SINCLAIR KNIGHT MERZ
SKM

Independent Market Operator
IMO
Wholesale Electricity Market

Review of the Maximum Reserve Capacity Price 2010 – Non Power Station Elements

- Final
- 16 November 2010

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Sinclair Knight Merz
ABN 37 001 024 095
100 Christie Street
PO Box 164
St Leonards NSW
Australia 1590
Tel: +61 2 9928 2100
Fax: +61 2 9928 2500
Web: www.skmconsulting.com

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1. Introduction

As a part of the establishment of the Wholesale Electricity Market (WEM) within the South West Interconnected System (SWIS), the Government of Western Australia (WA) setup an Independent Market Operator (IMO) to administer and operate the market.

The Market Rules require the IMO to conduct a review of the Maximum Reserve Capacity Price (MRCP) each year. As part of this process Sinclair Knight Merz (SKM) has been commissioned to determine the following for the year 2010:

- Capital cost (procurement, installation and commissioning, excluding land cost) of a generic 330 kV three breaker mesh switchyard configured in a breaker and a half arrangement that facilitates the connection of a 160 MW Open Cycle Gas Turbine (OCGT) power station to an existing transmission line.
- Fixed Operating and Maintenance (O&M) costs of this switchyard. The cost shall be in 5 year periods covering 1 to 50 years.
- Capital cost (procurement, installation and commissioning, including shallow land easement cost) of a 2 km, 330 kV overhead single circuit steel lattice tower transmission line that connects the power station and the switchyard, whereby the switchyard is located in the vicinity of an existing 330 kV transmission line. The capital cost will also include easement acquisition costs.
- Fixed Operating and Maintenance costs of this overhead transmission line. The cost shall be in 5 year periods covering 1 to 60 years.
- Ensure the switchyard and the transmission line arrangements comply with the requirements of Western Power's Technical Rules for new developments.

This report should be read in conjunction with the scope of work agreed between IMO and SKM which explains the scope of this project in detail and is attached in Appendix A.

Given that this report will focus on the non power station elements, it should be read in conjunction with SKM's report entitled "Review of the Maximum Reserve Capacity Price 2010 – Power Station Elements".

2. Executive Summary – Non Power Station Elements

SKM estimates the capital cost of building a new switchyard and connecting it to a nearby 330 kV transmission line to be $11.50 million in mid 2010 figures.

The capital cost of building a new 2 km, 330 kV single circuit transmission line from the power station to the switchyard is estimated to be $2.24 million in mid 2010 figures.

The capital cost to acquire the easement along the 2 km transmission line is estimated to be $3.5 million in mid 2010 figures.

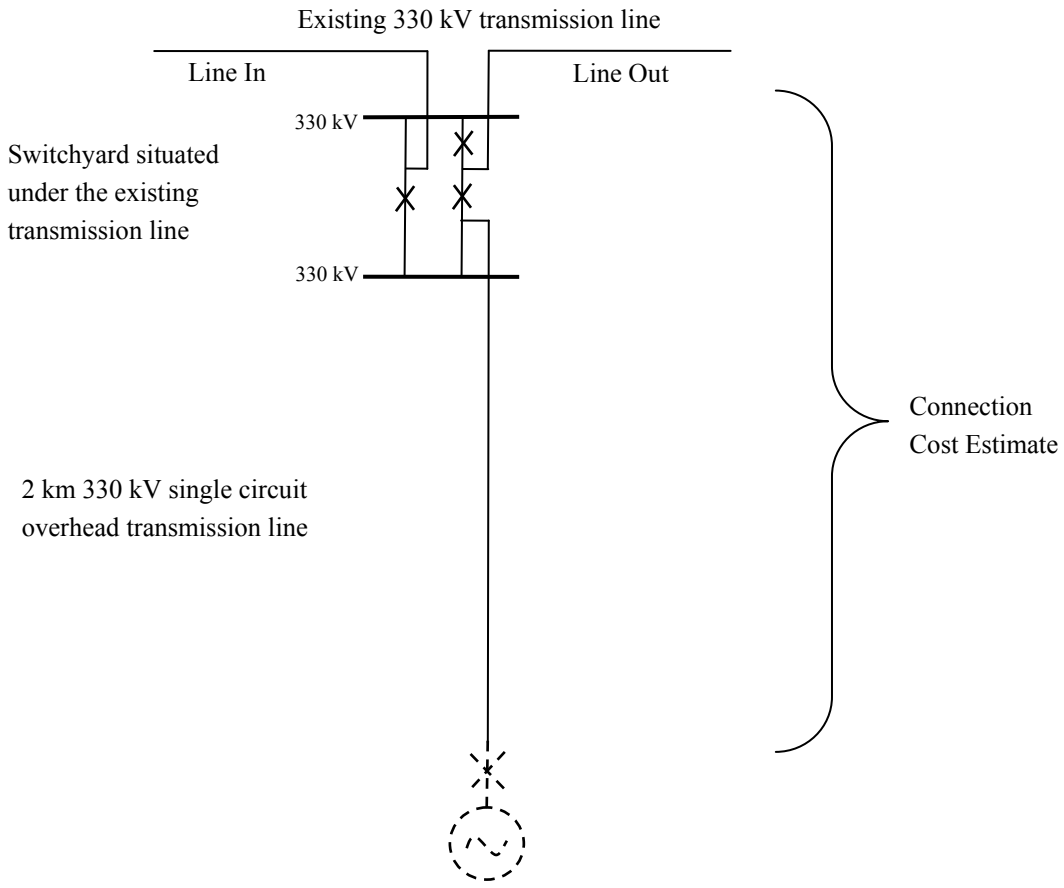
SKM estimates the annualised fixed operating and maintenance costs over the asset lifetime for the switchyard and the transmission line to be $55,000 pa and $1,050 pa respectively, assuming the assets are an incremental addition to a large asset base. The annual fixed network access tariffs for the use of system charge, control system service charge and the metering charge are $1.736 million, $120,129 and $16,996 respectively.

