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18 October 2010

Mr Lyndon Rowe
Chairman
Economic Regulation Authority
Level 6, 197 St Georges Terrace
Perth WA 6000

Dear Lyndon

SUBMISSION OF PROPOSED CAPITAL PROJECT FOR NFIT PRE-APPROVAL

In accordance with s6.71(b) of the Electricity Networks Access Code 2004, I am pleased to submit Western Power's request for the Authority to determine that the attached proposed transmission network augmentation meets the requirements of the *new facilities investment test.*

The augmentation establishes an electricity supply to Collgar Windfarm via the construction of a new terminal substation. The estimated cost of the Collgar Windfarm connection is approximately $21.7M, of which Western Power submits that $13.9M satisfies the *new facilities investment test.*

These and other similar submissions will provide Western Power with confidence about the quality of its project justification in advance of the Authority's future assessment of the efficiency of actual capital expenditure during the current regulatory period.

This formal submission comprises this covering letter and the attached detailed submission documents. Electronic versions are also enclosed, for publication by the Authority. A related spreadsheet is also provided for the Authority's use in its assessment (but is not for publication).

I look forward to receiving the Authority's determination on this submission.

Yours sincerely,

PHIL SOUTHWELL
GENERAL MANAGER REGULATION & SUSTAINABILITY

DM# 7594931

Submission to the Economic Regulation Authority

APPROVAL OF NEW FACILITIES INVESTMENT

Construction of Collgar Terminal Substation and associated works for the connection of Collgar Windfarm.

DATE: *11 October 2010*

DOCUMENT PREPARED BY:
Western Power
GPO Box L921, Perth WA 6842
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safe reliable efficient

Contents

1 Summary

Western Power is undertaking works to connect Collgar Windfarm to the South West Interconnected Network (SWIN). These works consist of the construction of Collgar Terminal Substation (CGT), and associated works for the connection of Collgar Windfarm. The works required for the Collgar Windfarm connection to the SWIN include:

Connection Works:

(i) Construction of two circuit breaker bays at CGT and associated works which are dedicated to the customer's connection;

(ii) PLC communication works to link CGT into the communications scheme between Merredin Terminal and West Kalgoorlie Terminal; and

(iii) Implementation of a run back scheme to prevent the overloading of the 132 kV transmission line between Northam and Merredin as a result of the customer's connection.

Shared Network Works:

(i) Substation earthworks;

(ii) Cut-in to the Eastern Goldfields 220 kV overhead line to connect CGT to the SWIN;

(iii) Construction of two circuit breaker bays at CGT and associated works for the line connections, in a manner compliant with the Technical Rules; and

(iv) Upgrading of the existing direct inter-trip protection scheme between Merredin, Yilgarn and West Kalgoorlie Terminals to comply with the Technical Rules.

The connection works satisfy section 6.52(a), but not section 6.52(b) of the *Electricity Networks Access Code 2004* (the Code). Therefore, this portion of the works does not satisfy the New Facilities Investment Test (NFIT) and is funded by the connecting customer through a capital contribution. The remaining works (referred to as the Shared Network Works) do satisfy all requirements of NFIT.

Table 1 Summary of works

Element of Works	Comment	Value that meets NFIT
Connection Works:		
Installation of two circuit breaker bays	Fully funded by customer	$0M
PLC communication installation	Fully funded by customer	$0M
Run-back scheme	Fully funded by customer	$0M
Shared Network Works:		
Substation earth works	Justified under s6.52(b)(i)	$1.5M
Cut-in to the Eastern Goldfields transmission line	Justified under s6.52(b)(i)	$1.0M
Installation of two circuit breaker bays	Justified under s6.52(b)(i)	$10.3M
Upgrade of the existing protection scheme on the	Justified under s6.52(b)(i)	$1.1M

Element of Works	Comment	Value that meets NFIT
Eastern Goldfields 220 kV transmission line	& s6.52(b)(iii)	
Total value of works that meets NFIT		$13.9M

2 Background

Collgar Windfarm Pty Ltd (the Customer) submitted a Network Access Application requesting that Western Power connect Collgar Windfarm with a Declared Sent Out Capacity (DSOC) of 250 MW to the South West Interconnected Network (SWIN) by 27 April 2011. Collgar Windfarm will be located adjacent to the Merredin – Yilgarn 220 kV transmission line approximately 25 km east of Merredin Terminal.

Western Power, in consultation with the Customer, conducted a design study to determine the most efficient way to implement the connection request. Western Power determined the scope of works required to connect Collgar Windfarm to the SWIN by breaking it down into the following components to maximise the options assessment:[1]

1. Establishment and configuration of Collgar Terminal (CGT) which will connect Collgar Windfarm to the SWIN
2. Connection of CGT to the SWIN
3. Consideration of any future or proposed augmentations to the SWIN
4. Operation restrictions associated with the connection of Collgar Windfarm to the SWIN
5. Communications requirement for CGT
6. Protection requirements for CGT

The recommended option for each of the scope of work items was used to calculate the total estimated project cost, the Customer's capital contribution for the Connection Works and the Shared Network Works.

The recommended option and other options evaluated are to ensure that Western Power is efficiently minimising costs in relation to the scope of works to be undertaken for the Collgar Windfarm connection. This is consistent with the requirements of the New Facilities Investment Test (NFIT).

The study determined that the construction of a 4-switch mesh substation connected to the Merredin – Yilgarn 220 kV transmission line is the least cost solution that satisfies the requirements of the planning criteria (Technical Rules), the NFIT and the Customer's requirements. Cost allocation was determined in accordance with the NFIT and Western Power's approved policies.

[1] DM# 6941932

3 Proposed Augmentation

The proposed augmentation consists of several distinct components of work, as set out in Table 2.

Table 2 Components of the network augmentation

	Augmentation component	Component cost of augmentation
1	Construction of two dedicated circuit breaker bays and associated works for connection of Collgar Windfarm	$5.9M
2	PLC Communication works	$1.1M
3	Runback scheme	$0.8M
4	Cut-in to the Eastern Goldfields 220 kV transmission line	$1.0M
5	Construction of two circuit breaker bays and associated works	$11.8M
6	Upgrade of the existing protection scheme on the Eastern Goldfields 220 kV transmission line	$1.1M
	Total cost of augmentation	$21.7M
	Less risk allowance	$2.1M
	Total cost of augmentation net of risk allowance	$19.6M

The first three components of the augmentation are connection assets. These connection assets are dedicated assets required only for the connection of Collgar Windfarm. These will be fully funded by the Customer through a capital contribution and will not result in any net increase in cost to other network users. The remaining components are considered shared network assets. The shared assets are required for the connection of Collgar Windfarm, but do not exclude use by other network users.

The pre-approval of the NFIT submission only applies to the construction of the shared network assets. The presentation of the works associated with the connection assets is included to provide a transparent view of the total network augmentation.

3.1 Long-term planning considerations

In order to ensure an optimised long-term investment path and minimal cost and disruption to the Customer and other network users in the Eastern Goldfields, Western Power conducted analysis of options to meet possible future load growth scenarios. This analysis indicates that increasing the voltage of the Eastern Goldfields 220 kV transmission line to 275 kV in 2018 is likely to be the least cost approach to augmenting network capacity[2].

Given this possibility, it is important to consider the potential impact on the Customer and other network users in the Eastern Goldfields when a voltage upgrade occurs. Likely impacts would be early replacement of customer assets, connection assets and shared network assets at CGT as well as interruption to the Customer's operation, resulting in a loss of income. The severity of these additional costs will depend, among other things, on the time required for construction and how much of this time the Customer would be offline.

An approach that avoids much of the additional cost and disruption is to ensure that the connection assets and the shared network assets are rated to at least 275 kV. To assess

[2] At this stage, the upgrade is indicative and the precise timing is subject to customer demand. The voltage upgrade would follow installation of local generation in 2013.

the merits of this approach, the cost impact of installing plant and equipment rated at three different voltages were considered for the primary plant: 220 kV; 275 kV; and 330 kV at CGT. The estimated upfront costs associated with these options are shown in Table 3. Plant and equipment rated at 330 kV is preferred to 275 kV by Western Power as 330 kV is a standard rating for Western Power, allowing procurement within a shorter timeframe.

Table 3 Total upfront estimated cost for 220 kV, 275 kV and 330 kV plant

Item	Cost estimate		
	220 kV	275 kV	330 kV
Plant procurement	$4.3M	$4.9M	$4.8M
Design	$1.5M	$1.7M	$1.4M
Civil and structural works	$4.8M	$5.1M	$5.7M
Installation works and associated costs	$4.3M	$4.3M	$4.3M
Commissioning	$0.7M	$0.7M	$0.7M
Cut-in to 220 kV transmission line	$0.9M	$0.9M	$0.9M
Communications	$1.0M	$1.0M	$1.0M
Runback scheme	$0.8M	$0.8M	$0.8M
Estimated total	$18.3M	$19.4M	$19.6M

Note: Refer to DM# 6941932 (Section 4) for further details on these costs. The costs in this table exclude risk

In defining the options, it was apparent that a hybrid option involving use of plant and equipment rated at 220 kV and structures rated at 275 kV would deliver a lower cost than if the plant, equipment and structures were uniformly rated for 275 kV or 330 kV. Hence, the options under consideration were modified as follows:

A. Install plant and equipment rated at 330 kV (suitable for operation at 275 kV);

B. Install plant and equipment at 220 kV with allowance for upgrade to 275 kV at a later date (the hybrid option); and

C. Install plant and equipment at 220 kV and make no allowance for upgrade to 275 kV at a later date.

Options A and B incur additional cost, most of which would be incurred upfront. The remainder of the additional cost would be incurred at the time the Eastern Goldfields 220 kV line is upgraded. The estimated total present value costs for all three options are presented in Table 4.

Table 4 Total cost estimates for the three options

Option	Upfront Estimated Cost	275 kV CGT Upgrade Additional Estimated Cost (PV)	Total cost (PV)
Option A	$19.6M	$0.0M	$19.6M
Option B	$18.9M	$2.5M	$21.4M
Option C	$18.3M	$5.2M	$23.5M

Note: present value calculations use a pre-tax, real discount rate of 6.76%. This corresponds to the first access arrangement period when this assessment was undertaken.

Based on the assumption that the voltage upgrade occurs in the anticipated timeframe, it is clear from Table 4 that Option A is the least cost option. If the voltage upgrade does not occur, then Option C is the least cost option.

The need to make a judgement about the likelihood of the voltage upgrade proceeding as anticipated is unavoidable. Ultimately, the issue is whether the upgrade is likely to occur within a timeframe that delivers a net benefit.

In order to conduct this assessment, Table 5 presents the additional cost of upgrade in nominal dollars. That is, the costs have not been discounted to a present value estimate. This cost would be incurred at the time of the voltage upgrade.

Table 5 Estimated nominal cost of upgrade to CGT at the time of the Eastern Goldfields transmission line upgrade

Initial plant and equipment voltage rating	Cost
330 kV plant (Option A)	$0.0M
220 kV plant with allowance for 275 kV future upgrade (Option B)	$4.3M
220 kV plant with no allowance for 275 kV future upgrade (Option C)	$8.8M

The remaining additional itemised cost associated with Option B is presented in Table 6. The main cost items reflect the need to replace circuit breakers, disconnectors, current and voltage transformers. The associated foundations and structures would also require modification.

Table 6 Estimated additional nominal cost of upgrade associated with Option B

Item	Cost
Re-design and re-commissioning	$0.8M
Primary plant procurement for replacement of main primary plant	$2.4M
Civil and structural re-workings	$0.5M
Installation re-workings	$0.6M
Total estimated cost	$4.3M

The additional itemised cost associated with Option C is shown in Table 7. There are major costs associated with upgrading CGT for operation at 275 kV; all major primary plant, foundations and structures would be required to be replaced and a reconstruction of the CGT switchyard compound would be required.

Table 7 Estimated additional nominal cost of upgrade associated with Option C

Item	Cost
Re-design and re-commissioning	$1.3M
Primary plant procurement for replacement of main primary plant	$2.5M
Civil and structural re-workings	$2.4M
Installation re-workings	$2.6M
Total estimated cost	$8.8M

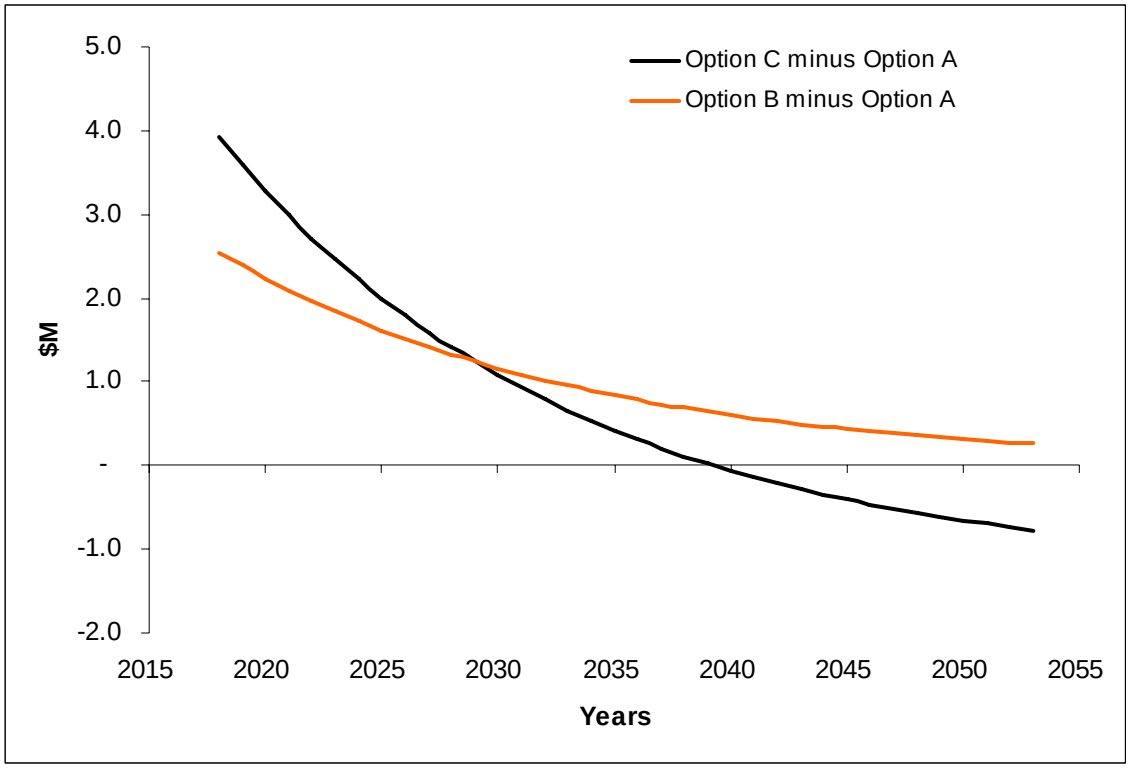
The timing of this anticipated upgrade is a crucial consideration. Current expectations are that it would occur in 2018. However, it is possible that the upgrade occurs at a later date. Given the uncertainty associated with the anticipated augmentation of the Eastern

Goldfields 220 kV transmission line, it is prudent to calculate the present value of each option and from this, determine the least cost, long-run solution.

