

**CONNECTION AND OPERATION  
DISTRIBUTED GENERATION  
OVER 10KW CAPACITY**

**Documentation Revision Control:**

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Approved For Issue By: Network Manager

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## 1.1 SCOPE

The purpose of this document is to define the process for the connection of generation to NWL's network. The generating unit shall comply with the standards specified in this document.

This standard applies to generating units having an output capacity of at least 10kW, which are connected to NWL's network.

Applications for connection of generators of greater capacity than 1,000kW, while also subject to this standard, will require further specific investigations into network security and integrity due to scale. These investigations shall be supported by a detailed concept design submitted by the applicant.

Connection requirements for generators of a capacity less than 10kW are defined in NI 05/36 *Distributed Generation Up To 10kW Connection Standard*.

### 1.1 Application

This document applies to all operators of embedded generation within the above mentioned scope which is, or is to be connected to NWL's electricity network. It should be applied in conjunction with the methodologies outlined in *NWL Connection Agreement for Distributed Generation (DG) Standard*.

### 1.2 Objective of this Standard

The objective of this document is to provide a clear perspective of NWL's technical requirements for the enquiry, approval, installation and connection of small embedded generation.

This document may also serve as an informative document for NWL consumers wishing to connect embedded generation to NWL's network.

### 1.3 Referenced Documents

#### 1.3.1 Industry Rules and Standards

Electricity (Safety) Regulations 2010

Electricity Industry Participation Code 2010

SM-EI Safety Manual - Electricity Industry (SM-EI) – Parts 1, 2 and 3 inclusive

NZIECP 35 Power Systems Earthing

AS/NZS3000:2007 Electrical Installations (known as the Australian/New Zealand Wiring Rules)

AS 4777 Parts 1, 2 and 3 – Grid Connection of Energy Systems Via Inverters

UL 1741 Standard for safety of Inverters, Controllers and Interconnection System equipment for use with Distributed Energy sources

#### 1.3.2 NWL Documents

NI 05/34 NWL Connection Agreement for Distributed Generation (DG)

NS 05/05 Standard for Connection to NWL Electricity Network

NI 05/36 Embedded Generation Under 10kW Connection Standard

## 1.4 Definitions

Unless stated below, words and phrases in this specification have the meaning defined in: -

- AS/NZS 4676
- Common English language definitions.

Term	Description
DG	Distributed Generation. A synonym for Embedded Generation
Embedded Generation	A generator connected to a (NWL) distribution network intended to supply within the local network. The term differentiates generators from those that are directly connected to a transmission network intended to supply at a regional or national level.
ICP	Installation Control Point.
Grid	For the purposes of this document, NWL's network.
Grid-Tied	A generator operating in parallel with the network.
Inverter	A transistor based electronic device designed to convert DC to AC.
MACQS	Means Multilateral Agreement for Common Quality Standards.
Network	Means NWL's distribution system of electrical power. For the purposes of this document, the term 'network' refers to the low voltage (400V) and high voltage (11kV, etc.) networks for the connection of embedded generation and all equipment that may be affected upstream

## 2 BACKGROUND

This standard is intended for generation operators wishing to connect significant generation to the NWL network. Energy conversion for plant of this size is usually from small hydro schemes, large solar arrays, and fertiliser works by-product, etc. Smaller plant (<100kW) may use induction or synchronous generators where the energy source is kinetic or may use several solid state inverters in parallel for direct current (DC) sources such as photo-voltaic panels. Larger plant designs may utilize synchronous generators or turbo-alternators.

Protection systems for significant generation plants require careful co-ordination with NWL's network protection systems in order to minimize fault events and power quality issues on the network and to eliminate unnecessary tripping of the generation protection system.

## 3 SYSTEM REQUIREMENTS

### 3.1 Momentarily Paralleled Standby Generators

Where a consumer has generating equipment for standby or emergency supply purposes, changeover switches and changeover devices are required such that parallel connection to the NWL network is not possible for longer than two (2) seconds. Such equipment shall comply with *AS/NZS 3000:2007 Wiring Rules*.

Upon request, information on the generation facility and test results shall be provided to NWL on the information and test details report as scheduled in *Appendix A Embedded Generation Plant Specification and Commissioning Report* of this document.