3. Switchyard and Overhead Transmission Line Connection Capital Costs

3.1 General Issues and Assumptions

The output from the power station will be transmitted by a 2 km, 330 kV single circuit steel lattice tower transmission line to the existing transmission line. The connection point to the existing transmission line will be a three breaker mesh switchyard configured in a breaker and a half arrangement. This arrangement is shown in Figure 3-1.

All connection costs have been calculated from the isolator on the high voltage side of the generator transformer and therefore do not include any of the costs associated with the generator transformer and switchgear.

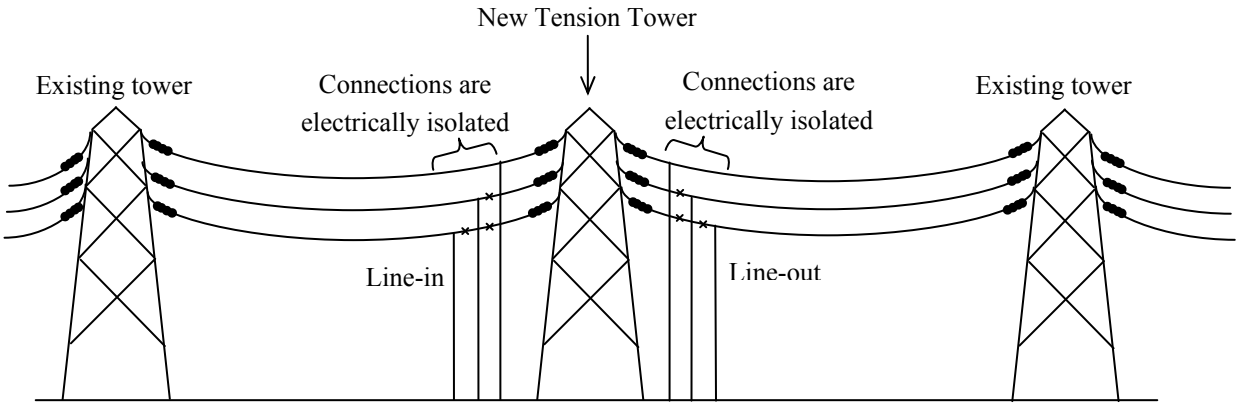


- **Figure 3-1 Overall connection arrangement.**

The switchyard consists of two breaker and a half diameters (arrangement or configuration of switchbays). The first diameter has one centre bay and two spare (empty) feeder bays and is connected to the existing transmission line. The second diameter has one feeder bay, one centre bay and one spare (empty) feeder bay and is connected to the generator and the existing transmission line. A general arrangement and single line diagram for this switchyard can be seen in Appendix E. This switchyard will be located under the existing transmission line.

It has been assumed that the switchyard will be located under the existing transmission line and will be constructed on flat land in a rural setting with minimum or no vegetation and no unforeseen environmental or civil costs associated with the development.

It is assumed that the existing transmission line will not require modification to allow for this connection with the exception of one new tension tower located next to the switchyard to allow for connection into the new switchyard. SKM has considered a single tension tower configuration, with the new tension tower being positioned between two existing towers to allow for a '*Christmas tree connection*' as shown in Figure 3-2. Costs associated with any staging works have not been considered.



- **Figure 3-2 Elevation of connection point into the existing transmission line.**

The new transmission line is assumed to be a single circuit 330 kV construction with 2 conductors per phase. The rating of the line has been selected to facilitate the transport of up to 200 MVA (at a power factor of 0.8, a 160 MW OCGT can export up to 200 MVA).

The transmission line connecting the power station to the switchyard is assumed to be constructed as follows:

- 50% flat - 50% undulating land;

- 50% rural - 50% urban conditions;
- no gas pipeline crossing;
- allowance for one road crossing per km;
- minimum or no vegetation requiring very little clearing; and
- no unforeseen environmental or civil costs associated with the development.

The main advantage of this arrangement is the flexibility for future development of the power station. Additional generation capacity can be easily transferred to the existing network by connecting to the spare feeder bay. Additional diameters can also be easily added in the switchyard alongside the proposed diameters.

3.2 Switchyard Capital Costs

The capital costs for the 3 breaker mesh switchyard configured in a breaker and a half arrangement has been estimated at $11,504,234 in mid 2010 dollar value. This estimate includes civil, infrastructure, all primary and secondary plants & equipments, a connection tension tower located next to the switchyard and EPCM cost reflective for the South Western region of Western Australia. It is assumed that OPGW is installed in the existing and new transmission lines, therefore the cost of two OPGW terminal ends are included. The cost estimate does not include the cost of land. Refer Appendix C for the detailed switchyard cost estimate.

