Distribution Headworks Methodology

ELECTRICITY NETWORKS CORPORATION
("WESTERN POWER")

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{Note: This methodology has been prepared in accordance with the requirements of the Electricity Networks Access Code 2004.}

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1. Definitions

In this headworks methodology the following terms are used and have the same meaning as given in the *contributions policy* or the *Code* (reproduced below for convenience).

"**alternative options**" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "alternative options" means "alternatives to part or all of a network enhancement, including demand-side management and generation solutions (such as distributed generation) either instead of or in combination with a network enhancement".}

"Code" means the *Electricity Networks Access Code 2004* (as amended).

"connection application" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "connection application" means an application lodged with Western Power under the *applications and queuing policy* that has the potential to require a modification to the *network.}*

"connection point" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "connection point" means "an *exit point* or an *entry point* or a bi-directional point identified or to be identified as such in an *access contract"*.}

"contributions policy" has the same meaning given to it in the *Code*.

{Note: Under the *Code* "*contributions policy*" means "a policy in an *access arrangement* under section 5.1(h) dealing with *contributions* by users".}

"cpi" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "cpi" means the "all capitals consumer price index" as defined by the Australian Bureau of Statistics.}

"customer" has the meaning given to it in the *Act*.

"distribution system" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "distribution system" has the same meaning given to it in the *Code*, but excludes equipment within zone substations used for the transportation of electricity at nominal voltage of less than 66 kV.}

"feeder diversity factor" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "feeder diversity factor" means "the factor applied to the *capacity requirement* that reflects the effective contribution of the *connection* capacity to the feeder peak load".}

"forecast costs" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "forecast costs" means "any or all of the *forecast new facilities investment* or the forecast *alternative option costs*, as applicable, to be incurred by Western Power with regards to *works"*.}

"headworks" has the same meaning given to it in the *contributions policy*.

{Note under the *contributions policy* "headworks" means "enhancements required to the existing *HV* three-phase *distribution system* that provides for an increase in capacity of that system".}

"headworks charge" has the same meaning given to it in the *Code*.

{Note: Under the *Code* "headworks charge", in respect of a *headworks scheme*, means "the amount payable by a *user* to a *service provider* under the *headworks scheme* in respect of a *connection point*".}

"headworks scheme" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "headworks scheme" means the *scheme* described in clause 6 of the *contributions policy*.}

"mixed zone" has the same meaning given to it in the *contributions policy*.

{Note" Under the contributions policy "mixed zone" has the meaning given to it in section 5.3 of the *price list information* in the *access arrangement*.}

"network" has the same meaning given to "Western Power Network" it in the *Code*.

{Note: Under the *Code* "Western Power Network" means "the *covered network* that is *covered* under section 3.1". The "Western Power Network" is the portion of the SWIN that is owned by the Electricity Networks Corporation.}

"network assets" has the same meaning given to it in the *Code*.

{Note: Under the *Code* "network assets", in relation to a *network* means "the apparatus, equipment, plant and buildings used to provide or in connection with providing *covered services* on the *network*, which assets are either *connection assets* or *shared assets*".}

"reasonable time" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "reasonable time" means the time determined in accordance with clause 5.3 of the *contributions policy*.}

"relevant area" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "relevant area" with respect to *connection applications* in relation to the *distribution system* means any area where the *relevant connection point* is located at a distance along the line feeder route equal to or greater than 25 km from the *relevant zone substation* within the *network* in the *rural zone* or *mixed zone*.}

"relevant connection point" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "relevant connection point" means, with respect to a *connection application*, the appropriate *connection point* as determined under clause 6.5 of the *contributions policy*.}

"relevant zone substation" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "relevant zone substation" means the zone substation to which the new or upgraded *connection* will be connected under normal system operating conditions.}

"SWIS" has the meaning given to it in the *Code*.