Figure 1 presents the results of this calculation. This chart depicts the difference in cost (in present value terms) between the cost of Option A and the next least cost option (i.e. the minimum of Option B and Option C) of upgrading the voltage rating of CGT plant and equipment in preparation for the voltage upgrade of the Eastern Goldfields transmission line. This presentation assumes that the voltage upgrade is inevitable. Given this assumption, the key consideration is the timing of the upgrade. That is, whether the upgrade occurs some time after 2018.

The chart shows that there is a benefit of implementing Option A provided the voltage upgrade occurs some time within the next 29 years. If the upgrade occurs in 2018 as is currently anticipated, the cost saving achieved by adopting Option A is $2.5M. However, if the voltage upgrade does not occur until 2050, then Option A represents a net cost of $0.7M. The breakeven year is 2039.

Figure 1 Present value cost comparison of alternative options



Note: pre-tax, real discount rate of 6.76% was used in the present value calculations

Given information available to Western Power, it is considered prudent that Western Power allow for the voltage upgrade of the Eastern Goldfields transmission line when determining the optimum design for CGT. The forecast information that Western Power has is summarised in section 5.2 (p. 12) of this submission. On the basis of this information, Western Power submits that upfront installation of 330 kV plant and equipment minimises the total estimated cost of the installation of CGT over a reasonable period of time and associated costs for the Customer and other network users.

4 Substation Design Options Analysis

In its Options Assessment report (Attachment 1) Western Power identified alternative options for each major works component. The two options that made a material difference were the configuration of CGT and the upgrade of the inter-trip protection scheme.

Configuration of CGT

The configuration options considered were:

Option 1: Two circuit breaker installation. This is the minimum requirement that is compliant with N-1 planning criteria. However, it would not comply with other criteria in the Technical Rules. A key shortcoming is that this configuration would require customer circuit breakers to clear faults on the Eastern Goldfields transmission line. It would also be reliant on customer circuit breakers to protect the Eastern Goldfields transmission line from customer equipment faults.

Option 2: Three circuit breaker installation. The addition of the third circuit breaker ensures compliance with the Technical Rules. The third circuit breaker would be treated as a connection asset. This configuration limits flexibility and would force Collgar Windfarm offline if one of the circuit breakers is out of service.

Option 3: Three switch mesh arrangement. This arrangement is also fully compliant with the Technical Rules and would allow Collgar Windfarm to continue to export electricity to the SWIN in the event of a single circuit breaker outage. The benefits of this configuration would be exclusively realised by Collgar Windfarm. The number of circuit breakers and the treatment of these assets in Option 3 is the same as Option 2 with Option 3 being the more efficient option.

Option 4: Greater than three switch mesh arrangement. This option complies with the Technical Rules and could offer the Customer additional operational flexibility over and above that of Option 3, but does not offer additional benefit to other network users. Additional assets requested by the Customer in excess of Option 3 are treated as connection assets.

Alternatives to the construction of CGT were also considered including connection to Merredin Terminal via the construction of 25 km of single circuit line at 220 kV as well as a double-circuit 132 kV line. These options were ruled out due to the likely substantially higher cost compared to the options considered above. In addition, system studies indicated that the 132 kV double-circuit line would result in greater overload of the 132 kV system within the local area, resulting in more stringent constraints on Collgar Windfarm output.

Option 4 was ultimately selected based on the planning criteria, the NFIT and the Customer's requirements.

Upgrading of the existing direct inter-trip protection scheme

The Technical Rules offers no scope to avoid upgrading the inter-trip protection scheme on the Eastern Goldfields transmission line between Merredin, Yilgarn and West Kalgoorlie Terminals. The only option is to implement the upgrade at the time of connection. Bundling this work with the other Collgar project works delivers a reduction in the cost compared to implementing this work as a separate project.

5 Access Code Considerations

5.1 New facilities investment test requirements

Prior to new facility investments being added to the capital base, several requirements under section 6.52 of the *Electricity Networks Access Code 2004* (the Code) must first be met. Section 6.52 is reproduced below.

6.52 *New facilities investment* satisfies the *new facilities investment test* if:

(a) the *new facilities investment* does not exceed the amount that would be invested by a *service provider efficiently minimising costs*, having regard, without limitation, to:

(i) whether the *new facility* exhibits economies of scale or scope and the increments in which capacity can be added; and

(ii) whether the lowest sustainable cost of providing the *covered services* forecast to be sold over a reasonable period may require the installation of a *new facility* with capacity sufficient to meet the forecast sales;

and

(b) one or more of the following conditions is satisfied:

(i) either:

A. the *anticipated incremental revenue* for the *new facility* is expected to at least recover the *new facilities investment*; or

B. if a *modified test* has been approved under section 6.53 and the *new facilities investment* is below the *test application threshold* – the *modified test* is satisfied;

or

(ii) the *new facility* provides a *net benefit* in the *covered network* over a reasonable period of time that justifies the approval of higher *reference tariffs*; or

(iii) the *new facility* is necessary to maintain the safety or reliability of the *covered network* or its ability to provide contracted *covered services*.

The new facilities investment test elements are referred to as the 'efficiency test' (section 6.52(a)), 'incremental revenue test' (section 6.52(b)(i)), 'net benefits test' (section 6.52(b)(ii)) and 'safety and reliability test' (section 6.52(b)(iii)).

In order for the new facility investment to satisfy the requirements of the Code, the efficiency test and at least one of the other remaining tests must be satisfied.

5.2 Assessment with respect to section 6.52 (a) of the Code

Section 6.52(a) of the Code requires that any new facilities investment that is to be added to the capital base does not exceed the amount that would be invested by a service provider efficiently minimising costs.

To demonstrate compliance with this section of the Code, Western Power submits that it must:

- ensure the most appropriate option has been selected to meet the requirements associated with reasonable forecasts of growth of covered services;
- demonstrate that the design and design standards are appropriate; and
- demonstrate that the delivery cost of the new facility is efficient.

Choice of network option

The key criteria used to determine the most appropriate option were:

- Compliance with the Technical Rules
- Customer requirements
- Potential for load growth and its impact on the Customer's operations as well as other users.

The reasoning underlying the first two criteria is self evident and does not require further elaboration. The third criterion required careful consideration. As of the time of writing, there are no other applicants in the Applications Queue requiring connection within the immediate vicinity of Collgar Windfarm. There is, however, the potential for further load growth in the Eastern Goldfields.[3]

All of the potential load growth is directly related to mining. Mining related block loads can be difficult to forecast accurately as it is exposed to global economic fluctuations that are difficult to predict. The current forecasts are based on an assumption that present favourable economic conditions will continue into the future. As demonstrated in Figure 1 (page 9), provided the potential loads trigger the planned transmission line upgrade within 27 years, the choice of network option delivers a prudent network outcome.

Given this, Western Power submits that it is prudent to allow for a likely upgrade in voltage in the Eastern Goldfields transmission line.

Design standards

The second requirement with respect to section 6.52(a) of the Code is to demonstrate that the selected network option's design and design standards will be efficient. The chosen design associated with the shared assets delivers the lowest long-run cost subject to compliance with the Technical Rules.

The key consideration was the design of the four switch mesh configuration (Option 4, page 10) for CGT. As indicated in Section 4, the minimum standard configuration is the three switch mesh installation in which one of the circuit breakers is deemed a connection asset. Therefore, the efficient design of the shared assets component of the CGT configuration consists of two circuit breaker bays.

The customer opted for the four switch mesh arrangement and will, accordingly, fund the additional cost.

Cost of delivery

The third matter for Western Power to demonstrate is that the project will be delivered efficiently. In order to ensure that efficient delivery and value for money is obtained, a delivery strategy consistent with Western Power's balanced portfolio framework has been adopted for the construction of the Collgar Windfarm project works. A summary is presented in Table 8.

[3] Refer to DM# 6548832 for details

Table 8 Delivery portfolio

Delivery mechanism	Value	Percent of Works
Competitive tender	$8.4M	46%
Preferred plant supplier contract	$4.3M	24%
Western Power internal resource	$5.4M	30%
Total	$18.1M	

Note: costs exclude risk and earth works. Earth works were delivered by the Customer and deducted from the capital contribution on the basis that it satisfied NFIT.

The delivery strategy results in $12.7M (70%) of the project base cost being delivered by external suppliers with the balance $5.4M (30%) provided by specialist Western Power resources.

All designs will be completed by Western Power resources applying standard designs that are subjected to qualified external peer review. Internal specialist resources are also used for low cost, high value technical tasks (such as commissioning) ensuring the plant satisfies network connection requirements.

The design and construction for the CGT earthworks will be undertaken by the Customer and will be approved by Western Power. The Customer will undertake the earthworks at an expected lower cost than Western Power given the economies of scale with the Customer undertaking the wind farm civil works simultaneously.

All plant procurement will be undertaken in accordance with Western Power approved standards and policies. In order to ensure efficiency, Western Power has supplied standard plant from period contracts that have been negotiated with suppliers via a competitive preferred vendor process.

Planned outages to connect Collgar Terminal into the Eastern Goldfields transmission line will be planned to minimise the cost of dispatching generation in Kalgoorlie and the East Country in the interim to supply local load.

A detailed breakdown of the work packages and associated delivery mechanism is shown in Appendix 1.

5.3 Assessment with respect to section 6.52 (b)(i) of the Code (Incremental Revenue Test)

Section 6.52(b)(i) requires the new facility investment to be recovered via the anticipated incremental revenue in section 6.52(b)(i)A. A new facility investment will pass the incremental revenue test if the anticipated incremental revenue from the new investment is greater than the cost of the facility. This analysis is undertaken by comparing the present value of the anticipated additional revenue to Western Power from the Customer less the present value of the costs associated with servicing the new facility.

As the major augmentation is specifically proposed in order to allow the connection of Collgar Windfarm to the shared network, the incremental revenue test was used to satisfy the second part of the NFIT.

Western Power has used a tariff of $2,178,750 per annum, being an estimate of the likely revenue for a 250 MW DSOC. The calculations also reflect an assumption of flat real network access price from the date of commissioning and have used a real discount rate of 6.76% (corresponding to the first access arrangement period in which the agreement was

determined). There is sufficient incremental revenue over a period of 15 years to cover the cost of the shared assets. Consequently, the second part of the NFIT is satisfied.

Details of this assessment are included in Appendix 2.

5.4 Assessment with respect to section 6.52 (b)(ii) of the Code (Net Benefits Test)

Section 6.52(b)(ii) requires the new facility to provide a net benefit that justifies the approval of higher reference tariffs within a reasonable period of time. The net benefit classified in the Code is a net benefit to those who generate, transport or consume electricity. Analysis prepared by ACIL Tasman for the Mid West Energy Project[4] indicates that wind farms may offer a net benefit by way of reducing wholesale electricity market prices. A separate study would be required to quantify the net benefits offered by the connection of Collgar Windfarm. At the time of writing, this has not been conducted. Given that the shared network assets are justified under section 6.52(b)(i), it was deemed unnecessary to proceed with a market impact study.

5.5 Assessment with respect to section 6.52 (b)(iii) of the Code (Safety and Reliability Test)

Section 6.52(b)(iii) is satisfied when the covered network requires the new facility in order to maintain the safety and reliability of the covered network, or its ability to provide a contracted covered service.

This new facility except for the protection upgrade is not required for safety and reliability reasons. The benefit associated with the protection upgrade works has not been separately quantified.

[4] A Regulatory Test submission for the Mid West Energy Project (Southern Section) is available at http://www.erawa.com.au/2/537/48/electricity__network_augmentations.pm

6 Conclusion

From the above information, Western Power submits that the value of the proposed augmentation that meets NFIT is $13.9M. Western Power further submits that the connection assets do not meet the requirements of the NFIT. Therefore, the connections assets are fully funded by the Customer.

Table 6 summarises the components of the works and the value that satisfies the requirements of NFIT.

Table 5 Value of new facilities that meets NFIT

Element of Works	Comment	Cost of works	Value that meets NFIT
Construction of two circuit breaker bays and associated works	Fully funded by customer.	$5.9M	$0.0M
PLC Communication works	Fully funded by customer.	$1.1M	$0.0M
Runback scheme	Fully funded by customer.	$0.8M	$0.0M
Substation earth works	Meets “incremental revenue test” of the NFIT.	$1.5M	$1.5M
Cut-in to the Eastern Goldfields 220 kV transmission line	Meets “incremental revenue test” of the NFIT.	$1.0M	$1.0M
Construction of two circuit breaker bays and associated works	Meets “incremental revenue test” of the NFIT.	$10.3M	$10.3M
Upgrade of the existing protection scheme on the Eastern Goldfields 220 kV transmission line	Meets “incremental revenue test” of the NFIT.	$1.1M	$1.1M
Total value of works that meets NFIT			$13.9M

Appendix 1 – Procurement Strategy & Delivery Assessment

In order to ensure efficient delivery and value for money is obtained, a delivery strategy consistent with Western Power's balanced portfolio framework has been adopted for the construction of CGT. The breakdown of the delivery mechanisms are shown in Table 9.

