CONNECTION AND OPERATION
DISTRIBUTED GENERATION
UP TO 10kW CAPACITY

Documentation Revision Control:

Document Revision	Description of Change	Date
Version 001	**Initial Standard document**	**18 May 2012**
Version 002	Updated to align with updated DG Policy section 6.	**20 April 2015**

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Approved For Issue By: Network Manager

1 GENERAL

1.1 Scope

This standard covers the implementation of micro embedded generation.

Micro embedded generation is defined by NWL as being embedded generation under 10kW in both single and three phases.

This standard does not cover standby generators isolated from the network nor any other isolated generation.

1.2 Application

This standard 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's *Connection Agreement for Distributed Generation NI 05/34.*

This standard is intended primarily for Consumers wishing to connect alternative energy generation systems such as solar panels, wind or micro hydro turbines to the NWL network.

Since micro generation is usually derived from an intermittent source (e.g., solar, wind or hydro), the energy is rectified to DC. The DC bus then feeds into a grid-tied inverter which commutates the energy into AC and synchronises it to the utility line frequency.

Most micro embedded generation systems use little or no DC storage (e.g., batteries) as energy is imported or exported as required or available.

1.3 Objective of this Standard

The main objective of this standard is to provide a clear perspective of NWL's protocol for the enquiry, approval, installation and connection of micro embedded generation.

This standard may also serve as an informative document for Consumers wishing to connect micro embedded generation to the network.

1.4 Referenced Documents

AS4777.1-2005 Grid Connection of Energy Systems via Inverters Part 1 Installation requirements

AS4777.2-2005 Grid Connection of Energy Systems via Inverters Part 2 Inverter requirements

AS4777.3-2005 Grid Connection of Energy Systems via Inverters Part 3 Grid Protection requirements

AS/NZS 3000:2007 – Electrical Installations (AS/NZ Wiring Rules)

UL1741 (Underwriters Laboratories Inc.) Standard for safety of Inverters, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources.

IEC61727 (International Electrotechnical Commission) Characteristics of the Utility Interface

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

Electricity Industry Participation Code 2010

Electricity Act 1992

Electricity (Safety) Regulations 2010

NP25/60 NWL Permanent Disconnection Standard

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

NS 05/05 NWL Electricity Network Connection Standard

1.5 Definitions

Certificate Of Compliance (Electrical)	Means a form that provides a statement of compliance with Regulation 39 of the Electricity (Safety) Regulations 2010.
Consumer Customer	This term has the same definition and meaning as defined in the Electricity Act 1992, namely "…*any person who is supplied, or who applies to be supplied, with electricity*."
DG	Distributed Generation. A synonym for Embedded Generation.
Energy Retailer (of Electricity)	Means a person who supplies electricity to another person or persons for any purpose other than for resupply by the other person or persons; and "electricity retailing" has a corresponding meaning.
Embedded Generation	Generation connected to a (NWL) distribution network intended to supply within the local network. The term differentiates from generation which is directly connected to a transmission network intended to supply at a regional or national level.
Grid	For the purposes of this document, NWL's network.
Grid-Tied	Grid-Tied – An embedded generator electrically connected to, and operating in parallel with the network.
ICP	Means a point of connection on a local network or an embedded network which the distributor nominates as the point at which a retailer will be deemed to supply electricity to a consumer.
Inverter	An electronic device intended to convert DC into AC.
Micro Embedded Generation	A generator system connected to NW's LV network not exceeding 10kW, either single or three phase.
Modified Sine-Wave	A lower cost and usually more efficient type of inverter that outputs a trapezoid shape waveform rather than sine wave. This type of inverter causes high harmonic distortion making it unsuitable for connection in parallel with the network.
Net Metering	A system used in some countries where no alterations are made to the Consumer's wiring. The kWh meter is simply run in reverse when generation exceeds the load to offset the Consumer's energy usage. **This practice is illegal in New Zealand**.
Network (The)	Means a collective term commonly used as an abbreviation to mean the whole of the electricity distribution system – i.e., high voltage or low voltage delivery systems. In this document, The Network is taken to mean NWL's network (or NWL's works as defined in the Electricity Act 1992).
RCD	Residual Current Device. A type of circuit breaker that is triggered by 30mA of current flowing back through earth.
Service Main	For the purposes of this standard a Service Main has the meaning as defined in the (now revoked) Electrical Supply Regulations 1984, namely; "…*that portion of an electric line between the distribution line (i.e., the Distributor's supply system) or distribution main as the case may be, and the Consumer's main switchboard and which is used exclusively to supply electricity".*

2 SYSTEM REQUIREMENTS

2.1 Inverters

Inverters used for micro embedded generation differ from those usually available for consumer electronics.

Although low cost inverters intended for use in caravans, motor homes or boats are readily available, they are not suitable for grid-tied generation applications.