### 3.2 Parallel Connected Generating Units

Inverter based units shall comply with AS4777 Grid Connection of Energy Systems via Inverters and NZS 3000:2007 Wiring Rules. Non-inverter (AC) units shall comply with NWL's protection requirements as prescribed within this document.

#### 3.2.1 Portable Generating Sets

Portable mains parallel generating sets shall not be permitted to be connected to the NWL network by any person or persons except by NWL approved staff or contractors under emergency conditions.

### 3.2.2 Isolation from Network

Refer to Safety Manual – Electricity Industry (SM-EI) section 6 “*Isolation and Earthing for Work on HV Electrical Equipment.*”

### 3.2.3 Protection Co-ordination

The protection associated with embedded generating plant shall co-ordinate with the protection associated with the NWL distribution system as follows:

- (a) For generating plant directly connected to the NWL distribution system, the generator must meet the target clearance times for fault current interchange with the NWL distribution system in order to reduce to a minimum the impact on the NWL distribution system of faults on circuits owned by generators. NWL will ensure that the NWL protection settings meet its own target clearance times. The target clearance times are measured from fault current inception to arc-extinction, and will be specified by NWL to meet the requirements of the relevant part of the distribution system.
- (b) The setting or operating limits of any protection controlling a circuit breaker, or operating values of any automatic switching device at any point of connection with the NWL distribution system, shall be agreed between NWL and the consumer, in writing, during the connection approval process. The protection settings or operating values shall not be changed without the express agreement of NWL.
- (c) The Generator shall provide automatic isolation and non-reconnection for “no network voltage” within a maximum time of two (2) seconds. NWL may specify a faster disconnection time to not less than one second as determined by NWL Asset Management, on a case-by-case basis.
- (d) Auto-reclosing or auto-resynchronising by the generator plants protection and control system is not permitted until after at least after two (2) minutes of continuous NWL network re-energisation.
- (e) Inverter based generators must meet UL1741, IEC61727 or AS4777 Pt 3, protection requirements. Where these standards require more conservative parameters, then the provisions of NWL’s standard shall apply.

### 3.2.4 Supply to Islanded part of NWL’s Network

It is conceivable that a part of the NWL distribution system to which embedded generators are connected can, during emergency conditions, become detached from the rest of the system. Following this situation occurring, the generating units must automatically disconnect from the NWL Network within two (2) seconds.

### 3.2.5 Metering and ICP Status

An export meter shall be fitted adhering to the Electricity Industry Participation Code Part 10 – Metering. The NWL Project Engineer shall advise the NWL metering section of approvals of any application to enable ICP status to be updated.

The generator plant operator shall provide NWL, at NWL’s request, interval data and cumulative data recorded by their meters. Metering details shall be provided on the test and information sheet as detailed in *Appendix A Embedded Generation Plant Specification and Commissioning Report*.

### 3.2.6 Generators with Governors in Service

NWL must approve protection systems of generators with governors in service. Information on governors and the types in service are required to be supplied from the test and information sheet in *Appendix A Embedded Generation Plant Specification and Commissioning Report*. If such information is submitted to NWL, a further test may be required by NWL before the generator is permitted to be connected.

### 3.2.7 Summary of Protection Requirements

REQUIREMENTS	10kW to 100kW	100kW to 500kW	Above 500kW
Generator Circuit Breaker	X	X	X
Dedicated Transformer	X**	X	X
Disconnect Switch	X	X	X
Over-voltage Protection	X	X	X
Under-voltage Protection	X	X	X
Over-frequency Protection	X	X	X
Under-frequency Protection	X	X	X
Earth-fault Protection	X	X	X
Over-current Voltage Restraint Protection	n/a	n/a	X
Neutral Voltage Displacement Protection	X**	X	X
Synchronisation	X	X	X
Loss Of Mains Protection	X	X	X
Power Factor or Voltage Regulation Equipment	X	X	X
Fault Interrupting Devices	n/a	X	X
NWL SCADA Visibility Status and Metering	n/a	n/a	X

**X\*\* indicates** installation specific – at NWL discretion.

n/a indicates not required.

### 3.2.8 Generator Connection Diagram

A relay and single line diagram or similar connection schematic showing the proposed installation, protection system and connection point to the network shall be provided with the initial application. A confirmed design schematic shall be provided prior to the generator being commissioned.