3.3 Transmission Line Capital Costs

The capital cost for a 2 km long 330 kV single circuit, lattice steel tower, with 2 lemon conductors per phase and OPGW is estimated at $2,245,886 in mid 2010 dollar value. This estimate is based on a 400 m span length and includes EPCM cost reflective for the South Western region of Western Australia. As the line is only 2 km in length, an allowance for high fixed costs for short route length has been applied to the line cost based on SKM's recent experience on similar projects (note SKM's standard unit rates for transmission lines are based on a reference asset where the transmission line is constructed on a 100 km length). Refer Appendix D for the detailed transmission line cost estimate.

The easement for this transmission line is assumed to be 60 m wide along the 2 km route. The cost of the easement along the transmission line route depends on various factors such as the value of the land assigned by the WA Valuer General Office, which in turn is determined by the type, location, productive use of land and proximity to infrastructures among other factors. The easement cost also depends on the site specific conditions and negotiation with the owner of each property over which the easement will be required. Together, all these factors influences the easement cost and may result in vast range of estimates. Consequently, it is difficult to estimate the easement cost with a high degree of confidence at the conceptual stage.

SKM understands that the cost of the easement is determined based on the WA Valuer General's land value as follows:

- 100% for the tower footprint;
- 100% for the track (footprint below the 3 phase conductor spread); and
- 30% to 100% for rest of the easement depending on the productive use of the land and negotiation with the owners.

This is based on the assumption that it is possible to secure an easement readily. Such payments are one off payments made by the utility to the owners to secure the "right of way" easement. Additionally, the valuation, negotiation, survey and legal costs also need to be taken into consideration.

Given the variables discussed above, the cost of acquiring the easement can vary between the cost of acquiring a "right of way" easement over the required land and the cost of purchasing all of the land. Based on the discussion above, SKM believes the cost of acquiring a "right of way" easement is between 50% and 100% of the purchase value of the land.

For a 60 m wide easement along the 2 km long route, the cost to purchase the land is estimated approximately at $6,644,360[1] in mid 2010 dollar value.

Given the material impact the easement cost has on the cost of the generation installation, SKM have assumed that a site would be selected to minimise the cost of this easement. Thus, SKM have adopted a value of $3.5 million as the cost of the easement which represents an efficient acquisition of the easement (i.e. 50% of the purchase value of the land) with allowances made for valuation, negotiation, surveys and legal costs.

3.4 Compliance to Technical Rules for 330kV Switchyard and Transmission Line

The existing Western Power Technical Rules sets out the Transmission and Distribution System Planning Criteria for the SWIS network. Clause 2.5.2.3 states

[1] The land easement cost estimate is based on the average selling price of land at Collie, Bridgetown, Boddington and Manjimup. These regions are located nearer to the existing 330kV transmission line in the SWIS area. Different types of lands were considered so that the average represents 50% flat - 50% undulating land and 50% rural - 50% urban locations. However, the size of the land is typically large and does not represent the narrow corridor required for an easement. The cost estimate does not take into account the specific details and requirements of each property over which the easement will be required. Additionally the cost valuation, negotiation, surveys and legal costs are not included in the land easement cost estimate.

"The N-1-1 criterion applies to those sub-networks of transmission system where the occurrence of a credible contingency during planned maintenance of another transmission element would otherwise result in the loss of supply to a large number of consumers. Sub-network of the transmission system that are designed to the N-1-1 criterion include all 330 kV lines, substation and power stations"

The complete section containing the clause above is shown in Appendix B.

Clause 2.5.2.3 states that sub-networks are required to meet N-1-1 criterion. This means that the network will be required to withstand a forced outage of a transmission or generating element while another element is out of service due to maintenance without causing loss of supply to customers.

The connection of the generator to the transmission system is designed with a security of N (given the single circuit transmission line connecting the generator to the connection switchyard). The connection switchyard is designed with a security of N-1 (3 breaker mesh). This gives the power station an overall connection security of N.

As there is only one generator (and it would have a higher forced outage rate than the line and substation) it is considered appropriate to have a single connection to the transmission system. This configuration would need to be taken into account by Western Power, with particular regard to the specific location within the network when connecting the generator to the transmission system.

3.5 Connection Works Cost Escalation

The connection work cost escalation indices are developed using SKM's internal Capex Cost Escalation Model. The Model has been used extensively in developing a cost escalation index for a number of Transmission and Distribution Network Service Providers throughout Australia. The SKM cost escalation methodology has also been accepted by the AER in revenue proposals submitted by these utilities.

The Model draws upon 2006 and 2010 SKM strategic procurement studies which surveyed the network project capital expenditure of nine and eight electricity utilities respectively throughout Australia. Procurement specialists and equipment suppliers/manufactures were also brought into the process to ascertain the weighting of underlying cost drivers that influenced the final cost of each plant and equipment item. These cost drivers were identified through the projects undertaken by the utilities.