{Note: Under the *Code* "SWIS" has the same meaning as given to it in the *Electricity Industry Act 2004*, being "the interconnected transmission and distribution systems, generating works and associated works -

(a) located in the South West of the State and extending generally between Kalbarri, Albany and Kalgoorlie; and

(b) into which electricity is supplied by -

(i) one or more of the electricity generation plants at Kwinana, Muja, Collie and Pinjar; or

(ii) any prescribed electricity generation plant".}

"transmission system" has the same meaning given to it in the *Code*, but also includes equipment within zone substations used for the transportation of electricity at nominal voltage of less than 66 kV.

"user" has the same meaning given to it in the *Code*.

{Note: Under the *Code* "user" means "a person, including a *generator* or a *consumer*, who is a party to an [*sic*.] contract for services with a *service provider*, and under section 13.4(e) includes another *business* as a party to a *deemed access contract*".}

"works" has the same meaning given to it in the *contributions policy*.

{Note: Under the *contributions policy* "works" includes *headworks* and all works required to be undertaken to provide an *applicant* with the *covered services* sought by the *applicant* in a *connection application*.}

2. Introduction

This document explains Western Power's Distribution Headworks Scheme methodology used to determine the headworks prices that may be applied under the *Contributions Policy* as provided for in sections 5.17C and 5.17D of the Code.

2.1. Code Requirements

The following Code provisions apply to a headworks scheme.

5.17C Despite section 5.14, the Authority may approve a *contributions policy* that includes a **"headworks scheme"** which requires a user to make a payment to the service provider in respect of the user's capacity at a connection point on a distribution system because the user is a member of a class, whether or not there is any required work in respect of the user.

5.17D A headworks scheme must:

(a) identify the class of works in respect of which the scheme applies, which must not include any works on a transmission system or any works which effect a geographic extension of a network; and

(b) not seek to recover headworks charges in an access arrangement period which in aggregate exceed 1% of the distribution system target revenue for the access arrangement period; and

(c) identify the class of users who must make a payment under the scheme; and

(d) set out the method for calculating the headworks charge, which method:

(i) must have the objective that headworks charges under the headworks scheme will, in the long term, and when applied across all users in the class referred to in section 5.17D(c), recover no more than the service *provider's* costs (such as would be incurred by a *service provider efficiently minimising costs*) of any *headworks*; and

(ii) must have the objective that the *headworks charge* payable by one *user* will differ from that payable by another *user* as a result of material differences in the *users'* capacities and the locations of their *connection points*, unless the *Authority* considers that a different approach would better achieve the *Code objective*; and

(iii) may use estimates and forecasts (including long term estimates and forecasts) of loads and costs; and

(iv) must contain a mechanism designed to ensure that there is no double recovery of costs in all the circumstances, including the manner of calculation of other contributions and tariffs; and

(v) may exclude a rebate mechanism (of the type contemplated by clauses A4.13(d) or A4.14(c)(ii) of Appendix 4) and may exclude a mechanism for retrospective adjustments to account for the difference between forecast and actual values.

This methodology document explains how the requirements of sections 5.17D (i), (ii) and (iii) have been met in the *contributions policy*.

2.2. Code compliance of the methodology

Section 5.17D

With respect to section 5.17D(i), the proposed headworks scheme is designed to recover the forecast costs of headworks less a forecast allowance for network access revenue from customers connecting to the network and who are forecast to make use of the associated headworks. Headworks prices are to be reviewed regularly to reflect the actual costs of the provision of headworks.

With respect to section 5.17D(ii), the headworks scheme is designed such that the contribution for an applicant depends on their individual required electricity demand, their distance from the relevant zone substation, and the voltage of the network to which they are connecting. Consequently charges for each applicant will differ as a result of material differences in the users' capacities and the locations of their connection points.

With respect to section 5.17D(iii), the headworks scheme prices are based on estimates and forecasts (including long term estimates and forecasts) of loads and costs.