### 3.3 Network Connection Contract

Any distributed generation installation which is not connected under a specific network connection contract (with NWL) will be deemed to be connected under Regulated Terms, as specified by the *Electricity Industry Participation Code 2010 – Part 6 Connection of Distributed Generation*.

### 3.4 Access

The customer shall provide NWL or a NWL authorised service provider with safe and unobstructed access to the generation site and all upstream equipment at all reasonable times, providing:

- Access is required for matters concerning the generation circuit and its connection to the NWL network.
- NWL shall make a written request to the customer to access the site for scheduled works.
- NWL or a NWL authorised service provider may not interfere with the customer's equipment without expressed consent. This does not include methods of isolation.
- NWL may require immediate access to the customer's equipment in the event of an emergency (i.e., to prevent a breach of safety or damage to property). NWL shall inform the customer of the circumstances and events as soon as practicable.

### 3.5 Interruptions / Temporary Disconnection from the Network

NWL may, from time to time, isolate any embedded generation in order to perform certain maintenance tasks or manage the network capacity. Refer to NI 05/34 *NWL Connection Agreement for Distributed Generation (DG) Standard*.

### 3.6 Permanent Disconnection

Permanent disconnection of the ICP should comply with NWL's Standard NP 25/60 *Permanent Disconnection of ICP*. Permanent disconnection of the embedded generator circuit only shall include: -

- The customer informing their retailer of the disconnection.
- At least one device (circuit breaker, etc.) must be removed from the embedded generator circuit.
- The remaining circuit, if any, must be "made safe" and comply with *AS/NZS 3000:2007 Wiring Rules*.
- Any signs indicating the presence of embedded generation shall be removed from the customer service by NWL or an authorised NWL service provider.

## 4 CONNECTION AND APPROVAL PROCEDURES

### 4.1 Enquiry from the Customer

The customer must make an enquiry in writing to NWL about the connection of embedded generation. The customer must include the following information:

- Location – the address of where the generation is to be installed.
- Power – the maximum output from the AC connection of the generator.
- Type – the type of AC commutation device e.g.: electronic inverter, AC induction, synchronous, etc.
- Technical Specifications – Voltage, frequency, etc. Inverters must comply with AS4777. Other types may have special requirements.
- Schematic diagram distinctly showing the relevant existing circuits and the intended generation.
- The intended time frame for connection.
- A detailed concept design upon request.

### 4.2 Approval of Design

The approval process shall begin once the customer has supplied satisfactory information about the intended connection, and has paid the appropriate application fee. Depending on the type and size of the generator and connection details, further information may be required by NWL. This information will need to be provided by the generator at the reasonable request of NWL. When planning, protection and SCADA requirements are met, the design approval may be given by a member of NWL's electricity planning team. See *Appendix A, Application and Connection process*.

The generator shall complete the plant and commissioning report in *Appendix B Embedded Generation Plant Specification and Commissioning Report*, before connection can be approved and completed. Further tests may be required for load governed generators. The completed report shall be forwarded to NWL.

### 4.3 Retailer Contractual Agreement

The customer shall pursue an agreement with their energy retailer for the export of energy. There will be no additional charges from NWL for the export of energy.



#### 4.4 Inspection & Testing

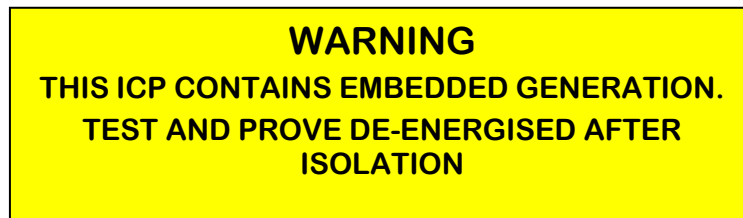
The final step before achieving the connection is inspection and testing. You must provide adequate notice of this with a time frame agreed to with NWL so that NWL can send a qualified representative to site for observation persons. The inspection of the site and installation of the metering equipment is by external contractors approved by NWL to work on the network. There is a separate charge by them for their installation work and inspection.

When the inspection and testing is complete, you must provide NWL with a written commissioning report that includes suitable evidence that the metering installation complies with required standards and rules.

