Pricing for Grid Connection Services

Pricing for Grid Connection Services
from 1 April 2000

An information booklet from
Transpower New Zealand Limited

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Contents

Glossary of Terms

The following terms are intended to aid an understanding of any special terms used in this booklet. They do not apply to any contract that may exist between Transpower and a customer.

Anytime Maximum Demand	The Anytime Maximum Demand for a customer at a point of supply in respect of any month is the average of the highest *p* demand peaks, at that point of supply, in the twelve months up to and including the specified month.
Anytime Maximum Injection	The Anytime Maximum Injection for a customer at a point of supply in respect of any month is the single highest injection peak, at that point of supply, in the twelve months up to and including the specified month.
Capacity Measurement Month	The Capacity Measurement Month is the month for which the most recent data are available when overall prices are calculated (see Appendix G).
Directly Connected End-User	An end-user, usually an industrial customer, that directly connects its equipment to Transpower's grid at a point of supply.
Generator	A customer who injects electricity into the grid.
HVDC link	The High Voltage Direct Current link that connects Benmore n in the South Island with Haywards in the North Island.
HVAC	High Voltage Alternating Current. HVAC assets form the majority of Transpower's grid. They exclude the assets that comprise the HVDC link.
Optimised Deprival Value (ODV)	The valuation methodology used to value Transpower's assets.
Optimised Grid	A theoretical grid determined by Transpower's valuation process, which uses the Optimised Deprival Value (ODV) valuation methodology.
Optimised Depreciated Replacement Cost (ODRC)	The value of the optimised grid assets, depreciated to reflect the remaining economic life of the corresponding physical assets currently in use.
Optimised Replacement Cost (ORC)	The replacement cost of the assets in the optimised grid.
Point of Supply	The substation or other location at which a customer's assets are physically connected to the grid assets (whether for injection or offtake).
Pole Lines	Any transmission line that is not built on steel towers.
Tower Lines	Steel tower transmission lines of any voltage.

1 Introduction

This booklet describes the application of the pricing methodology, effective from 1 April 2000, used to calculate the Grid Charges payable under the Grid Connection module (Part C) of Connections. It describes the methodology as applicable to lines companies, directly connected end users and generators.

The methodology described in this booklet is not immediately applicable to customers who have Output or Input Connection Contracts for connection to the grid that extend beyond 31 March 2000. For these customers, the third edition of the pricing booklet remains applicable.

The services covered by this booklet are described in detail in the Grid Connection module. The Grid Charges comprise the Connection Charge, the Interconnection Charge and the HVDC Charge. The methodology for the calculation of these Charges is set out below.

2 Pricing Methodology

The pricing methodology allocates Transpower's revenue requirement for the provision of its services by reference to whether assets involved are connection, HVDC or HVAC network assets. The revenue requirement includes the capital, maintenance, operating and overhead costs associated with making the assets available for the conveyance of electricity. Since the revenue requirement is derived from the Optimised Deprival Value of Transpower's assets, the assets are allocated on the optimised configuration of Transpower's grid.

The revenue requirement is allocated by three types of Grid Charges:

- Connection,
- Interconnection, and
- HVDC.

All customers who are not subject to Output or Input Connection Contracts pay a fixed annual Connection Charge. Only customers not subject to Output Connection Contracts who draw electricity from the grid pay Interconnection Charges. Only South Island generators who inject electricity into the grid, not subject to Input Connection Contracts, pay the HVDC Charge. The table below identifies which Grid Charges are applicable to the different types of Transpower's customers:

Customer type	Grid Charge: Connection	Grid Charge: Interconnection	Grid Charge: HVDC
Lines Companies	✓	✓	
Directly Connected End Users	✓	✓	
Generators	✓	✓ generator offtake only	✓ South Island only

These Grid Charges are described in detail in the following sections.

The pricing methodology is summarised diagrammatically in Appendix E.

2.1 Connection Charge

The purpose of the Connection Charge is to recover Transpower's costs of connecting a customer's electrical equipment (e.g. generators and/or distribution lines) to Transpower's core grid. The Connection Charge reflects the cost of connection to Transpower's core grid, namely, the cost of providing an identifiable set of assets required by a grid connection point.

These assets ("connection assets") are identified by the connection definition method.

