of the *Electricity Networks Access Code 2004* (**Code**).

This document provides a summary of the key information required to demonstrate compliance with the requirements of the access arrangement and the Code. This document also provides references to the key documents that support this Compliance Summary and capture the decisions and justifications made throughout the course of the project/program.

Where relevant, this D-factor Compliance Summary supplements key documents by:

- providing references to additional information and documents which assist in demonstrating compliance, created during AA3 but not referenced or included in the key project documentation
- providing supplementary information which supports and/or demonstrates compliance of the project where this was not apparent in any existing documentation
- providing evidence of compliance with the Works Program Governance Framework.

2. D-factor Compliance

Project / Program Numbers:	Gnowangerup Feeder Reinforcement [redacted]
Strategy / Activity Description:	NCS provision for the Ravensthorpe Power Station
Business case(s):	[redacted]
Regulatory Category:	Non-recurring operating expenditure

Project Overview:

NCS enable Western Power to procure generation and demand management in localised areas of network constraint and thereby defer the need for more costly network augmentation. The Ravensthorpe Power Station has been providing NCS since 2012/13. In this case, localised generation can be dispatched in response to network contingencies at peak times to ensure that covered services can be provided and reliability is not compromised. The proceeding information demonstrates the requirement for investment on the Gnowangerup Feeder and that the Ravensthorpe NCS is the most efficient solution which effectively deals with concerns relating to reliability and capacity.

Ravensthorpe is serviced by the Gnowangerup Feeder, one of the longest feeders in the Western Power network, at 370km long. The feeder supplies approximately 1200 customers, a number of which experience issues associated with unsatisfactory supply. Due to its length and remote location the feeder presents some unique challenges including poor reliability, inability to cater for short term demand growth and quality of supply issues.

Prior to 2009, the Gnowangerup Feeder had close to no spare capacity. Consequently, the cost of new connections and the cost of increasing the supply capacity of existing connections was prohibitive as it would require significant augmentation. In 2009 the WA State Government, in recognition of these issues, funded a temporary power station in Ravensthorpe for two years. The power station was only used to supply the local Ravensthorpe town load and, with the Gnowangerup Feeder disconnected, operated as a network island. The commissioning of the power station alleviated some of the capacity issues on the Gnowangerup Feeder. As a result new load connections could proceed as they no longer faced prohibitive network augmentation costs. Furthermore, there was a significant improvement in reliability performance for those customers located in the Ravensthorpe town.

The monthly operating costs of the Ravensthorpe Power Station were significantly higher than expected and Government funding was exhausted before the December 2011 expected end date. This resulted in the power station being turned off and the Gnowangerup Feeder reconnected to Ravensthorpe. As a result, the issues of poor reliability, capacity constraints and quality of supply returned. An interim seasonal islanding scheme was implemented as a bridging solution to alleviate these issues.

In 2010 as part of ongoing planning Western Power undertook a comprehensive medium term planning study to determine the optimal solution for the issues encountered on the Gnowangerup Feeder. It was determined that any viable solution must:

- conform with the voltage profile limits defined in the Technical Rules
- ensure overhead conductors, underground cables, voltage regulators and other network equipment are not overloaded
- provide adequate protection reach[1].

1 Protection reach ensures that when a fault is detected on the network, supply is disconnected.

Of the 12 options considered in this study, two were considered to satisfy these criteria while representing the best value for money. These options were considered further in the Gnowangerup Feeder Reinforcement – [redacted] Ravensthorpe Edge of Grid Solution – Stage 2 Business Case.

The business case determined that NCS provision, via daily peak load lopping on the Gnowangerup Feeder, was the most efficient option and would provide adequate network capacity, improve security of supply and comply with the Technical Rules. This option is also sufficiently flexible and able to meet the changing needs of the surrounding community.

Western Power sought an extension of the seasonal islanding scheme until 2013, when the smart control system at the Ravensthorpe Power Station was commissioned. This control system was funded through the capital expenditure portion of the Gnowangerup Feeder Stage 2 business case[2]. The smart control system facilitated automation of daily peak lopping, bumpless transfers and bumpless reconnections. The bumpless capability ensures that there is no interruption to customers when transferring supply between the Ravensthorpe Power Station and the SWIS. Consequently, the power station run-time is considerably shorter at present with the 'new' configuration than it was with the 'old' configuration.