Table 9 Collgar Terminal substation – Costs and Delivery Mechanism

Project Work Package	Cost AU $M	Delivery Mechanism	Justification for the cost effectiveness of the selected delivery mechanism
Design	0.9	Internal	Design represents a small percentage of the project total. Many aspects of design and drafting require Western Power specific software and systems hence it is neither efficient nor effective to outsource. Where possible, standard 330 kV designs were utilised to minimise unnecessary additional work.
Material Procurement	4.3	Preferred Supplier Contract	Western Power has supplied standard 330 kV plant for the majority of the terminal yard. Western Power procures the plant from contracts negotiated with preferred suppliers via a competitive preferred vendor process.
Civil Works	3.1	Competitive Tender	The market delivers a high level of competence in a in civil capability; therefore the work package is subjected to a competitive tender process.
Steel Structures	1.1	Competitive Tender	Western Power does not have resources with steel structure fabrication and erection capability, therefore the work package is subjected to a competitive tender process.
Electrical Construction	3.3	Competitive Tender	Western Power's internal construction capability is fully committed during the terminal construction period; therefore the work package is subjected to a competitive tender process.
Protection	0.7	Internal	Protection design and implementation is technically complex, requiring specific knowledge and access to various Western Power systems and processes. Outsourcing is neither effective nor efficient at this time
Commissioning and SCADA	1.1	Internal	Commissioning and SCADA represents less than 6% of project total. Many aspects of commissioning require specific knowledge and experience with Western Power systems hence it is neither efficient nor effective to outsource at this time
Line Cut-in	0.9	Competitive Tender	Western Power has limited 220 kV line construction capability; therefore the work package is subject to a

Project Work Package	Cost AU $M	Delivery Mechanism	Justification for the cost effectiveness of the selected delivery mechanism
			competitive tender process.
Communications	1.0	Internal	Western Power has communication technical expertise familiar with the complex network communications system. Outsourcing would not be a viable option.
Run-back	0.8	Internal	The design and implementation of a run-back scheme is technically complex, requiring specific knowledge and access to various Western Power systems and processes. Outsourcing is neither effective nor efficient at this time
Other	0.9	Internal	Project Administration required to be performed by specialist Western Power resources such as Project Management, contract administration and monitoring, outage planning etc.
Risk	3.6		Main delivery risk associated with this project is the underlying granite and remoteness of the site, and the tight schedule required by the customer. In order to mitigate the granite earthworks risk ($1.50M) Western Power agreed with the customer that they would deliver this particular work package given the economies of scale and the Customer's greater civil capability to deal with any granite breaking (as the Customer will be undertaking the entire wind farm civil works simultaneously).
Total	21.7		$8.4M by competitive tender $5.4M by internal specialist resources $3.6M risk allowance ($1.5M scope under customer management)

Appendix 2 – Incremental Revenue Determination

In applying the incremental revenue test, Western Power uses standard spreadsheets which are updated as required to reflect the approved tariffs and discount rates prevailing at the time of agreement.

Tariff calculation

The following information is taken from the tariff calculation spreadsheet (DM# 6946718). The annual amount of $2,178,750 is used as the forecast annual incremental revenue for the year 2010/11 to determine the amount that meets the requirements of section 6.52(b)(i)(A) of the Code.

There is currently no published price for the Collgar connection and so the Customer's access charges are taken as the average use of system price between West Kalgoorlie GTs (8.123 $/kW/annum ex GST) and Muja Power Station (9.307 $/kW/annum ex GST) as CGT is located halfway between the two stations. This equates to 8.715 $/kW/annum ex GST based on 09/10 approved use of system charges.

Despite anticipated real price rises within the current access arrangement period, it has been assumed that there will be real price maintenance.[5] This is assumed to be conservative but reasonable over the forecast period.

Other assumptions include:

- Design and construction commencing year ending 2010;
- Tariff revenue commencing the year ending 2011 (required in service date of 18 April 2011);
- Operation and Maintenance costs set at the standard transmission rate of 2.46% of the shared asset cost;
- The discount rate corresponds to the approved rates for the first access arrangement (AA1) period;
- Discounted cash-flow period taken to be 15 years as per Access Arrangement;
- Connection works cost taken from A2 estimate including cost driver simple cost allocation and contingency, giving a total of $ 7,810,313; and

Shared works cost taken from A2 estimate including cost driver simple cost allocation and contingency, giving a total of $13,875,809.

Incremental revenue determination

Western Power has used its standard capital contribution calculation spreadsheet to determine the appropriate capital contribution. A copy of the output is provided in Figure 2. There was sufficient incremental revenue within a 15 year period to cover the cost of the shared assets.

[5] In other words, Western Power is allowing for the possibility of an offsetting real price decline some time in the next 15 years.

Figure 2 Incremental revenue determination

Western Power Revised Access Arrangement Capital Contribution Model

Ref	2	3	8	9	10	11	12	13	14	15
	Model Inputs									
	Applicant Details									
5		Applicant Details								
6		Applicant Name			Collgar Wind Farm - DM#6250563					
7										
	Economic Parameters									
9		Regulated WACC								
10		WACC (real pre-tax)			6.76%					
11		WACC (nominal pre-tax)			10.07%					
12		RBA Indicator Rate			11.10%	RBA Large Business Indicator Rate				
13										
	Asset Parameters									
15		Capital Costs								
16		Construction Commences in Year Ending 30 June			2010					
17				Year Ending 30 June	2010	2011	2012	2013	2014	TOTAL
18		Capital Cost of Shared Assets [$ Nominal]			13,875,809					13,875,809 external c
19		Capital Cost of Connection Assets [$ Nominal]			7,810,313					7,810,313 external c
20		Total Costs [$ Nominal]			21,686,122	0	0	0	0	21,686,122
21										
22		Operating Costs								
23		O&M Costs of Shared Assets			341,345	3% dist/2.46% trans internal cost - in today's dollars				
24		O&M annual escalation (real)			0.00%	assume 0% unless advised by Regulation, Pricing & Access Development				
25										
	Applicant Parameters									
27		Covered Service Revenue								
28		Applicant Revenue Commences in Year Ending 30 June			2011					
29										
30		Applicant Tariff Revenue			2,178,750	first year (exclude GST) - in today's dollars				
31		Applicant Tariff Revenue annual escalation (real)			0.00%	assume 0% unless advised by Regulation, Pricing & Access Development				
32										
	Model Parameters									
34		Model								
35		Discounted Cashflow Period			15	years (no longer than 15)				
36										
	Periodic Payments									
38		Payment Options								
39		Periodic Payment Period			0	years (no longer than 5)				
40		Credit Risk			Security in p	assume "Security in place (full amount)" unless advised by Treasury				
41										
	Model Outputs									
	Capital Contribution				Capital Contribution (ex-GST)		GST		Total (inc-GST)	
44		Calculated Capital Contribution								
45		Capital Contribution for Shared Assets			0		0		0	
46		Capital Contribution for Connection Assets			7,810,313		781,031		8,591,345	
47		Total Capital Contribution			7,810,313		781,031		8,591,345	
48					Capital contribution valid if full payment is received within 60 days of 8/10/2010					
49		IRR over Discounted Cashflow Period			10.13%					
50		Check			OK					
51										
	Periodic Payments									
53		Interest Rate								
54		Interest Rate			11.30%					
55		Monthly Payment Schedule		Periodic Repayment		Admin Fee	GST		Total (inc-GST)	
56		Upfront Payments				0	0		0	
57		0 equal monthly payments		0			0		0	

Note: Commercial agreements were signed on the basis of capital contributions calculations developed in the first access arrangement (AA1) period. Consequently, the approved parameters (e.g. discount rates and operating expenditure allocation) correspond to the AA1 period.

Attachment 1

Assessment of the options for the scope of works required to connect Collgar Windfarm to the SWIN, Collgar Windfarm Project T0285447, DM# 6941932.

OPTIONS ASSESSMENT

ASSESSMENT OF THE OPTIONS FOR THE SCOPE OF WORKS REQUIRED TO CONNECT COLLGAR WIND FARM TO THE SWIN

COLLGAR WINDFARM PROJECT T0285447

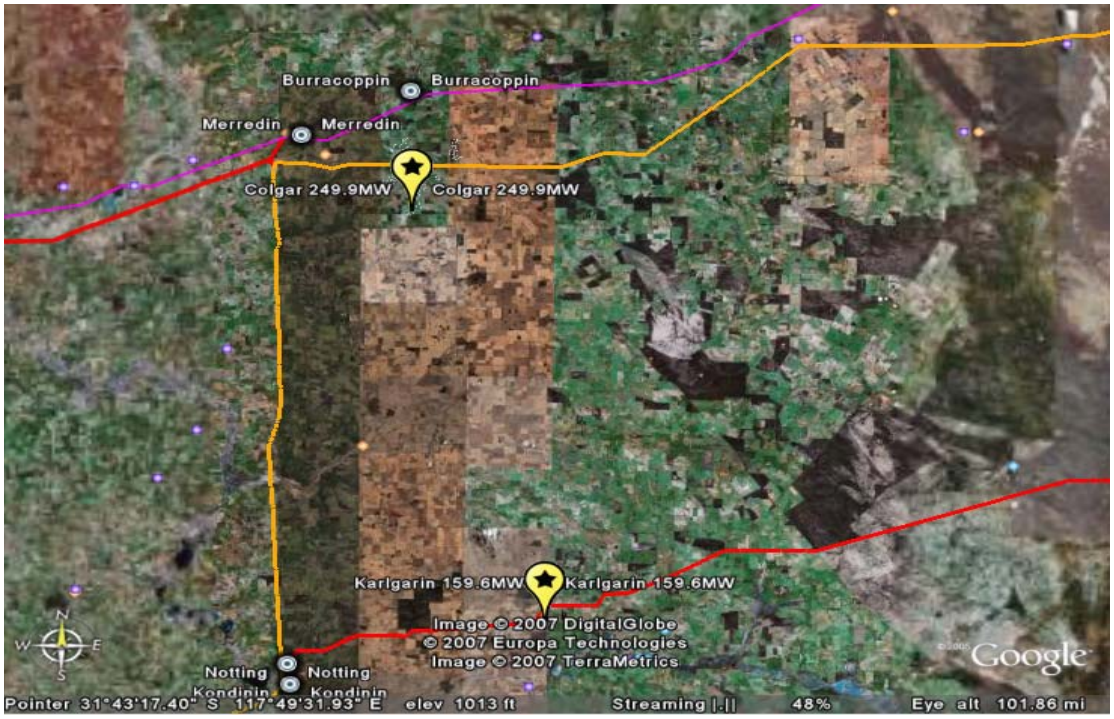
TABLE OF CONTENTS

Glossary of Terms

Acronym/term	Meaning
AA3	Access Arrangement 3
Access Code	Electricity Networks Access Code 2004
AQP	Applications and Queuing Policy
CCP	Capital Contributions Policy
CGT	Collgar Terminal Substation
CMD	Contracted Maximum Demand
Customer	Collgar Windfarm Pty Ltd
DSOC	Declared Sent Out Capacity
EGF	Eastern Goldfields
ERA	Economic Regulation Authority
GLT	Guildford Terminal Substation
MRT	Merredin Terminal Substation
NT	Northern Terminal Substation
PLC	Power Line Carrier
REC	Renewable Energy Certificate
SWIN	South West Interconnected Network
WP	Western Power
WKT	West Kalgoorlie Terminal Substation
YLN	Yilgarn Terminal Substation

1 BACKGROUND

The Customer submitted a grid connection application in 2007 for the connection of a windfarm power station to the SWIN with a DSOC of 250 MW approximately 25 km east of MRT. Western Power is required to undertake works to connect Collgar Wind Farm to the SWIN.



Site Location Map – Collgar Wind Farm

The connection of Collgar Wind Farm is broken into separate scope of works for the maximum evaluation of available options. The following Western Power scope of works is required to connect Collgar Wind Farm to the SWIN:

1. Establishment of CGT which will connect Collgar Wind Farm to the SWIN;
2. Connection of CGT to the SWIN;
3. Consideration of any future or proposed augmentations to the SWIN;
4. Operation restrictions associated with the connection of Collgar Wind Farm to the SWIN;
5. Reactive reserve reinforcements in the Perth metro area as a result of the connection of Collgar Wind Farm to the SWIN;
6. Communications requirement for CGT; and
7. Protection requirement for CGT.

This report will assess different options available for each of the above scope of works including allocation of cost in accordance with the AQP and CCP.

The recommended options for each of the scope of work items will be used to calculate the total estimated project cost and the Customer capital contribution for the Connection Works and Shared Network Works.

The recommended options and other options evaluated are for the purposes of demonstrating that Western Power is efficiently minimising costs in relation to the scope of works to be undertaken for the Collgar Wind Farm connection and providing the lowest sustainable cost over a reasonable period of time to demonstrate compliance with the *New Facilities Investment Test* under the Access Code.

2 CONFIGURATION OF CGT

2.1 Western Power Minimum Requirements for CGT

This section looks at the minimum requirements for CGT assuming a connection is made to the EGF transmission line. CGT, including the cut-in to the EGF Line, will be designed and operated for an N-1 planning criteria in accordance with clause 2.5.2.2(a) of the *Technical Rules* with the windfarm treated as a sub-network.

A line circuit breaker is required at CGT to meet the fault clearance times specified under the *Technical Rules*. There is currently no line circuit breaker at YLN. To meet the N-1 planning criteria for CGT, a second circuit breaker is required in parallel to the line circuit breaker for when the line circuit breaker is out of service. This avoids any unnecessary interruptions or outages the EGF line as a result of a line breaker being out of service.

Therefore, to achieve compliance with the *Technical Rules*, the minimum planning criteria for CGT is as follows:

1. 1 x line 220 kV circuit breaker;
2. N-1 - a second circuit breaker bay in parallel to the line circuit breaker bay for when the line circuit breaker bay is out of service ; and
3. meeting Good Electricity Industry Practice.

The alternative the above solution is establishment of line circuit breakers at YLN (to meet the required fault clearance times) which would be a more expensive solution given the requirement to retrofit YLN and associated outages on the EGF line (generation would have to be dispatched at WKT and YLN as a result of this outage).

2.1.1 Options Analysis for the Minimum Requirements for CGT

2.1.1.1 Option 1 – Two (2) Circuit Breaker Installation

To comply with the line circuit breaker requirement and N-1 planning criteria, the minimum requirements for CGT is a 2 circuit breaker arrangement as shown in figure 1.