2.1.1 Connection Definition Method

The connection definition method is applied to the optimised configuration of Transpower's grid in order to identify connection assets against which Transpower's revenue requirement to meet the costs of these assets can be allocated. Definitions of the terms used in the application of this method and some examples are given in Appendix E.

The grid is made up of circuits and nodes. A node is a substation on the grid where there is injection or offtake, or where two or more circuits join, or where line deviations occur. A circuit is an electrical link connecting two nodes.

Nodes are defined as either grid or connection. A connection circuit is defined as a circuit that has at least one connection node at one of its ends. A grid circuit is defined as a circuit that connects between two grid nodes.

Definitions of the terms used in the application of the connection definition method, the method by which nodes are defined and some examples are given in Appendix E.

2.1.2 Allocation of Assets

Substation user-specific assets (e.g. supply transformers and feeder bays) at both grid and connection nodes are allocated to the customer who uses them. Where customers share the use of such assets, a portion of these assets is allocated to each customer.

Where substation assets are not user-specific (e.g. line bays and buildings), the allocation is as follows:

- if the substation is a connection node, then these connection assets are allocated to customers who share the use of that connection node; and
- if the substation is a grid node, then the assets are deemed to be network assets.

Connection assets making up connection circuits (e.g. lines and circuit breakers) are allocated to the customers sharing the use of the connection circuit.

Assets making up grid circuits are deemed to be network assets. The revenue requirement to meet the cost of making network assets available is recovered via the Interconnection Charge.

Connection assets that are shared between customers are allocated in proportion to the Anytime Maximum Demand or Anytime Maximum Injection of the customers sharing the assets as at the Capacity Measurement Month.

2.1.3 *Calculating the Offtake Connection Charge*

Once connection assets are assigned, a Connection Charge is calculated. The Connection Charge is the sum of asset related, maintenance and operating cost components:

$$\text{Offtake Connection Charge} = \sum_{\text{Customer's connection assets}} \left\{ (\text{ORC} \times \text{ARR}) + \text{M} + \text{O} \right\}$$

where:

	ORC	=	Optimised Replacement Cost of the connection assets
	ARR	=	Asset Return Rate (see Appendix A)
	M	=	Maintenance component of the connection assets (see Appendix B)
	O	=	Operating component of the connection assets (see Appendix D)

2.1.4 *Calculating the Generator Connection Charge*

The generator Connection Charge is calculated differently from the offtake Connection Charge:

$$\text{Generator Connection Charge} = \sum_{\text{Customer's connection assets}} \left\{ (\text{ORC} \times (\text{ARR} + \text{GOR})) + \text{M} + \text{O} \right\}$$

where:

	ORC	=	Optimised Replacement Cost of the connection assets
	ARR	=	Asset Return Rate (see Appendix A)
	GOR	=	Generator Overhead Rate (see Appendix C)
	M	=	Maintenance component of the connection assets (see Appendix B)
	O	=	Operating component of the connection assets (see Appendix D)

2.1.5 *Application of the Connection Charge*

The Connection Charge for the price year is fixed at the beginning of the year and is charged to customers on a monthly basis.

2.2 Interconnection Charge

That part of the revenue requirement for the cost of making the HVAC assets available that is not allocated via the Connection Charge is allocated via the Interconnection Charge.

A flat $/kW interconnection rate is applied to all customers who offtake from Transpower's grid.

2.2.1 *Interconnection Revenue Requirement*

Details of the makeup of the HVAC Revenue Requirement are provided in Appendix G. The Interconnection Revenue Requirement is determined by subtracting the sum of all Connection Charges from the HVAC Revenue Requirement.

$$\text{InterconnectionRevenueRequirement} = \text{HVACRevenueRequirement} - \sum_{\text{Allcustomers}} \text{ConnectionCharges}$$