As noted in the business case, modifications were required to the Katanning substation, Gnowangerup Feeder and Supervisory Control and Data Acquisition (**SCADA**) systems to enable automated 'bumpless' islanding of the Ravensthorpe network. Some minor network reinforcement was also required to facilitate the daily peak lopping via the Ravensthorpe Power Station. However, for the purpose of this D-factor compliance summary only the operating costs relating to the contract with [redacted] for the ongoing lease, management and running costs for the Ravensthorpe Power Station are presented.

Table 1: Investment reconciliation overview ($M, nominal):

		$M, nominal
Internal approvals	AA3 submission*	[redacted]
	Business case	[redacted]
	Business case + change control	[redacted]
AA3	AA3 Actual	[redacted]
Variances	To AA3 submission*	[redacted]
	To internal approvals	[redacted]

* Note there was no approved expenditure associated with this project in AA3 as the Economic Regulation Authority advised that all NCS expenditure was to be recovered through the D-factor mechanism if it could be demonstrated that the expenditure met Code requirements 6.40 and 6.41. The AA3 submission forecasts represent the expenditure proposed by Western Power in its initial submission on the Proposed Revisions to the Access Arrangement for the Western Power Network.

Investment (nominal):	[redacted]

2 [redacted]

Basis & Refinement of Cost Estimates over time (including explanation of variances if applicable):	The cost of NCS can vary considerably depending on a number of factors including the running time, cost of fuel, power station configuration and contractual arrangements. For the purpose of establishing and running the NCS in Ravensthorpe, the business case proposed operating expenditure from the non-recurring expenditure category of: • [redacted] (nominal) for a new contract with [redacted] over five years for the lease, operation and maintenance of Ravensthorpe Power Station • [redacted] for fuel use (to run the associated power station) in the first financial year (2012/13). It is expected that this expenditure would continue annually, with the fuel sourced under Western Power's standing agreement with [redacted] The majority of the cost of the recommended option is the ongoing lease and operation of the Ravensthorpe Power Station. As Western Power had an existing agreement with [redacted] it was proposed that the revised agreement be established with similar terms and conditions, to upgrade and operate the power station for a further five-year term. [redacted] provided a firm quotation for this agreement, which informed the cost estimate in the business case. The business case noted that as this solution was the first of its kind on the Western Power network there was a chance that additional expenditure may be required or more time may be necessary to implement the solution. While overall operating costs associated with the NCS solution were not exceeded, the implementation of the 'bumpless' capability experienced delays and was not implemented in 2012 as expected. Instead, the bumpless capability had a staged implementation will full commissioning being completed in late 2013. The delays to implementation included access issues (relating to crops and weather) outside of Western Power's control as well as the emergence of additional technical issues and difficulty in scheduling planned outages in 2012. The variation between actual and forecast expenditure over the AA3 period was driven predominantly by the reconfiguration of the power station in November 2013. Daily peak lopping via bumpless transfers and bumpless reconnections as well as the reliability improvement function has driven operational cost savings and has significantly reduced the runtime of the power station. The number of Ravensthorpe Power Station operation events each year is dependent on: • the number of upstream faults from the Ravensthorpe town feeder • the number of times that the Ravensthorpe town load exceeds the daily peak lopping threshold (670 kW). Fuel costs were also lower than expected due to lower run times and a reduction in the price of diesel.
S. 6.40 – the non-capital cost component of approved total costs for a covered network must include only those non-capital costs which would be incurred by a service provider efficiently minimising costs	