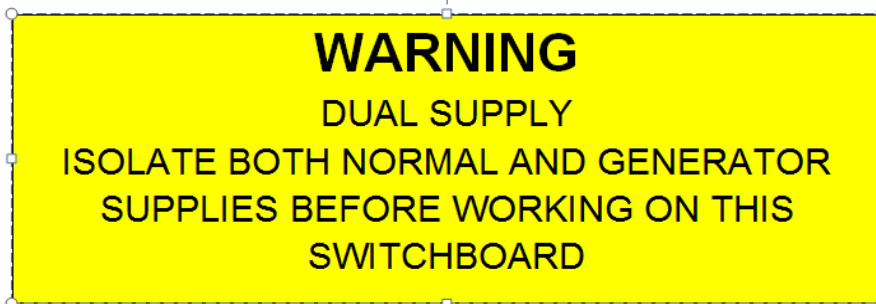
#### 4.5 Connection

The Consumer must provide a Certificate Of Compliance (COC), an Electrical Safety certificate (ESC) and a completed commissioning test report, signed by the registered electrician installing the embedded generation and a Record of Inspection (ROI) from a registered inspector, to NWL, verifying that the installation complies with the requirements of NWL's *Electricity Network Connection Standard (NS05/05)* plus all other network requirements and is electrically safe (i.e., the installation fully complies with the requirements of AS/NZS 3000– Wiring Rules). NWL may then approve the plant for connection to The Network.

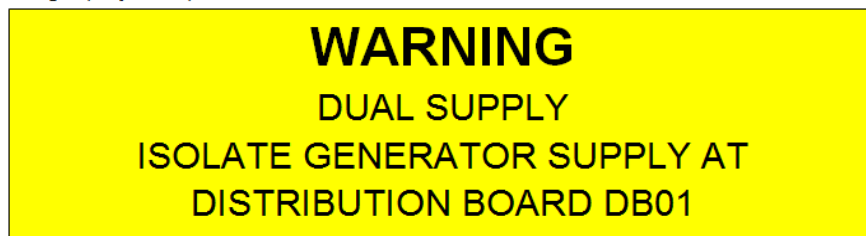
At the point of isolation between the generator and NWL's network a warning tag as shown below shall be fixed to the structure.



An example sign (in yellow) on the switchboard to which the generator is directly connected:



An example sign (in yellow) on all other switchboards within the installation:



#### 4.6 After Connection

The customer shall provide as-built information including drawings and schematics to NWL following connection of the embedded generation to the network. Within 10 business days, the SSDG owner must provide NWL with copies of the COC, ESC, and ROI.