2.2.2 *Calculating the Interconnection Rate*

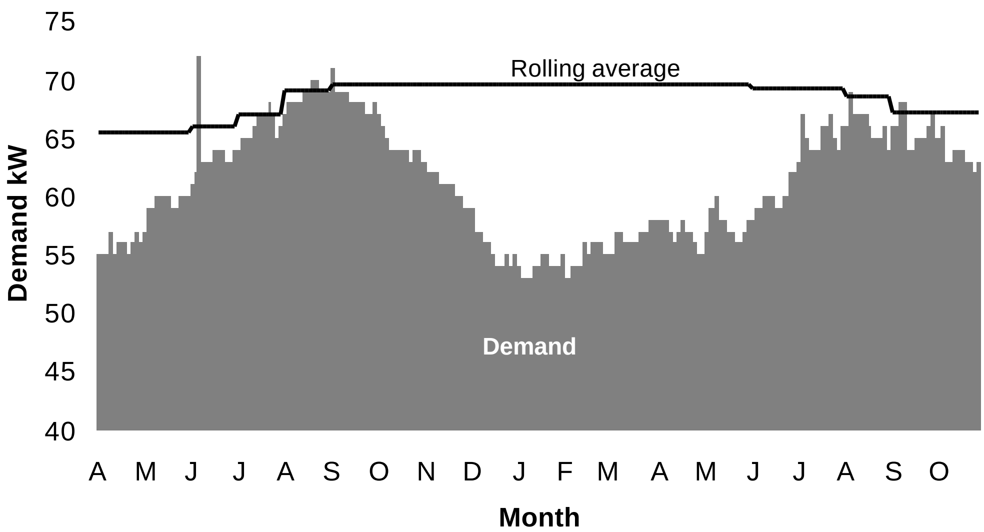
The Interconnection Rate is derived by dividing the Interconnection Revenue Requirement by the sum of all customers' Anytime Maximum Demand as at the Capacity Measurement Month:

$$\text{InterconnectionRate} = \frac{\text{InterconnectionRevenueRequirement}}{\sum_{\text{Offtakecustomers}} \text{AnytimeMaximumDemands}}$$

2.2.3 *Application of the Interconnection Charge*

The Interconnection Charge for each customer point of supply is calculated in respect of each month as one-twelfth of the product of the Interconnection Rate and the average of the *p* highest peaks[1] at the point of supply in the twelve months up to and including the month for which the charge is being calculated.

The following diagram illustrates how the rolling average is incrementally reset:



2.2.4 Waivers

Abnormal peak demands can be caused by, for example, a load shift between points of supply during maintenance on Transpower's grid or the customer's network.

The methodology is not intended to "double count" capacity requirements in such circumstances. Applications to waiver abnormal peaks will be accepted from customers and will be assessed by Transpower on a case by case basis at Transpower's absolute discretion.

Peaks arising from the failure of load control equipment and embedded generators will not be waived.

2.3 HVDC Charge

The purpose of the HVDC Charge is to recover Transpower's revenue requirement to meet the cost of making available the assets used to provide the high voltage direct current link between Benmore in the South Island and Haywards in the North Island.

2.3.1 HVDC Revenue Requirement

Details of the makeup of the HVDC Revenue Requirement are set out in Appendix G. This revenue requirement is allocated to all South Island generators who inject electricity into the grid.

2.3.2 Calculating the HVDC rate

The HVDC rate is derived by dividing the HVDC Revenue Requirement by the sum of the Anytime Maximum Injections as at the Capacity Measurement Month for all South Island generators.

$$\text{HVDCRate} = \frac{\text{HVDCRevenueRequirement}}{\sum_{\text{SouthIslandGenerators}} \text{AnytimeMaximumInjection}}$$

This $/kW flat rate is applied to all South Island generators who inject electricity into the grid.

2.3.3 Application of the HVDC Charge

The HVDC Charge for each customer point of supply in the South Island is calculated in respect of a specified month as one-twelfth of the product of the HVDC Rate and the maximum of the {Anytime Maximum Injection as at the Capacity Measurement Month} and the {peak injection at that point of supply between then and the specified month inclusive}.

3 Pricing Reports

Three pricing reports are used to describe the calculations behind each customer's Charges:

- Pricing Summary;
- Substation Assets; and
- Connection Charge.

They are shown on the following pages with an accompanying explanation.

Please note that the examples shown in the next few pages are hypothetical and are for illustrative purposes only.

3.1 Pricing Summary Report

This report summarises a customer's Connection Charge and Interconnection and HVDC rates on a point of supply basis.