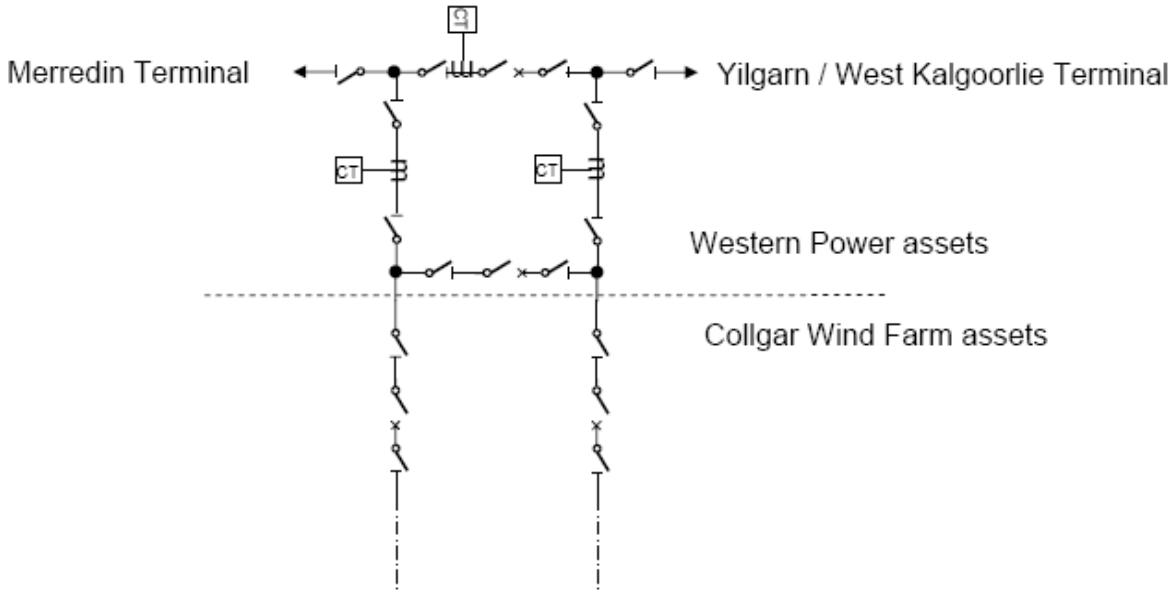


Figure 1 – 2 line CBs in parallel

However this arrangement would require, and be reliant on, customer circuit breakers to clear faults on Western Power equipment and protect Western Power transmission assets from any faults on the Customer's equipment which is not consistent with Good Electricity Industry Practice. As such a Technical Exemption from the *Technical Rules* would be required for proceeding with this configuration.

However, with the configuration shown in figure 1, any fault on the left, right and bottom legs of the mesh and on the connections to the windfarm circuit breakers will trip both the windfarm and the connection to the EGF. Circuit breakers would be required on the left and right legs of the mesh to avoid interrupting the supply to the EGF.

Any faults on the transmission line between CGT and WKT will result in disconnection of half the windfarm power station from the SWIN with this substation configuration.

This option is not considered to be a viable solution.

2.1.1.2 Option 2 – Three (3) Circuit Breaker Installation

To comply with the line circuit breaker requirement, N-1 planning criteria and Good Electricity Industry Practice, the minimum requirements for CGT is a 3 circuit breaker arrangement as shown in figure 2.

A dedicated circuit breaker bay is required to clear faults on Western Power equipment and protect Western Power transmission assets from any faults on The Customer's equipment to meet Good Electricity Industry Practice. This dedicated circuit breaker bay will only be utilised by Collgar Wind Farm and is treated as a connection asset as shown in figure 2.

The line circuit breaker bay and the second circuit breaker bay in parallel to the line circuit breaker bay form part of the EGF network and are treated as shared assets as shown in figure 2.

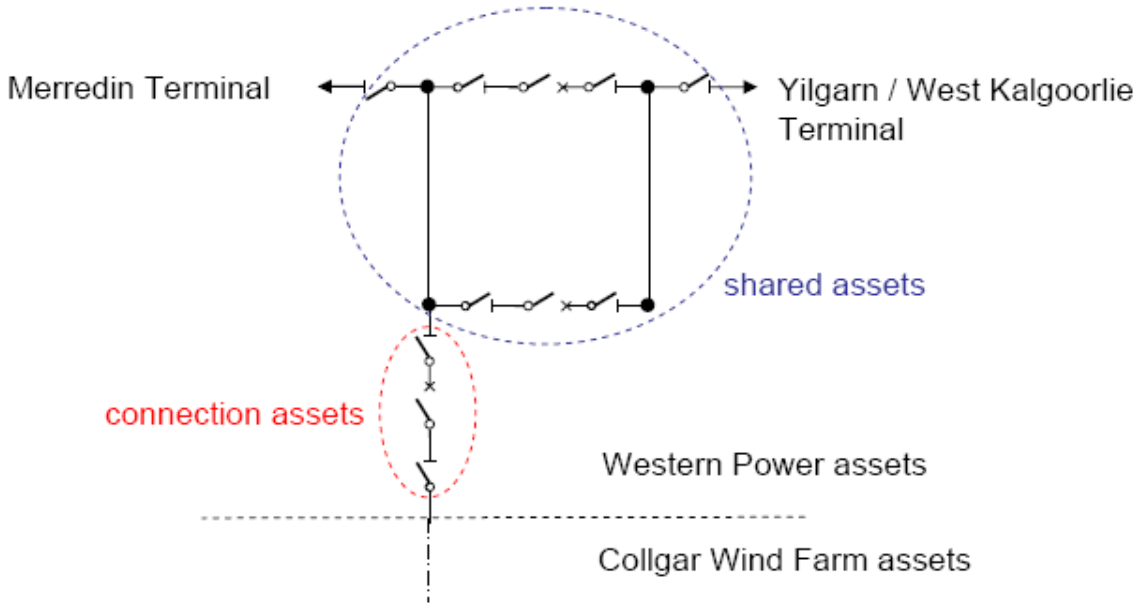


Figure 2 – 3 CB Installation

The cost for proceeding with this option is estimated at $14.8M.

No Technical Exemptions from the *Technical Rules* are required for proceeding with this configuration.

2.1.1.3 Option 3 – Three (3) Switch Mesh Arrangement

A 3 switch mesh arrangement, as shown in figure 3 meets all the minimum planning criteria outlined in section 2.1 and is equivalent to the Western Power minimum works required to connect Collgar Wind Farm to the SWIN outlined in Option 2.

This arrangement is an alternative to Option 2 and provides Collgar Wind Farm with greater operational flexibility over and above the minimum requirements outlined in Option 2, e.g. if any one of the circuit breaker bays was out of service then Collgar Wind Farm could still fully export onto the EGF line in either direction[1].

If the Customer elects to proceed with an arrangement which exceeds the Western Power minimum requirements for CGT in order to provide operational benefits for their facility, the Customer will be required to pay directly for all additional equipment which exceeds the Western Power minimum requirements for CGT. All assets which exceed the Western Power minimum requirements are treated as connection assets. This situation is covered by clause 7.2 and 7.3 of the CCP.

[1] It is proposed that Collgar Wind Farm will be automatically disconnected if islanded with the EGF load

The line circuit breaker bay and the second circuit breaker bay in parallel to the line circuit breaker bay (now shown as the circuit breaker bay on the right hand side of the switched mesh) are treated as shared assets as outlined in Option 2. The circuit breaker bay on the left hand side of the switched mesh is the equivalent of the dedicated circuit breaker bay in Option 2 and is treated as a connection asset.

The breakdown of connection assets and shared assets are shown in figure 3.

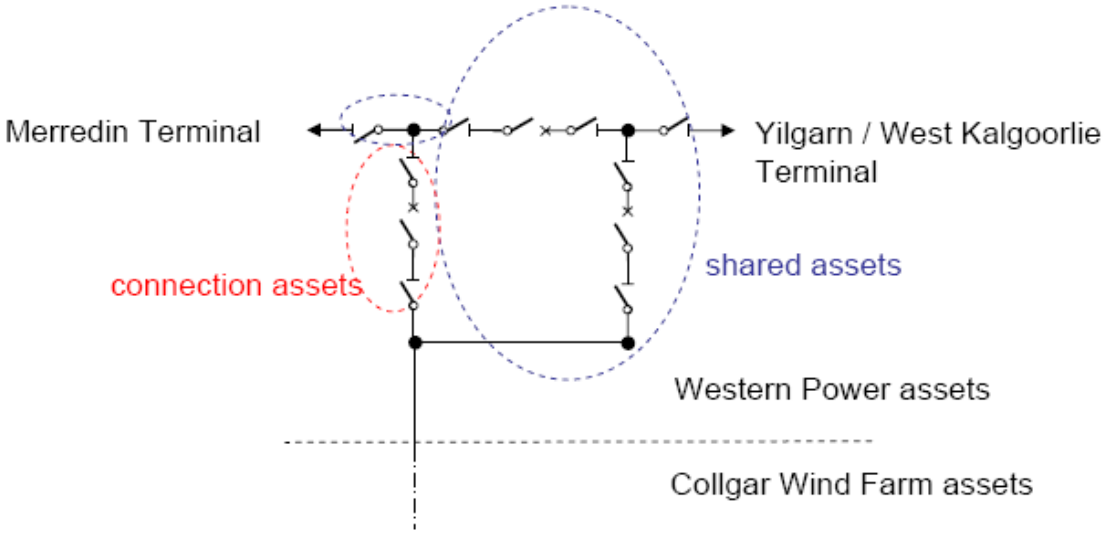


Figure 3 – 3 switch mesh

This arrangement does not require customer circuit breakers to clear faults on Western Power equipment and protects Western Power transmission assets from any faults on The Customer's equipment. This arrangement also allows for normal operation of the windfarm facility in the event of a fault on the transmission line between CGT and WKT.

The Customer would not be required to install their own main 220 kV circuit breaker with this arrangement and may elect to use the Western Power circuit breakers as a point of de-energisation in accordance with clause 3.3.3.10 of the *Technical Rules*

The cost for proceeding with this option is estimated at $14.8M.

No Technical Exemptions from the *Technical Rules* are required for proceeding with this configuration.

2.1.1.4 Option 4 –Greater than Three Switch Mesh Arrangement

Any arrangement over and above the 3 switch mesh arrangement shown in figure 3 above, such as a 4 switch mesh arrangement shown in figure 4 below, exceeds the Western Power minimum requirements for CGT.

If the Customer elects to proceed with an arrangement which exceeds the Western Power minimum requirements for CGT in order to provide operational benefits for their facility, the Customer will be required to pay directly for all additional equipment which exceeds the Western Power minimum requirements for CGT. All assets which exceed the Western Power minimum requirements are treated as connection assets. This situation is covered by clause 7.2 and 7.3 of the CCP.

The cost for proceeding with the configuration shown in figure 4 is estimated at $17.0M.

No Technical Exemptions from the *Technical Rules* are required on the Western Power side of CGT for proceeding with this configuration.

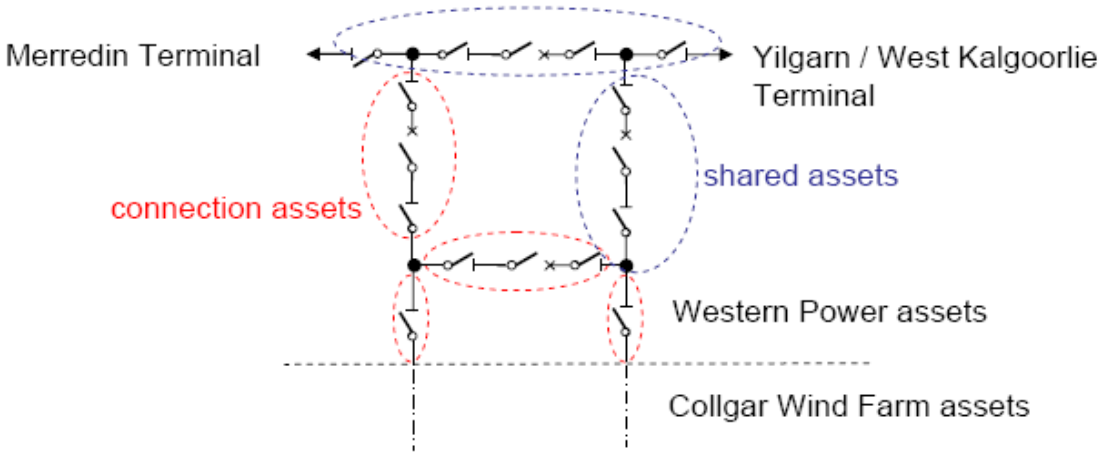


Figure 4 – 4 switch mesh

2.1.2 Network Planning & Development Minimum Requirements for CGT

The Network Planning & Development (NPD) Western Power minimum requirement for CGT is a 3 circuit breaker installation as shown in figure 2 (Option 2).

The 3 switch mesh arrangement in Option 3 (figure 3) is also equivalent to Option 2 (figure 2) provided the costs for the connection assets and shared assets are allocated appropriately as outlined in this document. The Customer would not be required to install their own main 220 kV circuit breaker and may elect to use the Western Power circuit breakers as a point of de-energisation in accordance with clause 3.3.3.10(c) of the *Technical Rules* providing the Customer indemnifies Western Power from any and all liability for using the Western Power circuit breakers as a point of de-energisation.

The NPD Western Power minimum requirements for CGT, based on two feeder circuits from the Customer's premises, is shown in figure 5. The Customer would be required to install their own 220 kV circuit breakers unless a Technical Exemption is submitted by the Customer and granted by Western Power for the Customer using the Western Power circuit breakers as a point of de-energisation.

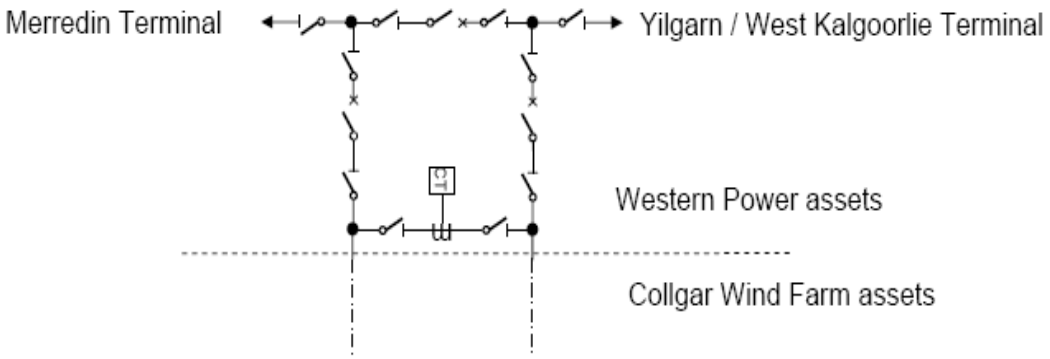


Figure 5 – switched mesh arrangement

2.1.3 Recommendation for the Minimum Requirements for CGT

The Western Power minimum requirements for CGT is recommended as a 3 circuit breaker installation as shown in figure 2 (Option 2), in particular considering the extra reliability and safety provided by Option 2 over Option 1 against the cost difference between the two options.