Identified Need & Timing:	As mentioned previously, in 2009 the WA State Government committed to fund the Ravensthorpe Power Station for a period of two years in order to alleviate power quality and reliability issues in the Ravensthorpe community. In 2010 it was identified that the running costs of the power station were higher than expected and the funding was forecast to be exhausted before the December 2011 end date. As a result, the islanded Ravensthorpe town load had to be reconnected to the Gnowangerup Feeder which reintroduced reliability and capacity issues. Until a more suitable solution could be assessed and implemented, Western Power was required to consider measures to ensure the Gnowangerup Feeder did not fail. These measures included: • denying connection of new loads, including upgrades of existing connected loads • disconnecting new loads that were connected over the period in which the State Government was funding the running costs of the Ravensthorpe Power Station • disconnecting existing load due to natural load growth on the Gnowangerup Feeder. If no action was taken it was determined that: • the relevant voltage limits defined in the Technical Rules would not be met during peak load periods • customers may experience overvoltage during light load periods that result in customer equipment damage • faults may not clear due to inadequate protection reach • the reliability performance experienced by customers on the Gnowangerup Feeder would not meet the minimum standards required in the Electricity Industry (Network Quality and Reliability Standards) Code (**NQRS Code**). It is noted that these mitigating actions were not necessary as Western Power developed and implemented a bridging solution to ensure supply was maintained to the Ravensthorpe town. The bridging solution was approved in May 2011 and established a seasonal islanding scheme, under which Ravensthorpe could be islanded and supplied by the power station over the winter peak demand period. This solution was remotely operated by Western Power's Network Operations Control Centre and efficiently managed the power station operating costs until a more permanent solution was implemented. At this time Western Power was progressing a comprehensive long term planning process for the Gnowangerup Feeder to determine the optimal solution to meet the community's needs, satisfy the Technical Rule requirements and deliver safe, reliable and efficient electricity. The business case supporting the implementation of a NCS solution was approved in November 2011 and the contract between Western Power and [redacted] was extended to accommodate the temporary operation of the Ravensthorpe Power Station. This contract was subsequently revised in 2015 for a term of three years, with the option to extend by a further two years.

Options Analysis:	In 2011, Western Power completed an 11-year planning study to identify the most cost effective, long term strategy for the Gnowangerup Feeder. The options considered in the report included network reinforcement, network augmentation, demand management and network lopping. The report evaluated 12 options: 1. Statcoms, switched capacitor banks, and switched reactor banks. 2. New 91 km 33 kV Feeder branch from GN559 to FZ6. 3. New 91 km 33 kV Feeder branch from GN559 to FZ6, plus conversion of the Katanning to Gnowangerup Feeder sections from 22 kV to 33 kV. 4. Statcoms plus conversion of the Katanning to Gnowangerup Feeder sections from 22 kV to 33 kV. 5. Daily peak lopping with Minor Network Changes. 6. Daily peak lopping with No Network Changes. 7. Annual Peak Lopping. 8. 132 kV Zone Substation at Jerramungup. 9. Transmission Options Funded by Mining Companies. 10. Demand Side Management. 11. Ravensthorpe Reliability Performance Improvement. 12. Do Nothing. These options were evaluated against a set of criteria including how effective they were at providing network capacity and compliance with regard to the requirements of the Technical Rules, as well as consideration of their net present cost. Several of these options were deemed to be prohibitively expensive or were not technically viable and as such were not considered to meet the requirements. Following the initial evaluation Options 3, 5, 6, 7, 8 and 11 were considered to be viable. These remaining options were then assessed against cost, protection reach and voltage profiles, with the two highest ranking options (Options 3 *Distribution Network Reinforcement* and 5 *Daily peak lopping with minor network changes*) being considered in detail in the Stage 2 Business Case. Ultimately Option 5 was selected as the recommended option. The following discussion details Option 5 performance against the key criteria. **Network Capacity** – The daily peak lopping option provides spare capacity at the end of the study period (2021). In 2021, the forecast Ravensthorpe peak load is 1,255 kW, which is less than the proposed installed generation capacity of 1,500 kW. **Technical Rules Compliance** – Achieves compliance[3]. **Reliability Performance** – There is expected to be improvement in reliability performance for Ravensthorpe customers. However, this improvement is only expected in those periods that the Ravensthorpe Power Station is operating. This option was also assessed to have superior flexibility, improved corporate risk profile rating and is the lower cost option.

3 There are some Technical Rules non-compliance items associated with the NCS solution. However, they have been assessed as being of low to medium levels of risk and as such are monitored internally.