Example figures only

Pricing Summary

Customer: SOUTHERN ELECTRIC

Substation	**Load type**	**Interconnection Rate $/kW**	**HVDC Rate $/kW**	**Connection Charge $**
JTN	OFT	50.00		351,682
PVL	GEN		30.00	689,077
PVL	OFT	50.00		82,689
Total				1,123,448
Allocation of EV adjustment:		-1.0%	-1.5%	-1.0%

Example figures only

- Load type indicates generator or offtake.
- Economic Value (EV) adjustments (gains or losses) are allocated to customers on an annual basis. The magnitude of the adjustments can be found in the Year Specific Data in Appendix G. The annual EV adjustment is applied as a fixed adjustment to a customer's charge. The percentage adjustment is calculated as the ratio of the HVAC and HVDC EV adjustments to the HVAC and HVDC Revenue Requirements respectively. The EV adjustment is returned in 12 equal monthly portions, calculated for each customer at the beginning of each price year as follows:

$$\text{MonthlyEVadjustment} = \frac{1}{12}\left\{\begin{array}{c} \text{HVACRatio} \times \text{ConnectionCharge} \\ + \text{HVACRatio} \times \text{InterconnectionRate} \times \text{AnytimeMaximumDemand} \\ + \text{HVDCRatio} \times \text{AnytimeMaximumInjection} \end{array}\right.$$

where: HVAC Ratio	=	Ratio of HVAC EV adjustment to HVAC Revenue Requirement (see Appendix G)
HVDC Ratio	=	Ratio of HVDC EV adjustment to HVDC Revenue Requirement (see Appendix G)
Anytime Maximum Demand	=	The average of the *p* highest demand peaks in the twelve months up to the beginning of the price year
Anytime Maximum Injection	=	The highest injection peak in the twelve months up to the beginning of the price year

3.2 Substation Assets Report

This report lists all the assets for all the points of supply and the allocation of the assets as connection assets or network assets. Assets are grouped as general substation values (building, land, establishment and oil containment), transformers, switchgear or other assets.

Example figures only

Substation Assets

Substation: Paulsville (PVL) **Report for:** SOUTHERN ELECTRIC

Substation

Land Value	Building Value	Establishment Value	Oil Containment Value	Total Value	Customer Code	Load Type	Customer Allocation
$3,000	$259,179	$1,081,264	$0	$1,343,443	SELE	OFT	100.00%

Transformer

Asset ID	Voltage	Phases	MVA	Transformer Cost	Infrastructure Cost	Total Cost	Notional Location	Customer Code	Load Type	Custo Alloca
T1	110/11	3	5	$147,581	$546,431	$694,012	JTN	SELE	OFT	100.

Switchgear

Asset ID	Voltage	Type	No. of Switches	CB Value	Bus Value	Infra. Value	Protection Value	Total Value	Notional Location	Customer Code
1	11	K425	1	$0	$0	$89,341	$24,303	$113,644	PVL	SELE
2	11	K425	1	$0	$0	$89,341	$24,303	$113,644	PVL	SELE
3	11	K425	1	$0	$0	$89,341	$24,303	$113,644	PVL	SELE
37	11	K415	1	$0	$0	$92,834	$24,303	$117,137	PVL	SELE
38	11	K415	1	$0	$0	$92,834	$24,303	$117,137	PVL	SELE
39	11	K425	1	$0	$0	$89,341	$24,303	$113,644	PVL	SELE
4	11	K425	1	$0	$0	$89,341	$24,303	$113,644	PVL	SELE
92	110	E11	2	$117,852	$127,922	$70,667	$27,645	$344,087	JTN	SELE

Totals

Customer	Notional Location	Asset Value	Customer Switches
NETW	PVL	0	0.0
SELE	PVL	$3,184,036	9.0
			9.0

Example figures only

- A customer code of NETW means the asset is a network asset and is accordingly not included in the assessment of the Connection Charge.
- Where the connection asset is shared between two customers or locations, the proportion is shown in the allocation column. This split is based on the Anytime Maximum Demand or Injection for each customer using the specific assets at each point of supply, as described in section 2.1 of this booklet.
- A connection asset's notional location is the substation to which it is allocated. Often, this is the same as the substation where it is physically located. However, when the code is for another substation, it means another point of supply is using this asset. For example, on a spur line the substation at the remote end (A) would use for connection some of the assets at the substation at the grid end (B) and they would appear on substation B's Substation Asset Report, with A as the notional location.
- If the substation contains capacitors or other special assets, these would appear after the switchgear section, under a section heading "Other Assets".