It is recommended that if the Customer elect for Western Power to develop a 3 switch mesh arrangement as shown in figure 3 (Option 3), then the treatment of connection assets and shared assets are as per Option 2, i.e. 2 circuit breaker bays and associated busbar treated as shared assets with one circuit breaker bay treated as a connection asset.

It is recommended that if the Customer elects for Western Power to develop a 4 switch mesh arrangement as shown in figure 4 which is the current proposal, then two circuit breaker bays and associated busbar are treated as shared assets with the other two circuit breaker bays treated as connection assets. The cost estimate for a 4 switch mesh at CGT is $17.5M (including risk and overhead costs).

2.2 Alternative Options for Connection to the SWIN

This section looks at alternatives to connection to the EGF transmission line.

2.2.1 Alternative Option 1- Connection of Collgar Wind Farm to Merredin Terminal at 220 kV

This option includes a 220 kV line circuit, communications, SCADA, protection and 25 km of 220 kV line to connect at MRT 220 kV bus. A high-level cost estimate for this option is $4.0M for the line circuit bay at CGT (excluding the costs of any works at MRT) and $22.5M for the 25 km 220 kV line construction. A per km line construction cost estimate for 220 kV single circuit of $900k has been assumed. The total cost estimate

for this option exceeds the cost for the construction of the Western Power minimum requirements for CGT outlined in section 2.1.3.

2.2.2 Alternative Option 2 - Connection of Collgar Wind Farm to Merredin Terminal at 132 kV

A 132 kV connection to MRT would require the installation of 132 kV double-circuit transmission lines which is estimated to be a more expensive than 220 kV single circuit and a second line bay at both CGT and MRT. Connection at 132 kV would also likely result in a greater overload of the 132 kV system locally under certain system conditions resulting in significantly greater constraints on the Collgar Wind Farm output.

2.3 Recommended Option

The recommended option for the configuration of CGT is as per the recommendation for Western Power minimum requirements outlined in section 2.1.3 based on the cost of establishing a terminal substation at Collgar Wind Farm.

If the Customer requests anything which exceeds the Western Power minimum requirements for CGT (e.g. the second dedicated circuit breaker bay for the Customer's connection), the Customer will be required to pay full cost upfront for the asset that is over and above the minimum requirements and this will be treated as Connection Works.

No exemption would be required from the *Technical Rules* for the switched mesh configuration at CGT. However if the Customer elects to install two feeder circuits from their facility (as shown in figure 5) and do not install main 220 kV circuit breakers on these feeder circuits, then the Customer will be required to submit a Technical Exemption for non-compliance with clause 3.3.3.10 of the *Technical Rules*. A detailed single line diagram of the proposed configuration for CGT is contained in Appendix 1.

Note: the Customer has elected to proceed with a 4 switch mesh configuration as shown in figure 4. The Customer will not install their own main 220 kV circuit breakers but will use the Western Power circuits breakers in CGT as a point of de-energisation and will indemnify Western Power in the ETAC from any and all liability for any direct or indirect damage to the Customer's facility as a result of the Customer electing to use the Western Power circuits breakers to clear any faults.

The Customer is proposing to provide two separate feeder circuits from the Customer's premises to CGT and therefore does not comply with clause 3.3.3.10 of the Technical Rules. The Customer has submitted a Technical Exemption from compliance with clause 3.3.3.10 of the Technical Rules which has been granted by Western Power. A copy of this exemption is contained in Appendix 2.

3 CONNECTION OF CGT TO THE EGF LINE

CGT, including the cut-in to the EGF transmission line, will be designed and operated for an N-1 planning criteria. A technical exemption may be required from the ERA if CGT was designed to any other planning criteria. This section assesses options for the connection of CGT to the EGF line.

3.1 Option 1 – Two (2) Termination Pole Solution

This option assesses the connection of CGT to the EGF transmission line using two single circuit termination poles at an estimated cost of $0.9M. From an operational & safety perspective this two pole option virtually poses no risk of inadvertent contact with live conductors or induced voltages (from adjacent live circuits) during maintenance works on any one pole.

Two termination poles allow the line landing span conductors to terminate on CGT gantries perpendicular to its beam. In this way good engineering practice is employed to minimise loads on the gantry structure thus increasing security.

The EGF transmission line suffered major storm damage on three occasions in the recent past. Extensive repairs necessitating long outages were required to repair/replace three towers for each event. Two failures were attributed to tornado's, the third due to a convective downdraft or 'micro-burst'. The site of one tornado was at Bodalin, which is approximately 40 km north of CGT.

Also, the EGF line is relatively close to Meckering, the epi-centre of an earthquake in mid 1960s.

Design of CGT is based N-1 planning criteria. By applying a matching N-1 criteria to the cut-in, Collgar Wind Farm will continue to export power in the event of a fault (e.g. due to storm damage) on the termination tower connecting the transmission line between CGT and WKT which causes an outage on the EGF transmission line between CGT and WKT.

3.2 Option 2 – One (1) Termination Pole Solution

This option assesses connection of CGT to the EGF transmission line using one double circuit termination pole at an estimated cost of $0.6M.

This estimate is a very high level estimate for a single termination pole not previously used in this mode. The design and construction of this option is quite complex. It requires termination points for twenty four conductors and six overhead earth wires with an additional cross arm. In this way over stressing of adjacent towers is prevented avoiding the high cost to strengthen/reinforce adjacent suspension towers.

Future maintenance work of the line with this option is more labour intensive. It requires linesmen specially trained to carry out maintenance works on the de-energized line which is in close proximity to the energised line on the opposite side of the pole. An

increased crew size to ensure safety and provide operators for plant required to overcome restricted access will be required.

Failure of the single termination pole will disconnect Yilgarn, Kalgoorlie and the output of Collgar Wind Farm from the EGF transmission line.

The angle between landing span conductors and CGT gantry beam is more severe for the single pole termination. This in turn produces a higher loading condition on the gantry structure

Although CGT is in a relatively remote location, a single pole termination of thirty conductors will be a point of high visual pollution and less acceptable from an environmental viewpoint.

3.3 Summary

Option 2 is estimated to be the lowest upfront cost for connection of CGT to the EGF line. However considering the additional cost associated on maintenance during its life time with Option 2, it is estimated that Option 1 is overall the most cost effective option for connecting CGT to the EGF line.

Option 1 also has advantages over Option 2 by reducing the stresses on the termination pole/s and the gantry structures at CGT, avoiding the requirement for specially trained linesmen for maintenance on this section of the EGF line and reducing the risk with maintenance.

Option 1 will also reduce the vulnerability of the CGT connection (250 MW maximum export) to wind and seismic events on the EGF transmission line and minimise the visual impact of the CGT connection.

3.4 Recommendation

The recommended option for the connection of Collgar Wind Farm is Option 1.

No exemption would be required from the *Technical Rules* with this solution. This work item is treated as Shared Network Works given the requirement to establish 2 x line circuit breakers in parallel in CGT (which are Shared Networks Works) as outlined in section 2.1.

4 FUTURE AUGMENTATIONS TO THE EGF LINE

This section assesses the impact of proposed up-rating of the EGF line to 275 kV in 2018. Different options for the rating of primary plant at CGT are assessed considering the EGF line up-rate, including a brief cost benefit analysis.

It is noted that the estimates provided associated with the installation of 220 kV and 275 kV are high-level estimates, have associated tolerances and are not definite costs. It is not possible to get a detailed estimate for the construction of CGT using 220 kV plant without updating the latest structural and civil drawings for 220 kV to current applicable standards (the latest structural and civil drawings for 220 kV were for the construction of YLN over 20 years ago). There are no standards, drawings or designs available for 275 kV. For the purposes of evaluating the optimum voltage of the plant to be installed at CGT it is not deemed prudent to undertake detailed cost estimates given the timeframe and costs associated with this exercise.

There are no applicants currently in the Applications Queue seeking to connect around the Collgar Wind Farm location. As a result there is no requirement for CGT to be designed with the possibility of further applicants connecting.

4.1 Background and Discussion of Current Situation

4.1.1 Upgrading of the EGF Line from 220 kV to 275 kV

It is proposed to up-rate the EGF line from 220 kV to 275 kV in 2018 to cater for load growth in the East Country and EGF. This is documented in Appendix 3. The actual year of up-rate will be determined by the actual rate of load growth in the East Country and EGF, in particular new connections and disconnections of existing block loads. The cost to up-rate the current EGF Line to 275 kV is estimated at $113M[2] and will be deferred as long as it economically viable to do so. It is currently proposed to utilise local generation in the EGF area until around 2018 (Stage 1) and from 2018 up-rate the EGF line to 275 kV (Stage 2) to give an increased power transfer capability to the EGF region. Figure 6[3] shows the history and estimated forecasted trend for the summer peak load at WKT.

[2] Latest estimate from 2007
[3] Extract from the "Summer Load Trends Report 2010" – page 446, Appendix 3

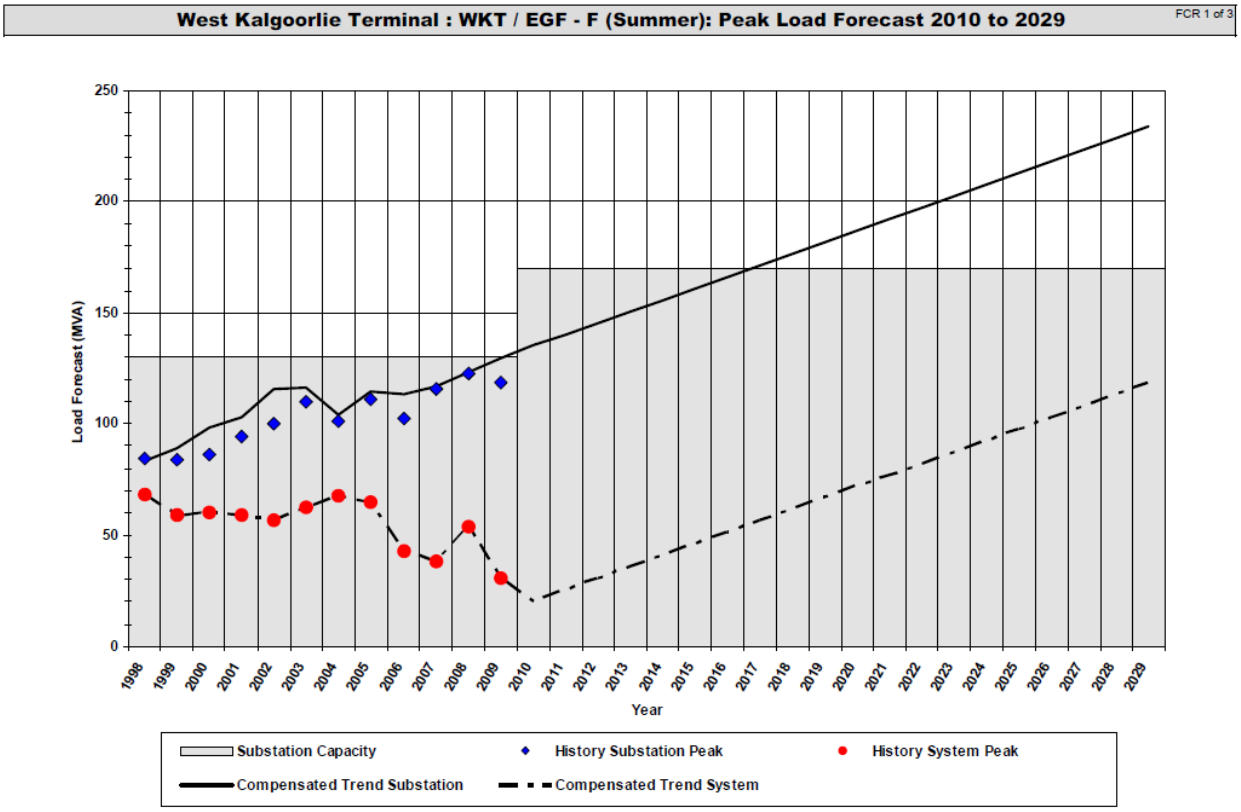


Figure 6: WKT Peak Load – Historic & Forecasted

Although Western Power are not currently committing to upgrading the line in 2018, given the current information, anticipated load forecast and available options, the recommended option is that the EGF line is up-rated from 220 kV to 275 kV in 2018. This is the best information available at this moment in time but it may be subject to change in the future if the load forecast changes or if the generation profile in the East Country and/or EGF changes.

The EGF line up-rate from 220 kV to 275 kV, alternative options for supplying the EGF Region in the future and supporting information are outlined in the documents listed in Appendix 3.

4.1.2 Impact of Upgrading EGF Line from 220 kV to 275 kV on CGT

CGT is scheduled to be in-service for April 2011, seven years before the proposed up-rate of the EGF line. Unless all plant is rated for operation at 275 kV, then the majority of the primary plant items will have to be replaced to allow the EGF line to be up-rated to 275 kV.

4.2 Cost Estimate for Installation - 220 kV, 275 kV & 330 kV Plant

Three different voltage ratings for plant to be installed at CGT are considered:

1. 220 kV – this is the current operational voltage of the EGF Line;
2. 275 kV – this is the proposed operational voltage of the EGF Line from 2018 onwards; and
3. 330 kV – this is a standard operational voltage used by Western Power in the SWIN and is the next operational voltage after 220 kV used on the SWIN.

220 kV and 330 kV plant are standardised items for Western Power as these voltages are used in the SWIN. However 330 kV is used more significantly throughout the SWIN and as such 330 kV plant is far more standardised than 220 kV plant, particularly considering the last major 220 kV augmentation on the SWIN was over 20 years ago at YLN. The EGF line is the only transmission line in the SWIN that operates at 220 kV. 275 kV is not a standard operational voltage in the SWIN. Western Power does not have standard designs or specification for 275 kV plant.

4.2.1 Cost Estimate for 220 kV, 275 kV and 330 kV Plant Procurement

Table 1 below details the estimated cost for 220 kV, 275 kV and 330 kV plant for the main primary plant items required to be installed at CGT.