	This option does present some technical risk due to the requirement to synchronise with the network and create an island, however it was expected that this could be adequately managed.
Scope of Works:	The works associated with Option 5 consisted of the following key activities: • Upgrading selected protection and voltage equipment along the Gnowangerup Feeder to address identified protection and supply quality (voltage) compliance issues. • Modifying the Katanning Substation, Gnowangerup Feeder and SCADA to enable automated bumpless, daily islanding of the Ravensthorpe power system. • Contracting with [redacted] for Ravensthorpe Power Station control upgrades, removal of one generator and ongoing lease and management for a five-year term. Thus, the business case sought approval to: • Proceed with implementation of Option 5, the daily peak lopping option (with network modifications) at an estimated capital cost of [redacted] with an in-service date of May 2012. • Execute a variation to the existing agreement with [redacted] to extend its term by up to 12 months until the new agreement is in effect. • Execute a new five-year (2012/13 – 2017/18) agreement with [redacted] for the hire and operation of Ravensthorpe Power Station with an expected value of [redacted] for fuel for 2012/13, with an expectation of similar fuel costs thereafter). • Continue to monitor the Gnowangerup Feeder voltage profile and seek to optimise the Ravensthorpe Power Station dispatch and manage operating costs. As previously noted, for the purpose of this D-factor Compliance Summary only the operating costs relating to the contract with [redacted] for the ongoing lease, management and running costs for the Ravensthorpe Power Station are considered here. The capital costs associated with the reconfiguration of the network are not included.
Implementation Timing:	The business case was approved in December 2011 and Western Power extended the contract with [redacted] to operate Ravensthorpe Power Station. To facilitate the establishment of the new contract, a variation to the previous agreement was sought to extend the term to ensure that services were able to be maintained while the new agreement was negotiated and executed. The smart control system, per the capital expenditure component of the Gnowangerup Feeder Reinforcement business case, was implemented in 2013, and resulted in more efficient operation and shorter runtimes at the Ravensthorpe Power Station.

Engineering Design:	This project was designed in accordance with Western Power's suite of standards, guidelines and manuals relating to planning and technical design. All documentation was developed in line with good electricity industry practice and met the relevant external standards requirements. The efficiency of design was further provided through the Business Case review and sign-off process where the least cost option that satisfies the technical requirements was selected as the preferred option.
Procurement:	All materials and equipment required to undertake this project were sourced in accordance with Western Power's corporate and procurement policies. This ensured compliance with the following requirements: Western Power's agreements were established via a competitive process to meet business requirements and deliver value for money. The selection, evaluation and award process was supported by the engagement of relevant subject matter experts, meeting Western Power's standards including safety, environmental, technical, commercial, and qualitative. Specific materials required to undertake this program were identified and requisitioned in Western Power's inventory management system by the responsible Operations Division once the design had been approved. Ordered material particulars were monitored closely and any required changes were promptly processed within Western Power's inventory management systems by the responsible Operations Division to minimise the impact and associated costs with amended requirements resulting from these changes. Economies of scale were leveraged through the bulk ordering of materials. In this case, Western Power's agreement with [redacted] for the purchase of diesel was particularly important.
Project/Program Governance:	This program was governed by Western Power's Works Program Governance Framework, and approval and delegated financial authority procedures. The Business Case was approved in accordance with Western Power's delegated authority procedures. The NCS contract between Western Power and [redacted] was extensively reviewed by Legal and was required to have the necessary approvals associated with a commercial contract.
Project/Program Management:	This project was delivered under Western Power's standard project management practices which impose specific controls in relation to: • project change/scope management • project time management • project cost management • project risk management • project performance monitoring • project closure. A Deliverability Checklist (attached to the Gnowangerup Feeder Reinforcement Business Case [redacted] was also completed prior to Business Case signoff.
Complies with S. 6.40	☒ Yes – necessary efficient minimum cost investment ☐ No

S. 6.41 – Where in order to maximise the net benefit after considering alternative options, a service provider pursues an alternative option in order to provide covered services, the non-capital cost component of approved total costs for a covered network may include non-capital costs incurred in relation to the alternative option if: a. the alternative option non-capital costs do not exceed the amount of alternative option non-capital costs that would be incurred by a service provider efficiently minimising costs; and b. at least one of the following conditions is satisfied: i. the additional revenue for the alternative option is expected to at least recover the alternative option non-capital cost ii. the alternative option provides a net benefit in the covered network over a reasonable period of time that justifies higher reference tariffs; or iii. the alternative option is necessary to maintain the safety or reliability of the covered network or its ability to provide contracted covered services	
S. 6.41(b) Justification Applied & Recoverable Portion (nominal):	☐ Incremental revenue $ ☐ Net benefit $ ☒ Providing covered services (safety and reliability) [redacted]