3.3 Connection Charge Report

This report identifies the total list of connection assets at a customer point of supply that have been allocated and the associated components of the Connection Charge (asset, maintenance and operating). The report groups these as substation assets followed by line assets.

Example figures only

Connection Charge

Customer SOUTHERN ELECTRIC

Substation JOHNSTON **Load type:** OFT

Asset Type	Asset ID	Sub-station	Asset Value	Asset Component	Maintenance Component	Operating Component	Customer Allocation	Connection Charge
LINE	JTN-PVL A		$4,513,794	$393,151	$187,603	$0	4.27%	$24,786
SUBS	JTN	JTN	$1,343,443	$117,014	$14,106	$0	100.00%	$131,120
SWIT	1	JTN	$113,644	$9,898	$1,193	$1,104	100.00%	$12,196
SWIT	2	JTN	$113,644	$9,898	$1,193	$1,104	100.00%	$12,196
SWIT	3	JTN	$113,644	$9,898	$1,193	$1,104	100.00%	$12,196
SWIT	92	PVL	$344,087	$29,970	$3,613	$2,208	100.00%	$35,791
TRAN	T1	JTN	$694,012	$60,448	$7,287	$0	100.00%	$67,736
							Total connection charges	$351,682

Example figures only

where:	Asset component	=	Value × Asset Return Rate
	Maintenance component	=	Value × Maintenance Return Rate (for substation assets) or Line length × Lines Maintenance Return Rate (for lines)
	Operating component	=	Operating cost per switch × number of switches defined as connection assets
	Connection Charge	=	(Asset component + Maintenance component + Operating component) × Customer Allocation

4 APPENDICES

A Rate of Return on Assets

An Asset Return Rate is applied so that the cost of funding the connection assets plus depreciation can be recovered through the asset component of the Connection Charge. The cost of funding the assets is the product of Transpower's Weighted Average Cost of Capital (WACC) and the Optimised Depreciated Replacement Cost (ODRC) of the assets. This can be represented as:

$$ARR = \frac{(WACC \times ODRC) + D}{ORC}$$

where:	ARR	=	Asset Return Rate
	WACC	=	Transpower's Weighted Average Cost of Capital
	ODRC	=	Optimised Depreciated Replacement Cost of HVAC assets
	D	=	total Depreciation on HVAC assets
	ORC	=	Optimised Replacement Cost of the HVAC assets

The Asset Return Rate applying for the current year is reported in the Year Specific Data in Appendix G.

The asset component of the Connection Charge is calculated as:

$$\text{Asset component} = ARR \times ORC_{\text{of assets allocated to customer}}$$

The value of HVAC assets is the total value of all assets in HVAC substations and all HVAC transmission lines that are allocated to customers. These do not include the communications system, the control centres, minor and other fixed assets, or works under construction. Asset values are documented in the "Optimised Deprival Valuation of Transpower's Fixed Assets" report.

B Maintenance Return Rates

The Connection Charge includes a component that recovers a portion of the routine maintenance costs incurred at substations and on connection transmission lines.

These charge components distinguish between substation maintenance and transmission line maintenance.

Maintenance rates are updated each year and use the average of the maintenance costs over the previous four July to June years. The rates used this year can be found in the Year Specific Data in Appendix G.

B.1 Line Maintenance

Line maintenance costs have been expressed as average rates, in $/km, for three categories of lines:

- 220kV tower lines
- Other tower lines
- Pole lines

Each average rate is based on four years of actual costs for every line in the category, divided by the total actual length of lines in the category. Significant replacement and refurbishment costs are not included. For example, the cost of a comprehensive line re-conductoring project would not be included, but the costs of replacing a few wood poles would be included.

B.2 Substation Maintenance

The four-year average actual cost of all substation asset maintenance is recovered in proportion to the ORC of substation assets.

The Maintenance Return Rate (MRR) is calculated as:

$$MRR = \frac{\text{Four year average actual maintenance cost}}{ORC_{\text{of substation assets}}}$$

The maintenance component of the Connection Charge is calculated as:

$$\text{Maintenance component} = MRR \times ORC_{\text{of assets allocated to customer}}$$

C Overhead Recovery

Overheads associated with HVAC assets are allocated to offtake customers and to generators.