Historical and forecast movements of these underlying cost drivers, from various sources as listed in Sections 3.6 and 3.7, are then used to populate the Model. This allows for suitable escalation indices that are specific for the electricity utility industry to be developed. These cost drivers are periodically updated in the Model.

The Capex Cost Escalation Model has been progressively refined since its first introduction. The enhancements have been undertaken by various means, including:

- Reviewing and updating supplier and contractor costs during subsequent asset valuation assignments;
- Obtaining updated budget price information from suppliers and contractors for individual plant, equipment and projects; and
- Other external project costs for non-utility clients that are project managed by SKM;

The EPCM cost element is applied in the form of percentage factor cost uplift on all other costs for switchyard and transmission line projects. Hence EPCM is also represented in 2010 dollar terms.

3.6 Switchyard Capital Cost Escalation

For the switchyard capital cost escalation, the following data types have been drawn on:

- **Table 3-1 Switchyard Capital Costs Escalation Data Sources.**

Source	Cost Drivers	Used for
ABARE, IMF, LME, World Bank, Wachovia, Brent, CRUspi, Consensus Economic Energy & Metal Monitor	Aluminium, Copper, Iron Ore, Oil, Steel	Equipments, P&C, Misc Materials, Structure
ABS, SKM, Treasury, The Construction Forecasting Council, Econtech Labour Cost Forecasts	CPI, General labour, Utility Labour, Civil Works	Installation, Erection, Commissioning, Foundation, Civil, Structure
ETA Union, Econtech Cost Forecasts	Site Labour	Installation, Erection, Commissioning
SKM	Switchgear, Transformers	Equipments

These indices have been compounded for each element in proportion to the ratio of the make up costs to which the indices are applicable. The switchyard capital costs consist of the following cost elements:

- Switchgear;
- Structure;
- Foundation;
- Civil;
- P&C;
- Erection;
- Commissioning; and
- Other.

The composite 2009 to 2010 capital cost escalation indices determined for the switchyard materials and the labour mentioned in the previous section are 0.82% and 4.40% respectively.

3.7 Transmission Line Capital Cost Escalation

For the transmission line capital cost escalation, the following data types have been drawn on:

- **Table 3-2 Transmission Line Capital Costs Escalation Data Sources.**

Source	Cost Drivers	Used for
ABARE, IMF, LME, World Bank, Wachovia, CRUspi, Consensus Economics Energy & Metals Monitor	Aluminium, Copper, Iron Ore, Oil, Steel	Conductor, Earthwire, Towers, Misc. Materials, Structure
ABS, SKM, Treasury, The Construction Forecasting Council. Econtech Labour Cost Forecasts	CPI, WPI, General labour, Utility Labour, Civil Works	Civil, Labour, Insulators, Fittings, Foundation
ETA Union, Econtech Cost Forecasts	Site Labour	Survey, Clearing & Access
SKM	Al Conductor	Al Conductor

These indices have been applied to capital cost and compounded in proportion to the relative mix for the different cost make up elements as follow:

- Conductor;
- Earth wire;
- Tower;
- Insulators;
- Fittings;
- Foundations; and
- Labour.

The composite 2009 to 2010 capital cost escalation indices determined for the transmission line materials and the labour mentioned in the previous section are -2.72% and 4.40% respectively. It was noted that the escalation in the conductor (and earth wire), tower and fitting market was negative due to the decrease in the market price for base metals during the 2009 to 2010 period.

4. Switchyard and Overhead Transmission Line Fixed Operation and Maintenance Costs

4.1 General Issues and Assumptions

SKM has developed the fixed operation and maintenance costs for the network connection on an asset class basis. SKM has used a bottom-up approach to estimate the fixed Operation and Mainteance (O&M) cost of switchyard and transmission line assets based on recent data from several Australian Transmission Network Service Providers (TNSPs). It is noted that these O&M estimates are based on the assumption that the assets represent an incremental additional to a large asset base.

Maintenance cost for an asset is incurred periodically according to its maintenance routines. Since this routine is different for different asset classes, SKM has smoothed these periodic costs evenly over the life of the switchyard and transmission line. The annualised fixed O&M cost estimated allows for the following:

- Cost of labour for routine maintenance;
- Cost of machine/miscellaneous items for routine maintenance; and
- Overheads (management, administration, operation etc.)

The annualised fixed O&M cost estimates for the switchyard and the transmission line are reported in Section 4.2 and Section 4.3 respectively. In addition to the above, the annual fixed transmission network access tariff is reported in Section 4.4 and is included in the estimation of the total fixed O&M cost for the network connection assets.

The annualised fixed O&M cost does not allow for defect or asset replacement during the lifetime of the assets. It should be noted that annual insurance costs and tax have been omitted from the annualised fixed O&M costs as these cost components will be dependent on the ownership arrangement.

Depreciation is a separate individual component that forms a part of a regulated utility's annual revenue entitlement. Unlike operational and maintenance costs, depreciation relates to the capital cost of the assets. It is an accounting method that allocates the capital cost of the assets over the series of accounting period to gradually write-off the value of the installed assets from the accounting book. Depreciation is not a part of asset's ongoing cost to maintain and operate it and thus is different from operational and maintenance costs. Therefore, it is not included in the fixed O&M costs estimation.