2.3. Overview of Headworks Scheme

(a) Distribution headworks are major enhancements to the existing three-phase distribution system to provide increased electricity capacity to meet growth in customer electricity requirements. Distribution headworks may include major works such as overhead HV power lines, voltage regulators, step-up and step-down transformers, network augmentations, and new distribution feeders.

(b) The headworks scheme and associated prices apply to the provision of distribution infrastructure only, not transmission infrastructure, and in particular applies to those customers seeking to connect to the network in the rural and regional areas of the SWIS. Other areas of the SWIS (such as the CBD and metropolitan Perth) are excluded from the scheme, and charges for increases to network capacity in those areas are determined on a case by case basis.

(c) The headworks scheme includes a headworks charge that allows for an equitable sharing of costs between all new customers, including customers seeking to upgrade existing connections, and one which presents less of a financial barrier to developments triggered by individual customers.

(d) The headworks scheme applies to connection applications in relation to the distribution system where the relevant connection point is located at a distance equal to or greater than 25 kms from the relevant zone substation in either the rural zone or mixed zone within the network.

(e) The headworks charge varies depending on the location and the connection voltage level. It reflects the average cost Western Power incurs in providing additional electricity capacity to the relevant parts of the network. The charge does not include the direct costs of customer connection to the existing network, including reticulation of underground electricity services for new subdivisions, which are determined in addition to the headworks charge.

3. Objectives of the headworks scheme

This section sets out the objectives used in determining the headworks scheme and prices.

(a) The headworks scheme has been designed to meet the high-level objectives described below.

  (i) Comply and be consistent with the regulatory framework;

  (ii) Provide a method for allocating the costs of the provision of network distribution headworks to customers seeking to connect to the network in a fair and equitable manner;

(iii) Be as cost reflective as is reasonable to reflect the network user's utilisation of the network headworks capacity;

(iv) Be as simple and straight forward as is reasonable taking into account other objectives; and

(v) Provide price stability and certainty to enable network users to make informed investment decisions.

(b) The methodology must ensure that headworks contributions will, in the long term, recover no more than Western Power's costs of headworks.

4. Methodology Overview

This section provides an overview of the methodology used in determining the headworks price. It is noted that the cost of the provision of electricity capacity at a particular location is a function of:

(i) the amount of capacity sought by a customer;

(ii) the distance along a feeder from the zone substation; and

(iii) the voltage level of the feeder line, and the costs of the power line infrastructure itself.

On this basis, the approach taken to develop the headworks prices is as follows.

(a) Western Power has modelled a standard feeder to determine the capacity available at various distances along the feeder and determined the cost to provide that capacity in terms of a fixed cost ($ per kVA) plus a variable cost ($ per kVA) for the provision of that capacity at the various lengths of line. Modelling was carried out separately for 22 kV and 33 kV lines.

(b) The results of the modelling carried out under (a) have then been reduced to a standard mathematical formula that defines the cost of distribution headworks required to deliver capacity at any point along a fully developed feeder. This mathematical approach has been further adjusted to reflect the costs associated with a number of actual studies to ensure the price structure is robust and that it meets the objectives and principles of the headworks scheme.

(c) Price lists have then been produced that enable a headworks charge to be determined for an applicant seeking a new connection to the network or for a load increase at an existing connection. The charge is based on:

(i) the capacity sought;

(ii) the distance to the zone substation; and

(iii) the voltage of the feeder supplying the customer.

5. Methodology

5.1. Modelling of a Standard Feeder

(a) As developing and applying locational specific headworks charges in all possible SWIS locations is not a feasible or practicable outcome, Western Power has developed a standard SWIS headworks price based on modelling of standard distribution feeders.

(b) A distribution planning study was conducted and identified:

(i) the optimal (fully developed) standard feeder capacity for line distances in steps from 50 km to 300 km for each of 22 kV and 33 kV voltage levels; and

(ii) the distribution line construction cost estimates from recent representative baskets of actual projects, applied to the line distances in steps from 50 km to 300 km at each voltage level.