Offtake customers are allocated a portion of overheads through the interconnection rate.

Total generator overheads are determined in proportion to maintenance expenditure for offtake and generator connection assets and HVDC assets. The portion allocated to generation points of supply is divided by the total Optimised Replacement Cost (ORC) allocated to the generator connection assets to determine the Generator Overhead Rate (GOR). The overhead component for each generator point of supply is determined by multiplying the ORC of the generator connection assets by this Rate. The Generator Overhead Rate used is presented in the Year Specific Data in Appendix G.

HVDC overheads are allocated through the HVDC Rate.

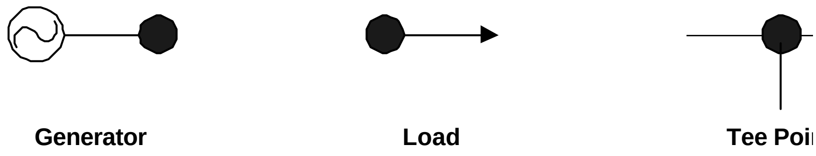
D Operating Costs

Operating costs are broadly correlated with the number of switching devices in a substation and are therefore allocated to connection assets in proportion to the number of switches associated with each asset category. A national average operating cost per switch is determined by dividing the total operating cost by the number of actual switches (totalled over the whole country). The operating component of the Connection Charge for a particular customer is determined by multiplying the number of switches allocated to that customer by the national average operating cost per switch.

E Further Connection Definitions and Examples

E.1 Definitions

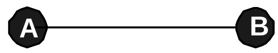
These are some of the symbols used in the examples below:



A circuit is an electrical link connecting two points of supply. Where there are two circuits on the same support structures (e.g. a double circuit pole line) they are treated separately.

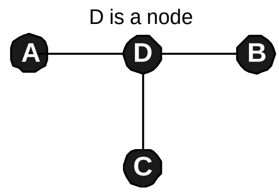
A **node** is defined as:

any point of supply, e.g. A and B



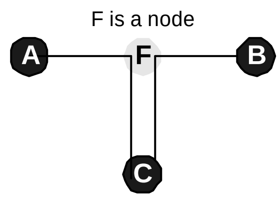
or

any points connected to more than two other nodes (such as a "tee point"), e.g. D



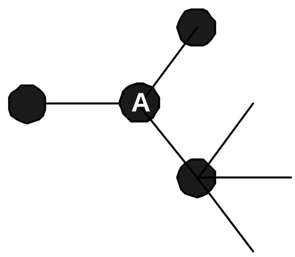
or

any points that enable connection of a node point to a circuit by way of re-routing the circuit (the commonly used engineering term for which is an "in-out deviation"), e.g. F



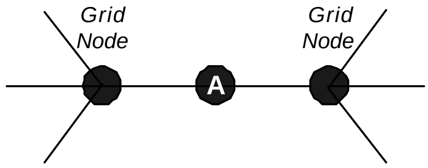
A **grid node** is defined as any node ("A" here) that is:

connected to at least three other nodes (either connection or grid)

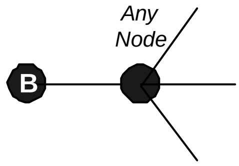


or

connected to two other grid nodes, or between two grid nodes but not necessarily adjacent

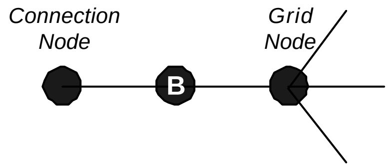


A **connection node** is defined as any node ("B" here) that is: connected to only one other node (either connection or grid nodes)