4.2 Switchyard Annualised Fixed Operational & Maintenance Costs

SKM has assumed that the average life of the 330 kV switchyard assets is 50 years. Table 4-1 shows the cumulative annualised fixed O&M costs presented in 5 yearly periods over the lifetime

of the switchyard assets. The annualised fixed O&M cost over the asset lifetime for the switchyard is $55,000 pa.

- **Table 4-1 Annualised fixed O&M costs for Switchyard Assets.**

Period	Cumulative Annualised Fixed Switchyard O&M Costs (AU$, 2010)
1 to 5 years	$ 275,000
6 to 10 years	$ 275,000
11 to 15 years	$ 275,000
16 to 20 years	$ 275,000
21 to 25 years	$ 275,000
26 to 30 years	$ 275,000
31 to 35 years	$ 275,000
36 to 40 years	$ 275,000
41 to 45 years	$ 275,000
46 to 50 years	$ 275,000

4.3 Transmission Line Annualised Fixed Operational & Maintenance Costs

Sinclair Knight Merz has assumed that the average life of the 330 kV transmission line is 60 years. Table 4-2 shows the cumulative annualised fixed operation and maintenance costs presented in 5 yearly periods over the lifetime of the transmission line assets. The annualised fixed O&M cost over the asset lifetime for the transmission line is $1,050 pa.

- **Table 4-2 Annualised Fixed O&M costs for Transmission Line Assets**

Period	Cumulative Annualised Fixed Transmission Line O&M Costs (AU$, 2009)
1 to 5 years	$ 5,250
6 to 10 years	$ 5,250
11 to 15 years	$ 5,250
16 to 20 years	$ 5,250
21 to 25 years	$ 5,250
26 to 30 years	$ 5,250
31 to 35 years	$ 5,250
36 to 40 years	$ 5,250
41 to 45 years	$ 5,250

Period	Cumulative Annualised Fixed Transmission Line O&M Costs (AU$, 2009)
46 to 50 years	$ 5,250
51 to 55 years	$ 5,250
56 to 60 years	$ 5,250

4.4 Annual Fixed Transmission Network Access Tariff

Section 4.2 of the Network Access Prices document titled "2010/11 Price List" published by Western Power states:

> "***Transmission Reference Tariff 2 (TRT2) consists of:***
> *(a) a User specific charge that is to be an amount per day which reflects the costs to Western Power of providing the Connection Assets under an Access Contract, which may consist of capital and non-capital costs.*
> *(b) a variable use of system charge calculated by multiplying the applicable use of system price (detailed in Table 3) by the declared sent-out capacity (DSOC) at the entry point (expressed in kW);*
> *(c) a variable control system service charge calculated by multiplying the control system service price (detailed in Table 11) by the nameplate output of the generator at the entry point (expressed in kW);*
> *(d) a fixed metering charge per revenue meter (detailed in Table 15) which is payable each day; and*
> *(e) excess network usage charges (if applicable).*"

For the purpose of this report, (a) is not applicable because it is assumed the total cost of connection assets are included in the capital and fixed O&M costs. Similarly, (e) is not applicable because a prudent generator will not supply more than the declared sent-out capacity (160 MW) to incur excess network usage charges.

The median use of system charge (GST inclusive) applicable from mid 2010 is $10.85/kW/annum[2]. For a 160 MW power station, the annual fixed use of system charge is determined at $1,736,407.

[2] Table 3 from the Network Access Price document titled "2010/11 Price List", available to download from Western Power website.

The control system service charge (GST inclusive) applicable from mid 2010 is $0.75/kW/annum[3]. For a 160 MW power station, the annual fixed control system service charge is determined at $120,129.

The metering charge (GST inclusive) applicable from mid 2010 is $16,996.05/metering unit/annum[4]. For a power station connected to the TNSP with one meter, the annual fixed metering charge is determined at $16,996.

4.5 Connection Assets Fixed O&M Cost Escalation

The major component of the connection assets (switchyard and transmission line) fixed O&M cost is labour cost. Therefore, the composite cost escalation index determined for the fixed O&M costs is equivalent to the Australian electricity-water-gas industry sector labour cost escalation index of 4.4% for the 2009 to 2010 period.

[3] Table 11 from the Network Access Price document titled "2010/11 Price List", available to download from Western Power website.

[4] Table 15 from the Network Access Price document titled "2010/11 Price List", available to download from Western Power website.

Appendix A Scope of Work

Extract from SKM proposal letter WPP1105

The project shall consist of three discrete elements as follows:

1.1. Power Station Estimate

1.1.1. Estimate the capital cost (procurement, installation and commissioning, excluding land cost) of a generic, industry standard liquid fuelled 160MW Open Cycle Gas Turbine power station. The estimate will include all the components and costs associated with a complete gas turbine project; and

1.1.2. Estimate the fixed operation and maintenance costs of the liquid fuelled OCGT power station of 160MW with capacity factor of 2% to mid 2010 value. The cost shall be in 5 year periods covering 1 to 5 years; 6 to 10 years; 11 to 15 years; 16 to 20 years; 21 to 25 years; and 26 to 30 years respectively.