Primary Plant Item	#	Cost Estimate for 220 kV	Cost Estimate for 275 kV	Cost Estimate for 330 kV
Circuit Breakers	4	$440,000	$760,000	$768,000
Current Transformers	12	$271,716	$312,000	$360,000
Voltage Transformers	12	$180,000	$186,000	$206,400
Disconnectors	12	$311,460	$420,000	$419,460
Station Post Insulators	170	$161,500	$380,800	$398,820
Wavetraps/LMUs	4	$185,648	$159,000[4]	$159,000
Surge Arrestors	6	$46,800	$56,400	$57,000
TOTAL		**$1,597,124**	**$2,115,200**	**$2,368,680**

Table 1: 220 kV, 275 kV & 330 kV Primary Plant Estimates

4.2.1.1 Requirement for Spares

There are currently limited spares available for 220 kV rated primary plant and no spares for 275 kV rated primary plant. The current 220 kV spares that are available are assigned to current 220 kV assets installed in the SWIN and further spares would be required for any new 220 kV assets installed at CGT. The following minimum spare 220 kV and 275 kV primary plant items are recommended to ensure that Western Power is acting in accordance with Good Electricity Industry Practice:

Primary Plant Item	# Spares	Cost Estimate- 220 kV	Cost Estimate - 275 kV
Circuit Breakers	1	$110,000	$190,000
Current Transformers	3	$67,929	$78,000
Voltage Transformers	3	$45,000	$46,500
Disconnectors	1	$25,955	$35,000

[4] No cost estimates could be received for this plant item (rated for 275 kV). Therefore the cost of a 330 kV wavetrap was assumed

Station Post Insulators	9	$8,550	$20,160
TOTAL		**$257,434**	**$369,660**

Table 2: 220 kV & 275 kV Primary plant Estimates - Spares

330 kV rated primary plant is standard and has the required spares available to ensure that Western Power is acting in accordance with Good Electricity Industry Practice.

4.2.1.2 Primary Plant Cost Estimate Summary

Item	Cost Estimate for 220 kV	Cost Estimate for 275 kV	Cost Estimate for 330 kV
Primary Plant	$1.6M	$2.1M	$2.4M
Primary Plant - Spares	$0.3M	$0.4M	$0.0M
Secondary Plant	$2.4M	$2.4M	$2.4M
TOTAL	**$4.3M**	**$4.9M**	**$4.8M**

Table 3: 220 kV, 275 kV & 330 kV Plant Estimates

There is no difference in secondary plant procurement costs for 220 kV, 275 kV and 330 kV at CGT.

4.2.2 Cost Estimate for Design with 220 kV, 275 kV & 330 kV Plant Installed

The design of a 330 kV Terminal substation requires the least numbers of man-hours compared to the design of a 220 kV or 275 kV Terminal substations given that there are a far greater number of 330 kV Terminal substations in-service in the SWIN. The majority of the 220 kV civil and structural design drawings will need to be updated to current standards. New electrical, civil and structural drawings would be required for designing CGT for operation at 275 kV.

The approximate cost for the design of CGT with the installation of 220 kV, 275 kV and 330 kV plant is estimated as follows:

Item	Cost
High Level estimate for Design - 220 kV	$1.5M
High Level estimate for Design – 275 kV	$1.7M
Estimate for Design - 330 kV	$1.4M

Table 4: 220 kV, 275 kV & 330 kV Design Estimates

4.2.3 Cost Estimate for Civil & Structural Works - 220 kV, 275 kV & 330 kV

The approximate cost for civil and structural works associated with the installation of 220 kV, 275 kV and 330 kV plant is estimated as follows:

Item	Cost
High Level estimate for Civil & Structural - 220 kV	$4.8M

High Level estimate for Civil & Structural – 275 kV	$5.1M
Estimate for Civil & Structural - 330 kV	$5.7M

Table 5: 220 kV, 275 kV & 330 kV Civil & Structural Estimates

The above estimates for the cost of civil works for installation of 220 kV and 275 kV plant are very high-level estimates as no detailed estimates have been performed recently for these works which could be used here. There are no specifications, drawings or designs currently available for 275 kV and drawings for 220 kV would be required to be updated to current standards. It is not prudent to develop all required specifications, drawings or designs for 220 kV and 275 kV to current required standards for the purposes of obtaining an estimate with a higher degree of accuracy.

The substation relay and metering building cost estimate is the same for a 220 kV, 275 kV or 330 kV plant installation at CGT.

4.2.4 Cost Estimate for Installation Works - 220 kV, 275 kV & 330 kV Plant Installed

The estimated cost difference for installation works with 220 kV, 275 kV or 330 kV rated primary plant installed at CGT is considered negligible over the course of the construction phase.

4.2.5 Other Costs Associated with the Installation of CGT

The costs for the CGT commissioning and EGF line cut-in are not expected to significantly vary if 220 kV, 275 kV or 330 kV rated plant is installed at CGT. The line termination poles will be suitable for operation at 275 kV in line with the existing structures used on the EGF line.

The costs for communications (including SCADA), protection design and the run-back scheme are independent of the voltage rating of the plant installed at CGT.

4.2.6 Summary of Cost Estimates

The cost estimate for the construction of CGT with 220 kV, 275 kV and 330 kV is broken down as follows:

Item	Cost Estimate - 220 kV	Cost Estimate - 275 kV	Cost Estimate - 330 kV
Plant procurement	$4.3M	$4.9M	$4.8M
Design	$1.5M	$1.7M	$1.4M
Civil and Structural Works	$4.8M	$5.1M	$5.7M
Installation works and associated costs[5]	$4.3M	$4.3M	$4.3M
Commissioning	$0.7M	$0.7M	$0.7M
Cut-in to 220 kV transmission line	$0.9M	$0.9M	$0.9M
Communications	$1.0M	$1.0M	$1.0M

[5] Includes transport, accommodation and costs to site

Item	Cost Estimate - 220 kV	Cost Estimate - 275 kV	Cost Estimate - 330 kV
Runback Scheme	$0.8M	$0.8M	$0.8M
ESTIMATED TOTAL	**$18.3M**	**$19.4M**	**$19.6M**

Table 6: 220 kV, 275 kV & 330 kV Total Estimated Costs

Please note these figures do not include risk, escalation or overheads.

4.3 Options Analysis for the Design and Construction of CGT

This section assesses the different options for the design and construction of CGT considering the proposed up-rating of the EGF line.

Any upgrading of CGT after the initial installation of plant to allow for operation of CGT at a higher voltage will be extremely expensive and may involve an entire re-construction of the main primary plant assets in the CGT switchyard including foundations and structures. There are also additional costs associated with the upgrading of CGT as follows:

1. downtime for the operation of Collgar Wind Farm, resulting in a loss of income and RECs for the Customer and/or their off-taker respectively, and
2. costs for dispatching generation in the EGF and East Country as a result of an outage of the EGF Line to retrofit CGT for operation at 275 kV[6].

Three options have been selected which assesses CGT being designed and constructed such that:

1. There is minimal upgrade to CGT for the proposed upgrading of the EGF line in 2018;
2. CGT is suitable for operation at 220 kV only but makes allowances for the proposed upgrading of the EGF line in 2018; and
3. CGT is suitable for operation at 220 kV only with no allowances made for the proposed upgrading of the EGF line in 2018.

4.3.1 Option 1 – Minimum Upgrade to CGT for Up-rate of EGF Line

This option assesses the initial installation of 275 kV rated primary plant at CGT, which is suitable for operation at 220 kV, so that there is minimal upgrades to CGT for the upgrading of the EGF line to 275 kV in 2018. For Option 1 a 330 kV plant installation is selected considering the cost estimate for this is of a similar order of magnitude as a 275 kV plant installation (see Table 6) but has a significantly earlier in-service date.

Cost

Work Item	Cost

[6] It is proposed to up-rate the EGF Line 'live', i.e. it is not proposed to de-energise the EGF Line during the up-rate apart for some works where necessary

330 kV plant installation	$19.6M
OPTION 1 TOTAL UPFRONT COST	**$19.6M**

Table 7: Option 1 Estimated Costs

Timeframe

Proceeding with the installation of 330 kV (as opposed to 275 kV) rated primary plant will allow Western Power to construct CGT in a timeframe that is reasonable and meets the Customer's required in-service date with standard plant and designs utilised. Installation of 275 kV plant at CGT would result in Western Power not being able to energise CGT in a reasonable period of time and not meet the Customer's required in-service date.

Future Costs

There are no other significant associated costs with up-rating the EGF Line for operation at 275 kV by proceeding with this option.

4.3.2 Option 2 – Reduced Upgrade to CGT for Up-rate of EGF Line

This option assesses the initial installation of 220 kV rated primary plant at CGT and making allowances in the design and construction for upgrades to CGT for operation at 275 kV in 2018.

There is a wide-ranging degree of allowances that can be made in the design to cater for the upgrade of CGT for operation at 275 kV based on the probability of the up-rate to the EGF line. Given the load forecasts currently available and the current proposal to up-rate the EGF line in 2018, this option should consider making all reasonable allowances in the initial design and construction for CGT to allow for upgrade of CGT for operation at 275 kV in 2018. An example of this would be the sizing of the initial compound, gantry structures, clearances and foundations such that it would be suitable for operation at 275 kV upon the upgrading of the EGF line.

Cost

Work Item	**Cost**
220 kV plant installation	$18.3M
Additional cost associated with allowance for 275 kV rated civil & structural works	+$0.3M[7]
Additional cost associated with allowance for design of 275 kV rated CGT	+$0.2M[8]
OPTION 2 TOTAL UPFRONT COST	**$18.8M**

Table 8: Option 2 Estimated Costs

Timeframe

Proceeding with the initial installation of 220 kV rated primary plant at CGT and making allowances in the design and construction for upgrades to CGT for operation at 275 kV in 2018 will result in a delay in the completion of CGT and meeting the Customer's required in-service date given the extra timeframe for completion of designs for 275 kV.

[7] See cost difference between civil and structural works for 220 kV and 275 kV in 'Table 6'
[8] See cost difference between design for 220 kV and 275 kV in 'Table 6'

Future Costs

There are significant costs associated with upgrading CGT for operation at 275 kV with this option; circuit breakers, disconnects, current and voltage transformers would be required to be replaced and the associated foundations and structures would be required to be modified. This upgrade cost is estimated at approximately $4.3M (nominal):

1. Re-design and re-commissioning - $0.8M;
2. Primary plant procurement for replacement of main primary plant items- $2.4M;
3. Civil and structural re-workings - $0.5M; and
4. Installation re-workings; $0.6M.

The Customer will lose significant income, their off-taker RECs and the electricity market will face increased costs to dispatch generation in the EGF as a result of Western Power proceeding with this option.

There is also a technology risk as primary plant scopes and/or availabilities may change by the time CGT is upgraded for operation in 2018 which may result in further upgrades being required to CGT (which could not be reasonably allowed for or anticipated when undertaking the initial design and construction for CGT).

4.3.3 Option 3 – Complete Upgrade to CGT for Up-rate of EGF Line

This option assesses the initial installation of 220 kV rated primary plant at CGT and making no allowances in the design and construction for upgrades to CGT for operation at 275 kV in 2018. This is initially the cheapest cost for the construction of CGT at a high-level estimated cost of $18.3M.

Cost

Work Item	Cost
220 kV plant installation	$18.3M
OPTION 3 TOTAL UPFRONT COST	**$18.3M**

Table 9: Option 3 Estimated Costs

Timeframe

Proceeding with the initial installation of 220 kV rated primary plant at CGT and making no allowances in the design and construction for upgrades to CGT for operation at 275 kV in 2018 will allow Western Power to construct CGT in a timeframe that is reasonable but may result in a delay in meeting the Customer's required in-service date given the extra timeframe for completion of 220 kV civil and structural designs.

Future Costs

There are major costs associated with upgrading CGT for operation at 275 kV; all major primary plant, foundations and structures would be required to be replaced and a re-construction of CGT switchyard compound would be required. A high-level cost estimate for this upgrade cost is approximately $8.8M (nominal):

1. Re-design and re-commissioning - $1.3M;

2. Primary plant procurement for replacement of main primary plant items- $2.4M;
3. Civil and structural re-workings - $2.5M; and
4. Installation re-workings; $2.6M.

The Customer will lose significant income, their off-taker RECs and the electricity market will face increased costs to dispatch generation in the EGF as a result of Western Power proceeding with this option.

4.3.4 Cost Benefit Analysis

The cost of proceeding with Options 1, 2 and 3 is shown in Table 10 below.

Option	Upfront Estimated Cost	275 kV CGT Upgrade Additional Estimated Cost [PV]
Option 1 - 330 kV plant installation	$19.6M	+ $0.0M
Option 2 - 220 kV plant installation with allowance for 275 kV future upgrade of CGT	$18.8M	+ $2.5M[9]
Option 3 - 220 kV plant installation with no allowance for 275 kV future upgrade of CGT	$18.3M	+ $5.2M[10]

Table 10: Summary of Estimated Costs

Option 1 has the highest upfront estimated cost and the lowest cost for upgrade to 275 kV whereas Option 3 has the lowest estimated upfront cost and the highest estimated cost for upgrade to 275 kV.

A Cost – Benefit analysis has been undertaken to assess the impact of deferring the additional initial cost of expenditure between Option 1 and Option 2 and Option 1 and Option 3 until a future date. This Cost – Benefit analysis is contained in Appendix 4. A 10 year delay in the upgrading of the EGF Line to 275 kV was also considered in the Cost – Benefit analysis for the purposes of assessing the impact of a delay to this project.

The Cost – Benefit analysis for proceeding with Option 1 instead of Option 2 is summarised as follows:

Option 1 versus Option 2	Cost Saving (PV)[11]
installation of 330 kV primary plant and avoiding upgrading CGT for operation at 275 kV in 2018	$1.7M
installation of 330 kV primary plant and avoiding upgrading CGT for operation at 275 kV in 2028	$0.5M

Table 11: Cost Benefit Analysis – Option 1 versus Option 2

[9] $4.3M nominal, see section 4.2

[10] $8.8M nominal, see section 4.3

[11] See appendix 4 for estimated cost saving calculations

The Cost – Benefit analysis for proceeding with Option 1 instead of Option 3 is summarised as follows:

Option 1 versus Option 3	Cost Saving (PV)[12]
installation of 330 kV primary plant and avoiding upgrading CGT for operation at 275 kV in 2018	$3.9M
installation of 330 kV primary plant and avoiding upgrading CGT for operation at 275 kV in 2028	$1.4M

Table 12: Cost Benefit Analysis – Option 1 versus Option 3

Although 220 kV is used elsewhere including Victoria and in the Pilbara it will be extremely difficult for Western Power to sell any used 220 kV assets considering the low demand for second-hand assets and the risks associated with removal and transport of these assets. Considering this, the Cost – Benefit analysis has assumed no income is to be received for disposing of the 220 kV primary plant assets upon their de-commissioning at CGT in 2018.