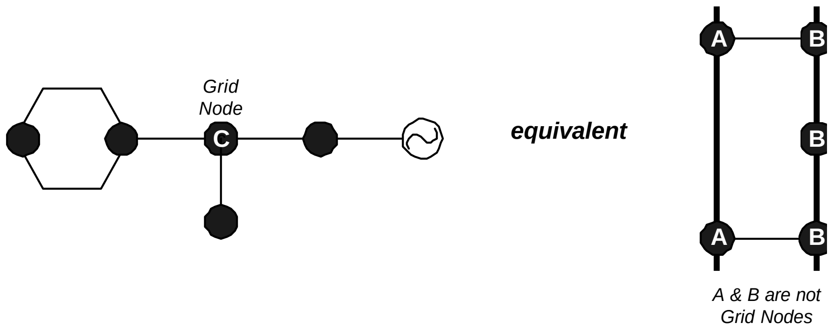


or

connected to no more than one grid node



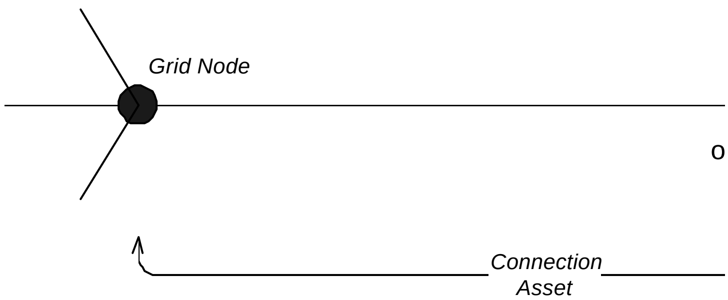
The following are further examples of grid nodes:



E.2 Applications of Connection Definition

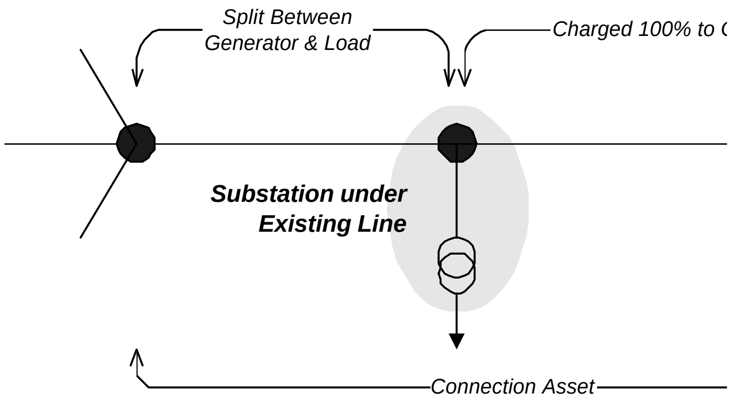
E.2.1 Radial Feeder / Spur Line

This is a simple case of a radial feeder or spur line from a grid node. All assets making up the connection circuit (the circuit breaker bays and the line to the connection point) and all assets at the connection point are considered connection assets. An example of this is:



E.2.2 Spur Line with Subordinate Connection

This is where an offtake customer or a generator is located directly under a spur line. As above, all assets from the grid node to and including the end are classified connection assets. The assets between the grid node and the subordinate point of supply will be shared between the two customers, while the section of line between the subordinate point of supply to the generator are allocated to the generator. An example of an addition to a spur line, directly under the line is:

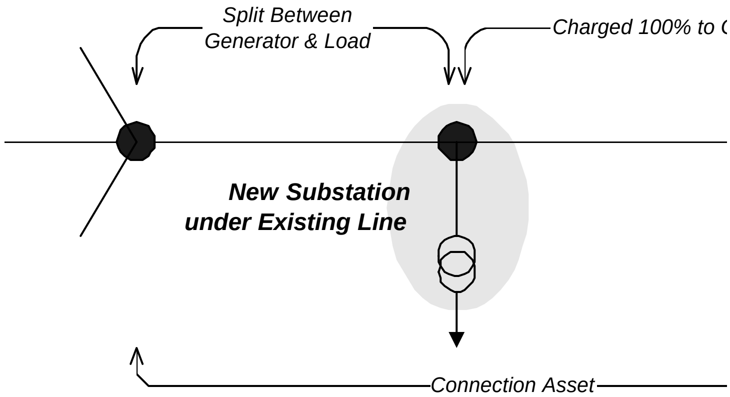


E.2.3 Application for Additions to the Grid

The cases given above are all for existing assets. Any new additions within a price year will be treated as per the examples below. A new investment will not cause a connection asset to become a grid asset: i.e., all sunk assets that are classified as connection assets will remain connection assets and will be shared according to the same rules as per existing assets. Assets will be re-assessed for new price years.