1.2. Connection Works Estimate

1.2.1. Estimate the capital cost (procurement, installation and commissioning, excluding land cost) of a generic, industry standard 330kV substation to a mid 2010 value that facilitates the connection of the above mentioned power station. The estimated cost will be based on a generic three breaker mesh substation configured in a breaker and a half arrangement. The substation will be located under an existing transmission line and include an allowance for 2km of 330kV overhead single circuit line to the power station that will have one road crossing. It shall be assumed that the switchyard will be located on 50% flat - 50% undulating land, 50% rural - 50% urban location and there will be no unforeseen environmental or civil costs associated with the development. The connection of the switching station into the existing transmission line will be turn-in, turn-out and will be based on the most economical (i.e. least cost) solution. It is assumed that the existing transmission line will not require modification to allow the connection with the exception of one new tower located at the substation to allow a point of connection. Shallow easement connection costs will be considered. Costs associated with any staging works will not be considered. The estimate will include all the components and costs associated with a standard substation;

1.2.2. Estimate the fixed operation and maintenance costs of this transmission line and meshed switchyard to mid 2010 value. The cost shall be in 5 year periods covering 1 to 5 years; 6 to 10 years; 11 to 15 years; 16 to 20 years; 21 to 25 years; 26 to 30 years; 31 to 35 years; 36 to 40 years; 41 to 50 years; 51 to 55 years; and 56 to 60 years respectively; and

1.2.3. Ensure the above mentioned transmission line and substation design and arrangement comply with the requirements of Western Power's technical rules for new developments.

1.3. Legal, Approval and Financing Estimate

1.3.1. Estimate a reasonable margin for the term 'M' used in the Market Procedure for: Determination of the Maximum Reserve Capacity Price (see attachment) giving due consideration to standard industry practices. It is expected that this will cover the following:

a. Legal cost associated with the design and construction of the power station

b. Approval costs including environmental consultancies and approvals, and local, state and federal licensing, planning and approval costs

c. Reasonable design costs associated with the power station which includes concept design, specification, tendering and contract negotiations;

d. Insurance costs required to insure the replacement of capital equipment and infrastructure.

e. Cost of Capital raising including borrowing fees;

Appendix B Western Power's Technical Rule, Clause 2.5.2.3 N-1-1 Criterion

2.5.2.3 N-1-1 Criterion

(a) The N-1-1 Criterion applies to those sub-networks of the *transmission system* where the occurrence of a *credible contingency* during planned maintenance of another *transmission element* would otherwise result in the loss of *supply* to a large number of *Consumers*. Sub-networks of the *transmission system* that are designed to the N-1-1 criterion include:

(1) all 330 kV lines, *substations* and *power stations*;

(2) all 132 kV *terminal stations* in the Perth metropolitan area, and Muja *power station* 132 kV *substation*;

(3) all 132 kV *transmission lines* that *supply* a sub-system of the *transmission system* comprising more than 5 *zone substations* with total *peak load* exceeding 400 MVA; and

(4) all power stations whose total rated export to the *transmission system* exceeds 600 MW.

(b) The range of operating conditions that are allowed for when planning a part of the *transmission system* to meet the N-1-1 criterion is set out in Table 2.9.

Table 2.9 Transmission system operating conditions allowed for by the N-1-1 criterion

Maintenance *Outages* and Contingencies
transmission line maintenance and unplanned *transmission line outage*
transformer maintenance and unplanned *transformer outage*
transformer maintenance and unplanned *transmission line outage*
busbar maintenance and unplanned *transmission line outage*
busbar maintenance and unplanned *transformer outage*
circuit breaker maintenance and unplanned *transmission line outage*
circuit breaker maintenance and unplanned *transformer outage*
circuit breaker maintenance and unplanned *busbar outage*
transmission line maintenance and unplanned *transformer outage*

(c) Under the N-1-1 criterion, each sub-network must be capable of withstanding the coincident planned and unplanned *outages* of *transmission elements* listed in Table 2.9 at up to 80% of the expected *transmission system peak load*. In determining whether the N-1-1 criteria have been met, the *Network Service Provider* may assume that, during the planned *outage*, *generation* has been rescheduled to mitigate the effect of the subsequent unplanned *outage*.

(d) Following the unplanned *outage* of the *transmission element*, the *power system* must continue to operate in accordance with the performance standards specified in clause 2.2, provided the *transmission system load* remains below 80% of the expected *peak load*.