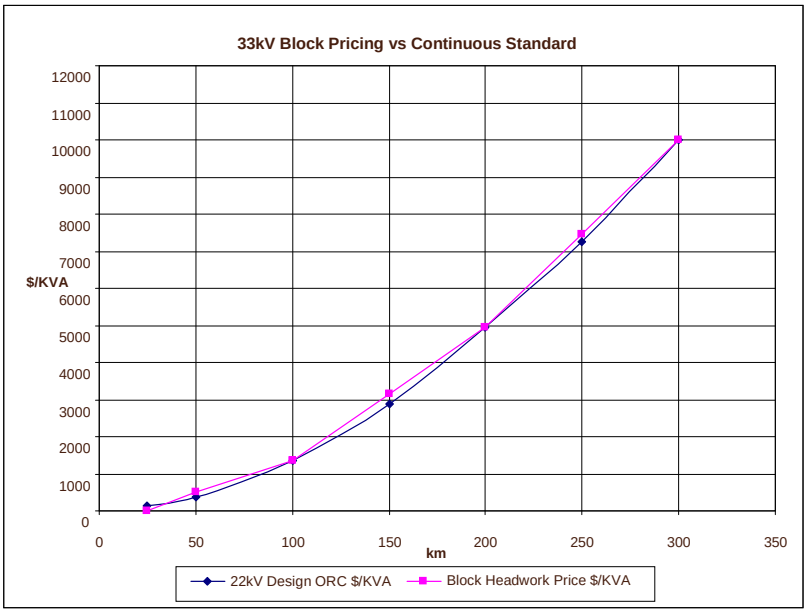
(c) These optimal replacement costs and capacity-distance outcomes were applied to determine a standardised headworks cost-capacity curve. This curve describes the calculation of a standardised headwork cost over each of the 50 km increments as follows:

(i) Standard headworks price = [Fixed cost (FC) plus Variable cost (VC)] / Capacity Delivered expressed in $/kVA.

{Note that the capacity of the feeder at each distance has been determined on the basis of using 19/3.25 all aluminium alloy conductor (AAAC), and installing two voltage regulators to maximise the capacity that could be obtained within the statutory voltage limits. Consequently the fixed cost is representative of the cost of the two regulators and the variable cost reflects the cost of the feeder line per km.}

(d) This capacity-cost curve was then converted mathematically into a headworks price applied in block increments of distance and taking into account the 25 km zero charge distance. Two part block pricing allows for practical application of distance pricing.

(e) The resulting headworks price (in $/kVA) for each block increment referred above is illustrated against the standard capacity-cost curve in the figure overleaf:



5.2. Headworks Modelling at Specific Locations

This section describes the location specific studies that were carried out to determine the actual cost of the provision of additional network capacity in seven locations within the SWIS.

(a) Western Power has conducted extensive modelling to determine the optimal network development pathway for seven representative locations within the SWIS (Walpole-Denmark; Bremer Bay; Ravensthorpe; Dongara; Brookton; Jurien Bay and Kalbarri).

(b) This modelling considered both network augmentation options and alternative network options (embedded generation) to meet the forecast load growth for each location. The key elements of the models developed included:

(i) Load forecasts. Central load forecasts were developed from the current customer application data available to Western Power, the existing customer load profile on each feeder, and from long term historical load growth rates for each region. Land subdivisions were allocated an estimated commencement date, diversified maximum demand and time to maturity. Low and high case load forecast scenarios were developed by considering adjustments to the underlying application data and long term load feeder growth rates.