Justification Description:	As previously discussed, the Gnowangerup Feeder presents some unique challenges including poor reliability, inability to cater for short term demand growth and quality of supply issues. The 2011 planning study highlights that at the time, the Gnowangerup Feeder annualised System Average Interruption Duration Index (**SAIDI**) was 1,321 minutes. It was also noted that the SAIDI performance of the worst single node on the Gnowangerup Feeder was much higher. In 2011, when the Ravensthorpe Power Station was turned off and Ravensthorpe was reconnected to the Gnowangerup Feeder Western Power was required to consider: • denying connection of new loads, including upgrades of existing connected loads • disconnecting new loads that were connected over the period in which the State Government was funding the running costs • disconnecting existing load due to natural load growth on the Gnowangerup Feeder. A comprehensive planning study established that if no action was taken: • the relevant voltage limits defined in the Technical Rules will not be met during peak load periods • customers may experience overvoltage during light load periods that result in customer equipment damage • faults may not clear due to inadequate protection reach • the reliability performance experienced by customers on the Gnowangerup Feeder would not meet the minimum standards required in the NQRS Code. It is noted that these mitigating actions were not necessary as Western Power developed and implemented a bridging solution to ensure supply was maintained to the Ravensthorpe community. The bridging solution established a seasonal islanding scheme, under which Ravensthorpe could be islanded and supplied by the power station over the winter peak demand period. This solution was remotely operated by Western Power's Network Operations Control Centre and efficiently managed the power station operating costs until June 2012, when the NCS solution was to be implemented. The Ravensthorpe Power Station operates under two modes to balance supply with demand: • daily peak lopping • seasonal peak lopping. Daily peak lopping works to bridge the gap between demand from Ravensthorpe with the maximum load that can be supplied through the Gnowangerup Feeder. When the demand from Ravensthorpe exceeds that which the feeder can supply, the Ravensthorpe Power Station is started and synchronised with the Gnowangerup Feeder. The power station output is then ramped up to the point where the power station output equals the demand of Ravensthorpe. The appropriate circuit breaker is then tripped to create an island where the power station is supplying the Ravensthorpe rural and town feeders.

	The reversal process involves ramping the Ravensthorpe Power Station output down to zero and then disconnecting the power station from the Gnowangerup Feeder so that Ravensthorpe feeders can be supplied by the Gnowangerup Feeder connected to the South West Interconnected System. The Ravensthorpe Power Station also has the functionality to perform seasonal peak lopping. This enables the power station to operate continuously, 24 hours per day as a local network island. This function will only be activated when certain criteria are met and is overseen by Western Power's network operators. Both daily peak and seasonal lopping functions are complemented by a function focussed on improving the reliability performance for Ravensthorpe customers. This function ensures that the power station is kept on standby and is available (if not in use for daily or seasonal lopping) to supply Ravensthorpe if an outage occurs on the Gnowangerup Feeder. Since the implementation of the smart control system in 2013, Western Power's SCADA system has had the capability to collect information including the duration and frequency of upstream faults and peak lopping events in Ravensthorpe. Based off this information it is evident that despite fault events occurring less frequently, the Ravensthorpe Power Station has spent more time running in response to faults than for peak lopping purposes. As detailed in the above discussion, the NCS solution has ensured that the network can provide a more reliable, better quality supply that can facilitate new customer connections. There is now adequate network capacity to accommodate the connection of forecast new loads (and the upgrade of existing loads). Finally, due to the implementation of the NCS, Western Power is now expected to meet minimum reliability obligations in Ravensthorpe as set out in the NQRS Code.
Complies with S. 6.41(b)?	☒ Yes fully ☐ In part ☐ No

3. Compliance with works program governance framework

The following table provides key documentation references as evidence that the program has been managed in compliance with Western Power's Works Program Governance Framework to the extent practicable. The primary evidence is the existence of mandatory phase record documents prepared prior to the project/program progressing to the next phase. The network control services detailed in this D-factor Compliance Summary relate to operating expenditure, however, the associated governance framework documents primarily cover the capital expenditure portion of the project. Western Power's operating expenditures were not required to follow the Works Program Governance Framework at the time (2011) when the Gnowangerup Feeder Reinforcement project was approved. However, the majority of necessary information required to support the preferred solution (including operating expenditure) has been included in the planning report and business case.

Phase	Mandatory Phase Record Document/s	DM Reference
1 - Initiation Phase	Initiation Estimate	
2 - Scoping Phase	Project Planning Report Scoping Estimate	[redacted]
3 - Planning Phase	Business Case Investment Evaluation Model Planning Estimate Project Management Plan	[redacted]
4 - Execution Phase		
5 - Closeout Phase		
6 - Benefits Realisation Phase	A formal benefits realisation will be undertaken post project execution and closeout	

4. Endorsements

All information presented in this document is considered accurate and is intended for use in supporting Western Power's submission to the ERA on this D Factor project.

Endorsed by:

Name	Position	Signature	Date