Appendix C Switchyard Capital Costs

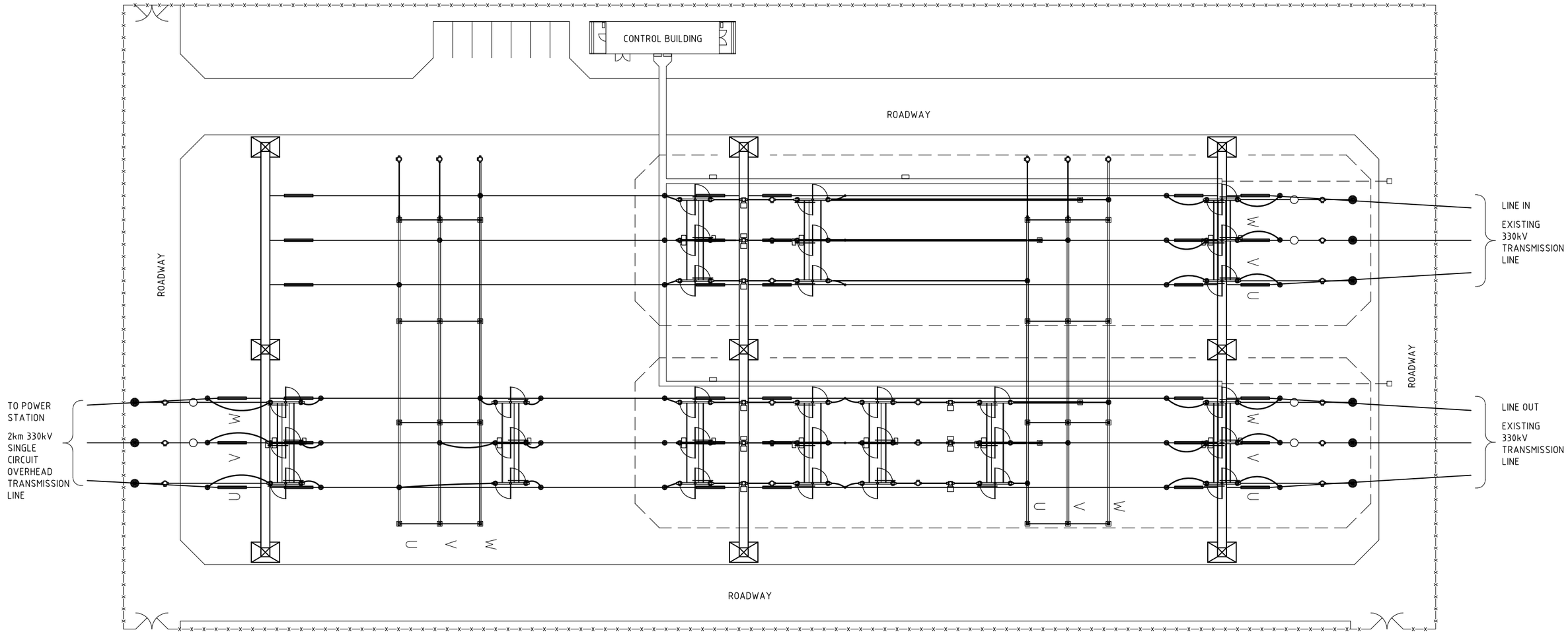
Asset Description / Component	Unit Cost (incl. EPCM factor, AU$, 2010)	Quantity	Cost Estimate (incl. EPCM factor, AU$, 2010)
330kV 3 breaker mesh switching station configured in a breaker & a half arrangement (i.e. One 1.5 diameter with 2XCBs + One 1.5 diameter with 1XCB). Allowance for a connection tower			
330kV switchyard establishment 100m × 100m incl contractor facilities and mobilisation	$3,364,401	1	$3,364,401
330kV busbars	$117,025	4	$468,101
330kV switchbays - Line bay in 1.5 arrangement	$1,935,578	3	$5,806,734
330kV switchbays - empty/spare	$341,268	3	$1,023,805
Substation communication system	$322,559	1	$322,559
Substation OPGW terminal	$56,211	3	$168,634
Connection point - new 330kV tension tower allowing for existing line cut-in and tee into the switchyard (assuming existing line to have 2×conductor per phase)	$350,000	1	$350,000
Total switchyard with connection tower cost estimate			**$11,504,234**

Appendix D Transmission Line Capital Costs

Asset Description / Component	Cost Estimate (incl. EPCM factor, AU$, 2010)
2km of 330kV Lattice Steel Tower, Single Circuit, 2×Lemon per phase, OPGW, 2 tension + 3 suspension towers and allowing high fixed costs for short route length	
Clearing (assuming very light clearing with no environmental issue)	$115,749
Structure	$1,489,006
Insulator	$41,200
Fittings	$75,340
Phase Conductor + Stringing	$309,731
OPGW Conductor + Stringing	$146,673
Clipping	$68,186
Transmission line total estimate (including all factors)	**$2,245,886**
Easement estimate (60m wide × 2km long)	$3,500,000
Total line and easement estimate	**$5,745,886**

Appendix E Drawings

HA01479-E-001	3 breaker mesh in breaker & half configuration general arrangement
HA01479-E-002	3 breaker mesh in breaker & half configuration single line diagram



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A	25/10/10	RD	AM	GG	PRELIMINARY

REF.	DRAWING NUMBER	REFERENCE DRAWING TITLE
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CLIENT APPROVAL

A.C.N 001 024 098
Sinclair Knight Merz Pty. Ltd
100 Christie Street
St Leonards
NSW 2065 AUSTRALIA

Tel: +61 2 9928 2100
Fax: +61 2 9928 2500
Web: www.skmconsulting.com

CLIENT: INDEPENDANT MARKET OPERATOR (WA)