(ii) Network distribution augmentation costs and/or embedded generation costs. All potential currently available and future network augmentations were considered. A cost estimate of each option was developed and the additional network capacity delivered was modelled by Western Power using load flow analysis. Alternative embedded generation option costs were established from current industry unit cost estimates. Embedded generation options considered included islanding, semi-islanding and peak lopping modes of operation. Peak lopping mode whereby the embedded generation is used to cap the feeder demand, (using load distribution curve) proved the lowest cost of these approaches.

(iii) Network distribution revenue was determined using average historical distribution revenue data for each location considered.

(c) The models determined the optimal network development pathway for each location over a long term 30 year study period, being that option that delivered the lowest net present value of meeting the forecast customer loads.

(d) In all locations considered the required investments did not meet the New Facilities Investment Test without customer contributions (by differing quantum). The models were used to develop a locational specific headworks charge that when applied to the forecast customer loads for that location, ensured that the net present value of revenue equalled the net present value of network costs over the period.

5.3. Adjustment of the Standard Headwork Formula

(a) Western Power considered the differences between the locational headwork charge determined by previous modelling and the standard optimal cost approach. Differences were noted in particular locations due to the existence of factors including initial spare feeder capacity; the existence of low cost network enhancement options or high cost options; the potential for deferment of network options by the use of embedded generation; and that typically time staging of network augmentation options under detailed locational modelling better matched costs with capacity requirements over time.

(b) Western Power considered options to minimise the gap between the standard optimal cost approach and the locational specific headworks cost determined from previous modelling along the feeder length. Typically the standard cost approach overstated the outcomes.

(c) The adoption of a 75% adjustment factor applied to the standard cost approach was found to provide close alignment between the actual locational modelled costs and the mathematically derived cost.

5.4. Publishing of Prices

(a) Western Power publishes the headworks prices applicable as a series of price list tables on its website. These price list tables show the headworks price payable by a customer (residential or commercial applicants) seeking connection to the network. Prices are displayed in 5 km distance increments (although actual distances are used when calculating the customer charge). These tables show:

(i) Distribution headworks prices: single commercial applicants (excludes standard revenue offsets);

(ii) Distribution headworks charges: residential subdivision and single residential applicants (includes standard revenue offsets);

(iii) Distribution headworks charges: commercial subdivision applicants (includes standard revenue offsets);

(b) Published price list tables display pricing for customer connection at both 22 kV and 33 kV voltage levels.

5.5. Determining the headworks contribution

(a) The *contributions policy* sets out the method for determining the headworks contribution. The headworks contribution so determined for a customer connection application depends on three factors:

(i) The capacity sought by the applicant (in kVA),

(ii) The distance from the nearest relevant zone substation (in km), and

(iii) The voltage of the distribution feeder to which the connection is made (either 22 kV or 33 kV).

6. Headworks Price List Review Process

This section sets out the procedures to be applied when adjusting the published headworks price list tables to ensure that current pricing reflects changes in the underlying construction cost structures.

(a) Western Power will adjust the headworks price lists ~~annually based on applying the relevant CPI index increase to the prevailing price lists~~for price inflation on an annual basis using March on March point estimates from the ABS All Groups CPI index (catalogue number: 6401.0).

~~(b)~~ Western Power will reset the headworks price list tables ~~annually based on movements arising from an annual review of the distribution construction cost estimates against those derived in section 5~~prior to the commencement of a new access arrangement period to reflect current distribution construction cost estimates (to ensure that movements in costs or efficiencies have been taken into account)~~. The price reset shall take account of the quarterly CPI price adjustments made over the previous 12 month period. ~~. The price reset will take account of the annual price adjustments made to account for price inflation over the access arrangement period.

(b)

Appendix A - Derivation of Distribution Feeder Capacity

This appendix sets out the basis for Western Power's determination of the capacity that can be delivered on a standard fully developed distribution feeder ("standard" feeder).

Standard Feeder Capacity

(a) Western Power conducted load flow studies to determine the capacity of a "standard" distribution feeder at both 22 kV and 33 kV voltages. The capacity delivered along a distribution feeder is determined by the distance from the source and the feeder voltage level (subject to appropriate conductor size and use of voltage regulators etc).