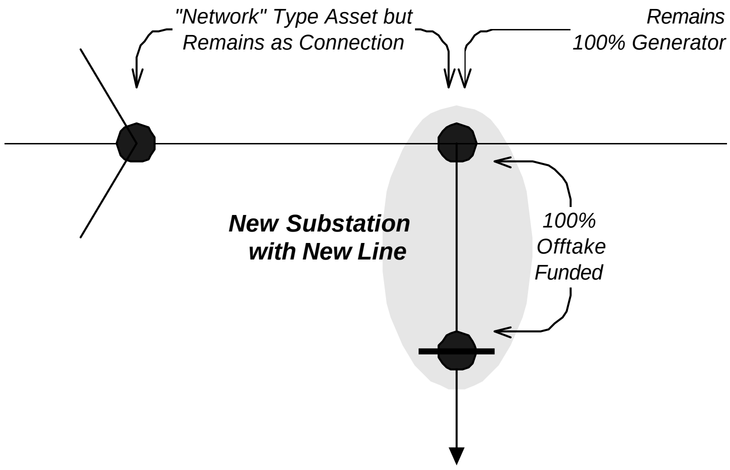
E.2.4 New Connection on Spur Line

An example of a new asset added directly under a spur line is:



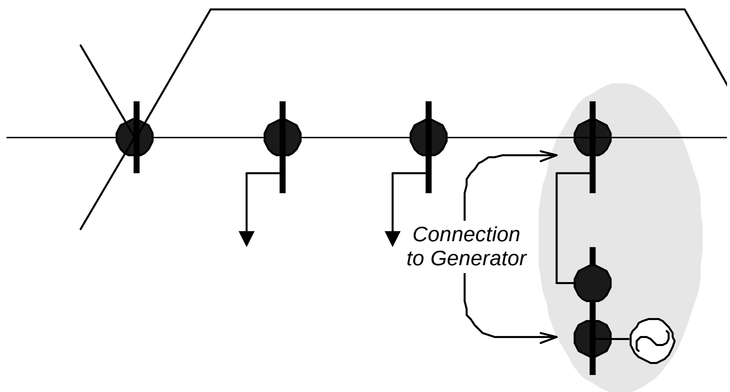
E.2.5 New Sub-Line off a Spur Line

A new sub-line off a spur line remains connection. The allocation of the common section of line remains a connection asset and shared between the two parties for the price year. An example of this is:



E.2.6 Additions from a Grid Asset

In the case of an addition of an offtake customer or a generator to a typical grid asset, the spur line from the "tee point" to the new substation will be classed as a connection asset. The others remain unaffected. An example of this is:



G Year Specific Data (for the year commencing 1 April 2000)

Capacity Measurement Month				August 1999
p Number of peaks averaged in calculating Anytime Maximum Demand				12
Asset Return Rate				8.71%
Maintenance Return Rate	Substations			1.05%
	220 kV tower lines			$ 940.71 /km
	Other tower lines			$ 1492.62 /km
	Pole lines			$ 2222.79 /km
Generator Overhead Rate				2.5%

HVAC Revenue Requirement			$ 410.0 M
Made up as follows:			
Operating and maintenance		$ 99.7 M	
Overheads (A&G, controllable costs)		$ 42.4 M	
Capital related costs		$ 267.8 M	
Post-tax capital charge	$ 133.1 M		
Tax charge (including tax shield)	$ 65.6 M		
Depreciation and write-offs	$ 69.3 M		
Service potential adjustment	$ -0.1 M		

HVDC Revenue Requirement			$ 76.7 M
Made up as follows:			
Operating and maintenance		$ 4.5 M	
Overheads (A&G, controllable costs)		$ 3.7 M	
Capital related costs		$ 68.5 M	
Post-tax capital charge	$ 30.1 M		
Tax charge (including tax shield)	$ 8.2 M		
Depreciation and write-offs	$ 26.7 M		
Service potential adjustment	$ 3.6 M		

Adjustment for past economic gains/losses	HVAC	$ -14.0 M
	HVDC	$ -7.7 M
Ratio of EV adjustment to Revenue Requirement	HVAC	-3.41%
	HDVC	-10.0%

All amounts specified in this Appendix are exclusive of GST