#### **4.7 Additional Line Charges**

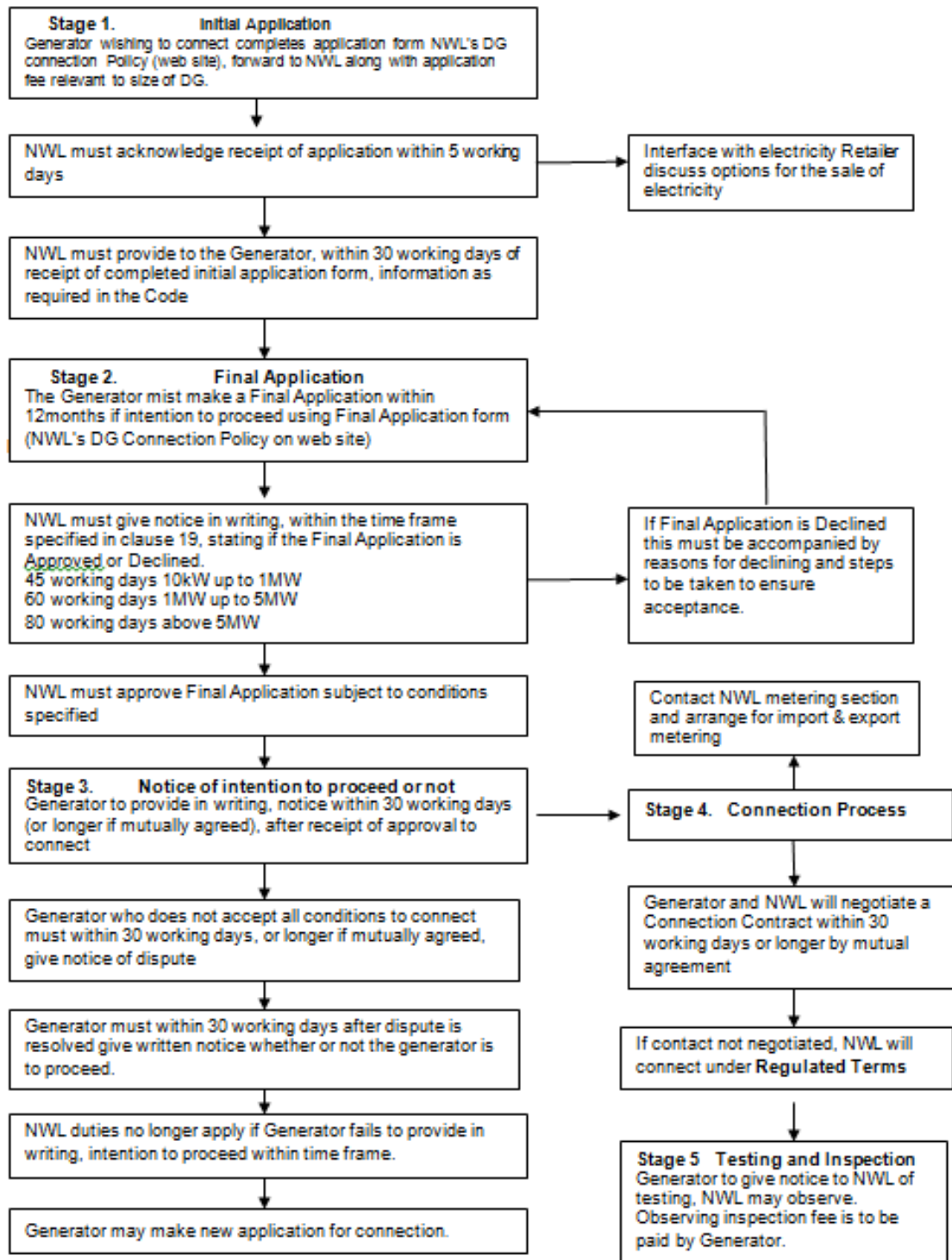
Even though you will be generating and selling your own electricity, you may be required to pay an additional line charge. This will depend on the nature of your installation and the agreement reached regarding payment for additional work required on the network that results from your installation. Any such charges will need to be agreed prior to connection and may either be billed directly to you or via your electricity retailer as an additional line charge.

**APPENDIX A - APPLICATION AND CONNECTION PROCESS**

**Appendix A - Application and Connection Process**

Part 6 of the Electricity Industry Participation Code 2010

Part 2 Process - Flow diagram for large distributed generation greater than 10kW



## APPENDIX B – DISTRIBUTED GENERATION OVER 10KW - COMMISSIONING REPORT (NF05/56)

ICP number (existing Installations only)	
Installed & Tested by:	
Date Test Completed:	
DG Capacity Confirmed on Site (kW)	
Loss of Network Supply auto-isolation test proven:	Yes/No
Auto-isolation disconnection speed: (<2s)	Yes/No
Auto Restart (if existing) delay proved (> 60s):	Yes/No
Under Frequency Disconnection Setting confirmed (<49.5Hz):	Yes/No
Confirm Under Frequency Relay disconnects DG:	Yes/No
Over Speed disconnection process proven (Hydro and Wind):	Yes/No
MEN Earth test result (Ohms)	
Protection Setting details:	
Certification Requirements (COC. Sighted): High Risk PEW (ROI. Sighted): (ESC. Sighted):	Yes/No Yes/No Yes/No
Clear/Durable Notices of DG Prominently posted at Network Connection Point, Switchboard and Meter Box:	Yes/No
Name of Electrical Inspector:	

NWL Network Engineer	
Contact Number	

Other tests requested by NWL/ Notes


Report completed by (name): \_\_\_\_\_

Contact phone number: \_\_\_\_\_

Completed report including COC, ESC and ROI shall be forwarded to NWL, PO Box 147, Oamaru, 9444 or, facsimile 03 434 8845. Email: [service@networkwaitaki.co.nz](mailto:service@networkwaitaki.co.nz)