(b) The load flow studies assumed that a fully developed distribution feeder will have two voltage regulators along its length. For simplicity, the study determined the point load that when located at the end of a feeder of varying 50 km increments, would lower the feeder delivered voltage level to the emergency planning limits. Such a load is considered representative of the voltage constrained capacity of the feeder.

(c) The results of these load flow studies are shown in the table below.

Line Length (km)	22kV Capacity (kVA)	33kV Capacity (kVA)
50km	6,500	14,300
100km	3,300	7,300
150km	2,250	5,100
200km	1,750	3,950
250km	-	3,340
300km	-	2,900

Appendix B - Derivation of Distribution Cost Estimate

This section sets out the basis for Western Power's determination of the distribution costs of a standard fully developed distribution feeder ("standard" feeder).

Standard Feeder Cost Estimate

(a) The cost estimates used for determining both the 33 kV and 22 kV "standard" distribution headworks infrastructure cost used in calculating the applicable headworks price lists are derived from the standard cost estimates developed by Western Power Country Planning and Development section. These standard estimation costs are used by Western Power in determining the connection quotations provided to customers.

(b) The following specification assumptions were applied in determining the cost estimates applied by Western Power for a fully developed standard feeder:

  (i) Voltage regulator (2 of 250 amp rated);

  (ii) Overhead 3 phase line construction cost (19/3.25 AAAC conductor). Distribution line construction costs were based upon wood pole overhead construction type, which is representative of most country distribution lines. Construction type is the same for both 22 kV and 33 kV voltage levels; and

  (iii) Substation feeder circuit cost is not included as it is normally treated as a transmission development cost item.

(c) Western Power updates these cost estimates on a regular basis to reflect up to date changes in the average standard cost of construction of new distribution infrastructure for use in customer quotations and internal budgeting. Refer to section 6 for details of the headworks price review procedures.

Appendix C - Revenue Offsets

This appendix describes the process for determining revenue offsets that may be applicable to a customer headworks contribution.

Overview of Offsets

(a) Headworks prices are reduced or offset by taking into account the network access revenue expected to arise from the connection over a reasonable period of time (which is assumed up to 15 years).

(b) These offsets will vary depending on whether the connection is for residential or commercial customers. The revenue offset for commercial loads needs to be individually assessed, as every case will be different.

(c) The revenue offset for residential and commercial land subdivisions can be pre-determined based on a set of standard assumptions which are listed in the table below.

Residential Land Subdivisions	Commercial Land Subdivisions
(i) 5 kVA ADMD per lot[1]	(i) 40 kVA ADMD per lot
(ii) 5000 kWh consumption per annum per lot	(ii) 20% load factor with 30% Off Peak energy consumed per annum per lot
(iii) Reference Tariff RT1 applied	(iii) Reference Tariff RT4 applied
(iv) 4 years to full maturity of land uptake	(iv) 4 years to full maturity of land uptake
(v) 15 years reasonable time period for revenue	(v) 15 years reasonable time period for revenue

(d) The price lists for residential and commercial subdivisions take the standard offset into account so that the headworks charge can be readily determined for such developments. Individual assessments may be required where specific land developments vary from these standard assumptions. The standard assumptions underlying the pre-determined revenue offset calculations are:

(e) The headworks price lists and indicative worked examples published by Western Power on its website provide indicative prices for the following three cases namely

(i) residential subdivision applications;

(ii) commercial subdivision applications; and

(iii) single commercial customer applications.

[1] ADMD is the After Diversity Maximum Demand for the connection

~~(f)~~In compiling the customer connection quotation, Western Power applies any network access revenue offsets that are surplus to the quantum of headworks charge applicable, as a further offset to any direct connection charges that may be payable by the customer, noting that revenue offsets are not to be double counted against both contribution requirements.

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