4.3.5 Summary & Discussion of Options

Installation of 220 kV primary plant at CGT with no allowances made for upgrading CGT for operation at 275 kV in 2018 as outlined in Option 3 is the lowest initial cost option for the construction of CGT. The initial estimated cost for the design and construction of CGT between Option 1 and Option 2 is considered negligible.

However installation of 330 kV primary plant at CGT (which is suitable for operation at 220 kV and 275 kV) as outlined in Option 1 is the lowest cost option[13] over a reasonable time allowing for the proposed up-rate of the EGF Line to 275 kV in 2018. Even if the up-rate of the EGF Line was delayed to 2028, installation of 330 kV primary plant at CGT is still the lowest cost option.

Proceeding with Option 1 would be consistent with our obligations under clause 6.52(a) of the Access Code which requires Western Power to demonstrate that the amount invested in the proposed project does not exceed the amount that would be invested by a service provider efficiently minimising costs. This preferred option also avoids significant costs to other parties such as the Customer who would face a loss of income from production, the Customer's off-taker (Synergy) who would lose RECs and the market who would face an increase in costs as a result of the requirement to dispatch generation in Kalgoorlie associated with any upgrade of CGT. Passing on costs to third party should be minimised where possible which is achieved by selecting Option 1 instead of Options 2 or 3.

Proceeding with Option 1 would also allow Western Power to construct CGT in a timeframe that is reasonable and meets the Customer's required in-service date. The Customer has procured their main step-up grid transformers so that they are suitable for

[12] See appendix 4 for estimated cost saving calculations

[13] The cost difference between a 330 kV and 275 kV plant installation at CGT is considerable negligible in comparison to the total estimated project cost and the significant earlier in-service date that a 330 kV plant installation has compared to a 275 kV plant installation at CGT (see section 4.3.1).

operation at 220 kV and 275 kV such that if CGT is up-rated for operation at 275 kV in the future, it will not impact on the Customer's facility. The Customer has sufficient incremental revenue over a 15 year period to cover the value of shared networks assets and will not be required to provide an upfront capital contribution for the shared network assets.

It is noted that although it is proposed to up-rate the EGF line to 275 kV 2018, this is dependent on load growth increasing as forecasted. As stated in section 2.3 of this memo, the long-term load growth in the EGF region is volatile and uncertain, and therefore the most efficient option into the future for supply of the EGF will vary depending on the actual load growth, the condition of the existing EGF line and budget available.

4.4 Recommendation for the Installation of Plant at CGT

It is recommended that:

(i) the design and construction of CGT allows for the proposed upgrading of the EGF line from 220 kV to 275 kV in 2018 based on the information provided in Appendix 3; and

(ii) 330 kV plant, which is suitable for operation at 220 kV and 275 kV, is installed at CGT to achieve:

a. the expected least cost option over a reasonable period given the proposed up-rating of the EGF line to 275 kV in 2018 as per Option 1; and
b. a significant earlier in-service date for CGT than a 275 kV plant installation.

5 OPERATIONAL RESTRICTIONS

5.1 Merredin – Northam 132 kV Transmission Line

With the connection of Collgar Wind Farm, the 132 kV transmission line between MRT and Northam Substation will be overloaded under certain system operating conditions (e.g. high generation dispatch from the EGF and high output from Collgar Wind Farm). This sub-section assesses the options to avoid the overloading of this transmission line.

5.1.1 Option 1 – Runback Scheme

This option assesses installation of a runback scheme to prevent the overloading of the Merredin-Northam 132 kV transmission line under N-0 and N-1 conditions as a result of the Customer's connection. The runback scheme will monitor the loading on the Merredin-Northam 132 kV transmission line and automatically send a signal to Collgar Wind Farm to reduce their MW output within 60 seconds to avoid damage to this transmission line. The estimated cost for installation of the runback scheme is $750k.

5.1.2 Option 2 – Re-conductoring of Merredin-Northam 132 KV transmission line

This option assesses re-conductoring of the Merredin-Northam 132 kV transmission line to a higher MVA rating to avoid the overloading of the Merredin-Northam 132 kV transmission line which is estimated to exceed $20M.

5.1.3 Recommendation

The recommended option for avoiding the overloading of the Merredin-Northam 132 kV transmission line under N-0 and N-1 conditions as a result of the Customer's connection is Option 1 based on cost.

No exemption would be required from the *Technical Rules* with this solution. This work item is treated as Connection Works as they are solely required for the Collgar Wind Farm connection and will not be shared with other users on the system.

5.2 Cunderdin - Kellerberrin 66 kV Normally Open Point

There is a normally open point between Cunderdin and Kellerberrin on the 66 kV system which is currently open. With the normally open point remaining open, the transformers at Merredin Substation will not be overloaded under N-0 and N-1 conditions as a result of the Collgar Wind Farm connection. This sub-section assesses the options for treatment of the normally open point as a result of the Collgar Wind Farm connection.

5.2.1 Option 1 – Not Charging the Customer for Upgrading Merredin Substation

This option assesses keeping the normally open point open with Collgar Wind Farm connected until there is a project which triggers the requirement for the normally open

point to be closed. If the normally open point between Cunderdin and Kellerberrin on the 66 kV system is to be closed in the future, the cost of ensuring that the transformers at Merredin Substation are not overloaded (as a result of the closing of this normally open point) will not be borne by the Customer, and will not restrict the output of Collgar Wind Farm. This cost instead is likely to be borne by the project that requires closure of the normally open point (to meet the requirements of the *Technical Rules*).

5.2.2 Option 2 – Charging the Customer for Upgrading Merredin Substation

This option assesses charging the Customer the cost of upgrading Merredin Substation to ensure the grid transformers at this substation do not get overloaded as a result of the Customer's connection with the normally open point closed. This approach would not be consistent with the "first come, first served" principle in the AQP and the allocation of "appropriate portion of any of the forecast costs which do not meet the new facilities investment test" under the CCP.

5.2.3 Recommendation

The recommended option for the treatment of the normally open point between Cunderdin and Kellerberrin on the 66 kV system is Option 1 based on Western Power approved policy.

No exemption would be required from the *Technical Rules* with this solution.

6 REACTIVE RESERVE

This section assesses the options for treatment of the costs for the installation of reactive support in the Perth metropolitan area as a result of the Collgar Wind Farm connection.

The following revised reactive reserve study results have been provided for the connection of Collgar Wind Farm:

2012:
No reactive support is required for the Collgar Wind Farm connection in 2012. The existing reactive reserve capability in the Perth metropolitan area is sufficient.

2014:
The following reactive support options have been identified for 2014 with Collgar Wind Farm connected:

Option	Reactive Support
1	1 x 90 MVAr Capacitor Bank NT and 1 x 90 MVAr Capacitor Bank GLT
2	2 x 90 MVAr Capacitor Bank NT
3	2 x 90 MVAr Capacitor Bank GLT

Table 13 – Reactive Support 2012 and 2014

The only difference between the 2012 and 2014 study case is the forecasted load growth increase of approx 150 MW per year. No other generation is assumed to connect between 2012 and 2014.

In 2014 with Collgar Wind Farm connected, existing or scheduled generation is required to be switched off in the Perth metropolitan area thus reducing the reactive support capability in the metropolitan area. Reactive support in the form of 2 x 90 capacitor banks are required to replace the reactive support provided by the existing or scheduled generation switched off in the Perth metropolitan area.

However if Collgar Wind Farm was not to connect to the SWIN then no reactive support is required to support the forecasted load growth increase between 2012 and 2014.

6.1 Option 1 – Allocation of Costs for 2012 Only

The Customer is only charged for the cost of reactive reserve for 2012 (which is zero cost). Collgar Wind Farm can connect in 2012 with no further reactive support reinforcement to the network. All applicants who are ahead of Collgar Wind Farm in the Applications Queue in the South-West are assumed to be connected before Collgar Wind Farm in the study and their connection will not trigger any further reactive reserve reinforcements in the Perth metropolitan area.

The Customer is not charged for the cost of reactive reserve for 2014 as the increased requirement for reactive reserve between 2012 and 2014 with Collgar Wind Farm connected is triggered by the connection of forecasted load growth. As Collgar Wind Farm is already connected in 2012, the cost for any increase in the requirement for reactive reserve between 2012 and 2014 should be borne by the applicant who causes this requirement, i.e. forecasted load growth.

There is also the likelihood of further generation who are behind Collgar Wind Farm in the Applications Queue connecting in the South-West between 2012 and 2014. The scenario studied in 2014 (just general load growth and no new generation) may vary. Therefore, the need for additional reactive support in 2014 may be determined by a different scenario with allocation of costs being determined appropriately.

This approach would be consistent with the “first come, first served” principle in the AQP and the allocation of “appropriate portion of any of the forecast costs which do not meet the new facilities investment test” for the connection of Collgar Wind Farm in 2012 under the CCP. Collgar Wind Farm would also be granted unconstrained access to the SWIN in 2012, i.e. they would not be subject to any further reinforcements apart from those which are initially required for the connection of Collgar Wind Farm.

6.2 Option 2 – Allocation of Costs for 2012 and 2014

The Customer is charged for the cost of reactive reserve for 2012 and 2014. The 2014 reactive reserve reinforcements would not be required if Collgar Wind Farm did not connect, i.e. there is sufficient reactive reserve in the Perth metropolitan area to cater for the connection of general forecasted load growth increase with Collgar Wind Farm not connected.

This approach may not be consistent with the “first come, first served” principle in the AQP and the allocation of “appropriate portion of any of the forecast costs which do not meet the new facilities investment test” for the connection of Collgar Wind Farm in 2012 under the CCP. Collgar Wind Farm would also not be granted unconstrained access to the SWIN in 2012, i.e. they would be subject to further reinforcements apart from those which are initially required for the connection of Collgar Wind Farm.

6.3 Option 3 – Allocation of Costs for 2012 and Costs Apportioned for 2014

The Customer is charged for the cost of reactive reserve for 2012 and a portion of the cost of reactive reserve for 2014. The cost of reactive reserve for 2014 is apportioned between the Customer and general forecasted load growth increase, e.g. a split on a per MW basis of the DSOC of Collgar Wind Farm (250 MW) and the contracted maximum demand (CMD) of the forecasted load growth increase (~ 300 MW). Both Collgar Wind Farm and general forecasted load growth increase contribute to the requirement for the increased reactive reserve in the Perth metropolitan area in 2014.

This approach would be covered under clause 5.4(d) of the CCP but may not be consistent with the “first come, first served” principle in the AQP.

6.4 Recommendation

It is recommended that the Customer is only charged for the cost of reactive reserve for 2012 as per Option 1. This approach would be consistent with the AQP and the CCP.

7 COMMUNICATIONS

This section assesses the options for meeting the communications requirements the Collgar Wind Farm connection, including the allocation of costs for proposed future augmentations to the communications system on the EGF line.

The *Technical Rules* require Western Power to have 2 physically diverse communication bearers to support the main protection system for the connection of the Customer's facility. There is an existing PLC system on MRT - YLN - WKT portion of the EGF transmission line that has electronic equipment redundancy, but not physical diversity, as both PLC bearers share the same phase wires. The existing PLC configuration is not compliant with the *Technical Rules* but is considered Grandfathered. The *Technical Rules* allows for facilities and equipment existing at 1 July 2007 to be deemed compliant until "upgraded or modified for any reason", at which time the modified or upgraded equipment must be brought into compliance with the current *Technical Rules*.

Western Power has on two occasions agreed to extend the PLC Grandfather determination to cover upgraded or modified configurations on the MRT – YLN - WKT line. The two projects where the exemption from compliance applied are the proposed line upgrade project EGF line 275 kV upgrade and approved asset replacement project replace MRT-YLN-WKT Analogue PLC.

It is proposed initially to connect Collgar Wind Farm into the Grandfathered PLC system to continue with the existing level of communications bearer at an estimated cost of $1.1M. This work item is treated as Connection Works as they are solely required for the Collgar Wind Farm connection and will not be shared with other users on the system.

For the second physically diverse communications bearer which is ultimately required for Western Power to fully comply with the current requirements of the *Technical Rules*, the following options were considered:

7.1 Option 1 – Extension of Existing Microwave Communications Link (Customer Charged)

This option assesses construction of a microwave communications link from MRT to WKT concurrent with the Collgar Wind Farm construction at an estimated cost of $8M with the Customer charged the cost for these works.

7.2 Option 2 – Extension of Existing Microwave Communications Link (Customer not Charged)

This option assesses raising a separate project for the construction of the microwave communications link from MRT to WKT. Funding for this project would be sought through the AA3 submission or special direct submission to the Dept of Treasury and Finance WA. The Customer would not be required to contribute to the cost of this proposed microwave link considering the non-*Technical Rules* compliant PLC

communications bearer system was pre-existing at the time of the Customer's connection and there is no further adverse impact on the non-*Technical Rules* compliant PLC communications bearer by the customers connection.

7.3 Option 3 – Satellite

This option assesses a satellite communications connection for Collgar Wind Farm. Telco or private carrier leased line offerings in general and satellite in particular offer best effort service delivery with no committed guarantees of circuit latency, availability and outage restoration times. For this reason satellite communications are not considered as suitable bearer for meeting the protection system requirements of the *Technical Rules*.

7.4 Recommendation

The recommended option for the provision of a second communications link for Collgar Wind Farm is Option 2 considering:

- The cost and drivers of the MRT to WKT microwave communications link project lend themselves to a separate budget submission and evaluation process.
- The limited obligation for a capital contribution towards the microwave that can reasonably be placed on the Customer connecting into an existing non-*Technical Rules* compliant communications bearer system whose connection has no further adverse impact on the non-*Technical Rules* compliant PLC communications bearer.
- The unsuitability of the other technology option identified.

Western Power intends to seek a temporary derogation to continue to use the physically non-diverse PLC communications bearer until the AA3 period. Western Power considers the requirement for a temporary derogation for only having a single communications bearer on the MRT-YLN-WKT 220 kV line to be Regulatory Compliance (that is solely a Western Power) one and does not impact on, and is not conditional for, the connection of Collgar Wind Farm. If the temporary derogation is granted, funding will be sought through the AA3 submission process. If the derogation is declined, funding will be sought immediately through a special direct submission to the Department of Treasury and Finance WA.

8 PROTECTION

This section assesses the options for meeting the protection requirements of the Collgar Wind Farm connection, including the allocation of costs for proposed future augmentations to the protection system on the EGF line.

The current direct inter-trip protection scheme on the EGF transmission line is to be upgraded to comply with the current requirements of the *Technical Rules*. This involves upgrade works at MRT, YLN and WKT. Slower clearance times present a stability issue with the connection of Collgar Wind Farm.