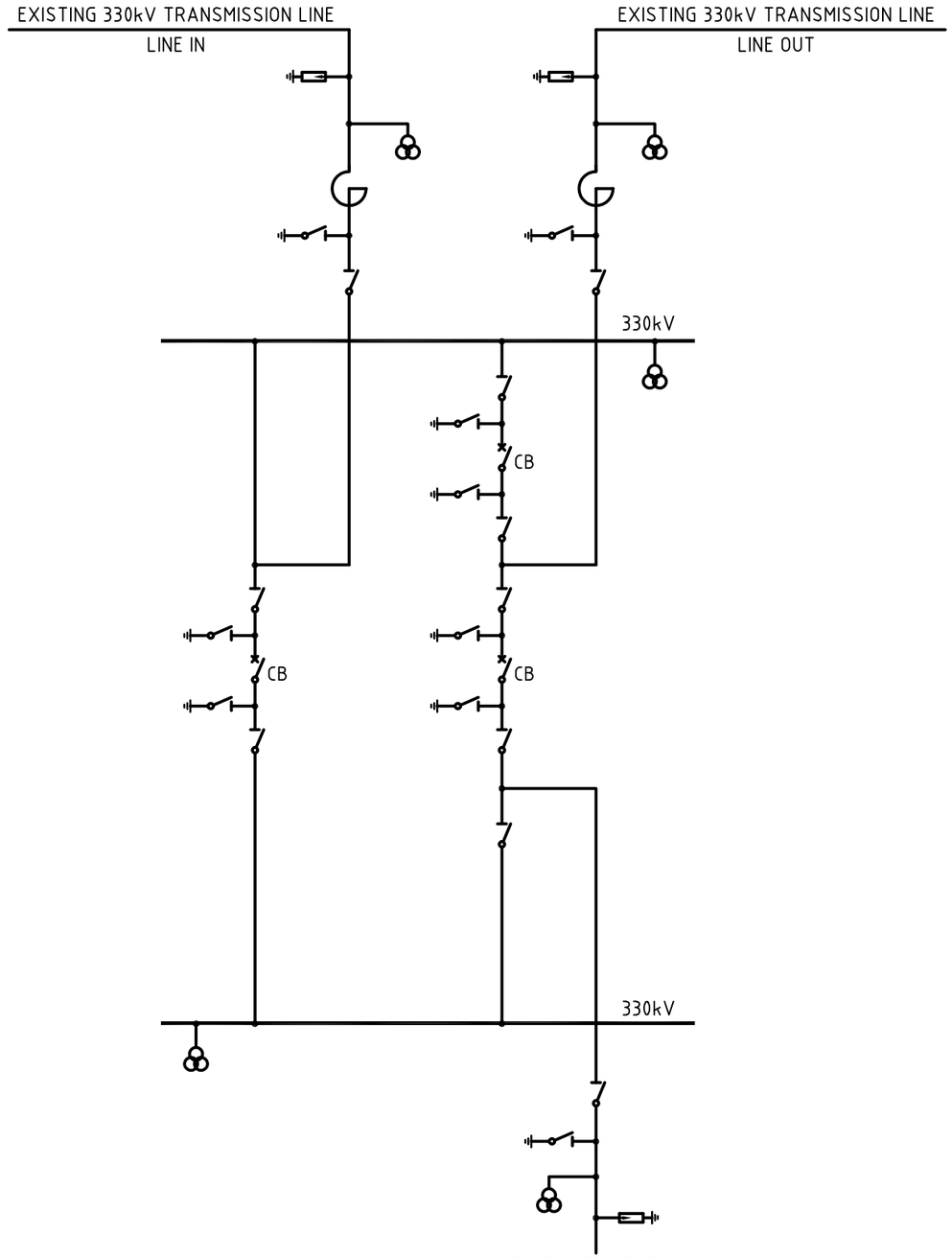
PROJECT: REVIEW OF MAXIMUM CAPACITY PRICE 2010
NON POWER STATION ELEMENTS

DRAWN	DRAFTING CHECK	REVIEWED PROJECT MANAGER	APPROVED PROJECT DIRECTOR
PC	PC	AM	GG
DESIGNED: AM	DESIGN REVIEW: RD		

TITLE: 3 BREAKER MESH IN BREAKER & HALF CONFIGURATION GENERAL ARRANGEMENT

SCALE	PROJECT No	DRAWING No	AMDT
NTS	HA01479	HA01479-E-001	A

Xrefs:
Plot Date: 25/10/2010@15:53:40 Login Name: prampagna Cad File: I:\HARB\Projects\HA01479\Deliverables\Drawings\Elec\Dwg\HA01479E001.dwg



No	DATE	DES'N REV	REV'D P.MGR	APP'D P.DIR	AMENDMENT
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A	25/10/10	RD	AM	GG	PRELIMINARY

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Sinclair Knight Merz Pty. Ltd
100 Christie Street
St Leonards
NSW 2065 AUSTRALIA

Tel: +61 2 9928 2100
Fax: +61 2 9928 2500
Web: www.skmconsulting.com

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PROJECT: REVIEW OF MAXIMUM CAPACITY PRICE 2010
NON POWER STATION ELEMENTS

DRAWN	DRAFTING CHECK	REVIEWED	APPROVED
PC	PC	PROJECT MANAGER	PROJECT DIRECTOR
DESIGNED	DESIGN REVIEW	AM	GG
AM	RD		

TITLE: 3 BREAKER MESH IN BREAKER AND HALF CONFIGURATION SINGLE LINE DIAGRAM

SCALE	PROJECT No	DRAWING No	AMDT
NTS	HA01479	HA01479-E-002	A

A3