Further dynamic system simulation studies are required to determine the exact level of protection reinforcements required at MRT, YLN and WKT which are directly triggered by the Customer's connection but modification of the existing protection schemes at these substations will be required in any event. Modification of these protection schemes without replacing them is not prudent or cost efficient considering:

(i) the existing relays are 25 years old and are close to the end of their operational life; and

(ii) the existing protection scheme is not employed elsewhere in the system, and re-engineering the existing schemes to integrate with the CGT installation would be at a significant cost and time, which would have resulted in a delay to the project connection. The modification to the existing schemes brings the scheme in line with current standards, and hence reduces the time and operational risk of cutting-in of CGT into the 220 kV system.

The existing protection schemes at MRT, YLN and WKT, which are being replaced for the Collgar Wind Farm connection, were proposed to be replaced when undertaking the extension of the microwave communications link from MRT to WKT (subject to approval and funding being received for this project).

The estimated cost for the protection upgrade works at MRT, YLN and WKT is approximately $1.0M and includes replacement of relays at these terminal substations.

8.1 Option 1 – Bring Forward Cost

The Customer is charged a bring-forward cost for these protection upgrade works proposed to be undertaken under the extension of the microwave communications link from MRT to WKT. Approval has not yet been received for the West Kalgoorlie Terminals microwave communications link project to proceed.

8.2 Option 2 – Customer Charged Cost for the Protection Works

The Customer is charged full cost for these protection upgrade works. There is no other approved project to upgrade this protection schemes and their immediate requirement is as a result of the Collgar Wind Farm connection.

8.3 Option 3 – Customer Not Charged Cost for the Protection Works

The Customer is not charged for these protection upgrade works based on the existing proposal to undertake these works under a separate project, the age of the current relays and the requirement to update the protection scheme to meet the *Technical Rules* requirements.

8.4 Recommendation

The recommended option for the allocation of cost for the protection upgrade works is Option 2 considering there is no other approved project to upgrade these protection schemes and the imminent requirement for these works is for the connection of the Customer's facility.

This work item is treated as Shared Network Works as there is benefit for other users on the system (including Western Power) by undertaking these works (e.g. upgraded protection scheme on the EGF line, 25 year old relays being replaced and the cost reduction for the proposed microwave communications extension project with this work item now removed from the scope of this proposed project). It is proposed that incremental revenue from the Customer's facility would cover the cost of this investment. There is sufficient incremental revenue from the Customer's facility over a 15 year period to cover the cost of the shared network assets and no upfront capital contribution is required for the shared network assets.

9 Summary

Based on the recommendations for each scope of works, the works required for the Collgar Wind Farm connection to the SWIN are summarised as follows:

1. Shared Network Works:
   (i) Cut-in to the EGF 220 kV overhead line to connect CGT to the SWIN using a 2 termination pole solution;
   (ii) Construction of two circuit breaker bays at CGT and associated works for compliance with the current *Technical Rules*' requirements; and
   (iii) Upgrading of the existing direct inter-trip protection scheme between MRT, YLN and WKT to comply with the current *Technical Rules*' requirements including replacement of relays at those terminal substations.
2. Connection Works:
   (i) Construction of two circuit breaker bays at CGT and associated works which are dedicated to the Customer's connection;
   (ii) PLC Communication works to link CGT into the existing PLC communications scheme between MRT and WKT; and
   (iii) Implementation of a run back scheme to prevent the overloading of the 132 kV transmission line between Northam and Merredin as a result of the Customer's connection.

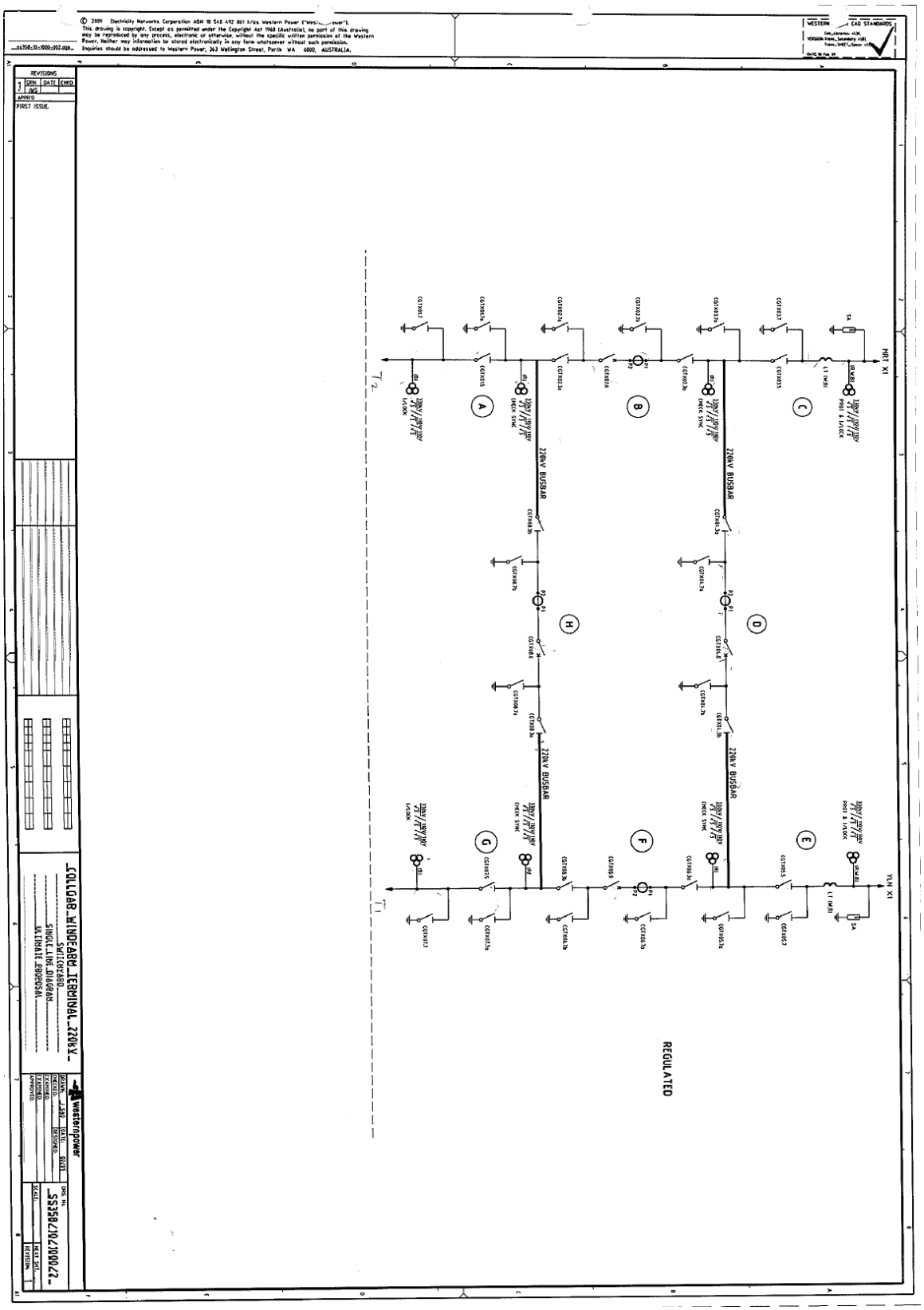
The cost estimate for each of the scope of works is contained in the A2 estimate.

The value of the Shared Networks Works and Connection Works are estimated at $13.9M and $7.8M respectively. There is sufficient incremental revenue over a 15 year period from the Customer's facility to cover the value of the Shared Networks Works and no upfront capital contribution is required.

Item	**Description**	**Amount**
Cost	Shared Network Assets required for the connection of Collgar Wind Farm	-$13.9M
Incremental Revenue	PV of incremental revenue (15 years)	+$17.2M
Difference		+$3.3M

Table 14 – Anticipated Incremental Revenue (15 years)

Appendix 1 – CGT Single Line Diagram



Appendix 2 – Technical Exemption Granted for non-compliance with clause 3.3.3.10 of the *Technical Rules*

westernpower

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Contact: Emmet Fitzsimons
(08) 9326 4462

9 September 2009

Mark Headland
Investec Capital Markets
Investec Bank (Australia) Limited
GPO Box 2539
Sydney NSW 2001

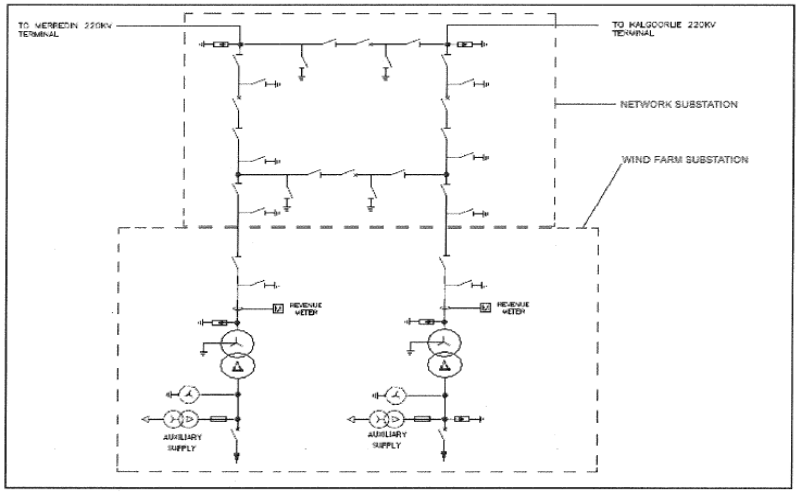
Dear Mr Headland

Application for exemption from compliance with the Technical Rules for Collgar 250MW Wind Farm Power Station

I am pleased to respond to your application, dated 29 July 2009, for exemption from compliance with clause 3.3.3.10(c)(1) of the Technical Rules for connection of Collgar Wind Farm 250MW power station to the network. I confirm that the requested exemption is granted, subject to the specific connection arrangement, as further detailed in this letter, being installed.

Technical considerations

Collgar Windfarm Pty Ltd have requested connection of the Collgar Wind Farm project to the Eastern Goldfields (EGF) line via two circuits and the proposed four circuit breaker meshed switchyard arrangement, as shown below.



The proposed arrangement does not comply with clause 3.3.3.10(c)(1) because the generator connection is via two circuits and there are no main switch circuit breakers in the generator's switchyard.

Western Power acknowledges the requestor's consideration of alternative technically compliant connection solutions. These are illustrated in Figures 2 and 3 of the request.

Western Power considers the proposed connection arrangement to be acceptable, because:

- it will not degrade the reliability of the connection or associated network, and
- it will not have any adverse effect on the network or any interconnected network.

Yours sincerely

Peter Mattner
Manager Regulation, Pricing & Access Development

Appendix 3 Up-rating of the EGF Line Documentation

The following documents outline the EGF line up-rate from 220 kV to 275 kV, alternative options for supplying the EGF Region in the future, and supporting information:

1. Regulatory Test for Reinforcement of the Eastern Goldfields Electricity Supply, Final Report, 31 August 2008 (DM#: 6770825). This Report was prepared by SKM for Western Power.

2. Eastern Goldfields Load Area – Strategic Plan (2008-2027), May 2008 (DM#: 4508738). At the time of writing this memorandum, the Plan is in the process of being updated. The updated (draft) document is contained in Eastern Goldfields Load Area – Strategic Plan 2009-2049 (DM#: 6132821).

3. 2008 Transmission and Distribution Annual Planning Report.[14]

4. 2009 Transmission and Distribution Annual Planning Report.[9]

5. Summer Load Trends Report 2010 – 2029 (Substation & System Peaks), South West Interconnected System (SWIS), August 2009 (DM#: 6333177). See pages 446 to 448.

6. Eastern Goldfields – Reinforcement Options to Supply Additional Load in EGF, Study Note 918, November 2006 (DM#: 3394206).

[14] The 2008 and 2009 Annual Planning Reports are available from Western Power's web site at: http://www.westernpower.com.au/subContent/aboutUs/publications/Annual_planning_report_.html?word=APR

Appendix 4 Cost – Benefit Analysis for 220 kV, 275 kV and 330 kV Plant Installation at CGT

This appendix presents the calculations associated with the cost comparisons of the alternative options, Option 1, Option 2 and Option 3.

The benefit-cost approach taken is to compare the net benefits in terms of future cost saving with the net present cost incurred when installing higher voltage rated equipment. Table 4.1 indicates that Option 1 imposes $0.7 million in additional costs. However, this is offset by avoiding future costs associated with retrofitting higher voltage equipment when the upgrade of the Eastern Goldfields transmission occurs.

Due to uncertainty associated with when the upgrade will occur, the present value of the retrofit has been calculated at two different points in time: 2018; and 2028. The 2018 timing is when the Eastern Goldfields transmission line is currently expected to be upgraded. The 2028 timing implies the upgrade is delayed by ten years.

Table 4.1 shows that the present value of the cost saving associated with Option 1 is more than the $0.6 million additional cost of Option 1 even if the upgrade is delayed by 10 years. Since the benefit is greater than the cost, Option 1 is the economically efficient option.

The same reasoning applies in Table 4.2, which compares Option 1 to Option 3. Therefore, Option 1 is clearly the preferred option and consistent with the objective of the *Electricity Network Access Code 2004*.

#	Item	$(M)	
(1)	Option 1 Cost (PV)	19.6	
(2)	Option 2 Cost (PV)	18.8	
(3)	Difference	0.8	(1) less (2)
(4)	Cost of Retrofit 2018 (PV)	2.5	
(5)	Cost of Retrofit 2028 (PV)	1.3	
(6)	PV Cost Saving 8 years	1.7	(4) less (3)
(7)	PV Cost Saving 18yrs	0.5	(5) less (3)

Note: PV denotes Present Value; NPV denotes Net Present Value

Table 4.1 – Cost comparison of Option 1 and Option 2

#	Item	$(M)	
(1)	Option 1 Cost (PV)	19.6	
(2)	Option 3 Cost (PV)	18.3	
(3)	Difference	1.3	(1) less (2)
(4)	Cost of Retrofit 2018 (PV)	5.2	
(5)	Cost of Retrofit 2028 (PV)	2.7	
(6)	NPV Cost Saving 8 years	3.9	(4) less (3)
(7)	NPV Cost Saving 18 years	1.4	(5) less (3)

Note: PV denotes Present Value; NPV denotes Net Present Value

Table 4.2 – Cost comparison of Option 1 and Option 3