Inverters labelled as “grid-tied” and conforming to either AS4777 or UL1741 or IEC61727 shall be used in order for the generation system to meet the performance and protection requirements deemed as necessary to connect to the NWL network.

2.2 Grid Protection Devices

Grid Protection Devices shall be installed to ensure that the inverter is isolated from the network in the event of an outage.

This is an important safety feature preventing the local LV network from being livened at risk to personnel after it has been isolated further upstream. Grid protection devices are usually incorporated into the inverter and must meet either AS4777 Part 3 or UL1741 or IEC61727 specifications for anti-islanding and reconnection.

NWL’s Minimum requirements are:

- Auto-isolate on loss of grid supply within 2 seconds.
- At least 1 method of active anti-islanding protection.
- Reconnection delay of at least 1 minute after normal grid supply is established.
- Settings must be password or lock protected.
- Total Harmonic Distortion less than 5%.
- Inverter power factor must be within 0.8 leading and 0.95 lagging.

2.3 Overvoltage Protection

In addition to the anti-islanding protection specified in section *2.2 Grid Protection Devices*, NWL requires protection against the generation causing excessive voltage at the network point of connection.

In order to safe guard against potential damage to consumer appliances the following requirements are required:-

- Inverter over voltage trip levels shall be set so that the voltage at the network point of connection does not exceed the maximum allowable under the Electricity Industry Participation Code 2010, that is nominal 230 VAC + 6%, or 243.8 volts. Note: a higher limit may be allowed if calculations are provided to NWL on the mains cable volt drop.
- Disconnection shall occur within 2 seconds of this limit being exceeded.
- Reconnection shall not occur until at least 60 seconds has elapsed following disconnection.
- It is strongly recommended that installers investigate the capacity of customer service networks to efficiently transport generated energy to the distribution network. Some installations may suffer degradation over time which results in poor earthing or high loop impedance. These conditions will inhibit the generators ability to export energy, and could lead to inverters tripping on high voltage at a local level.

2.4 Metering

The Energy Retailer may require a new kWh meter to be installed in an existing installation – usually replacing the current import meter.

The meter will measure energy imported and exported to and from the premises separately and must meet Electricity Industry Participation Code, Part 10, requirements for metering. Further information about metering should be obtained from the energy retailer.

The Consumer shall provide NWL (at NWL’s request) interval data and cumulative data recorded by those meters.

2.5 Access

The Consumer shall provide NWL, or a NWL authorised service provider a 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 Consumer to access the site for scheduled works.
- NWL, or a NWL authorised service provider may not interfere with the Consumer's equipment without their express permission. This does not include methods of isolation.
- NWL may require immediate access to the Consumer's equipment in the event of an emergency (i.e., to prevent a breach of safety or damage to property). NWL shall inform the Consumer of the circumstances and events as soon as practicable.

2.6 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 in accordance with the requirements of NWL's Connection Agreement for *Distributed Generation (DG) NI 05/34*.

2.7 Permanent Disconnection

Permanent disconnection of the ICP should comply with the requirements of NWL's *Permanent Disconnection Standard (NP25/60)*.

Permanent disconnection of the embedded generator circuit only shall include: -

- The Consumer informing their Energy Retailer of the disconnection.
- At least one device (circuit breaker, etc) must be removed from the embedded generator circuit to give physical disconnection.
- The remaining circuit, if any, must be "made safe" as per the provisions of AS/NZS 3000: Wiring Rules.
- All signs and labels shall be removed from the Consumer's service fuse (at point of network connection) by NWL or an authorised NWL service provider.

2.8 Signs or Labelling

It is the Consumer's responsibility to ensure that the generating circuit is clearly labelled on the main switchboard and any sub-main switchboards it passes through.

A label shall be placed on the Consumer's service fuse as a reminder to test and prove that the circuit is de-energised before carrying out any work on the Consumer's service main.

Refer to Appendix B for examples of signs and labels.

2.9 UPS Installations

Generation may be used in conjunction with batteries to provide an uninterruptible power supply (UPS) for certain circuits within the premises.

In this instance, no protection device shall interrupt the neutral or earth conductors between the network and the inverter.

This prevents the use of residual current devices (RCD's) between the inverter and the network.

3 THE CONNECTION PROCESS

3.1 Consumer Application for Connection

The Consumer must make an application in writing to NWL about the connection of embedded generation in accordance with the requirements of NWL *Distributed Generation (DG) Policy Standard (NI 05/34).*

The application must include the following information: -

- Location – i.e., the physical address of where the generation is to be installed.
- Power – the maximum AC generation (expressed in amps per phase) that will be injected into NWL's network at the point of connection.
- Type – the type of AC commutation device e.g., electronic inverter, AC induction, synchronous, etc.
- Technical Specifications – including Voltage, frequency etc, Inverters must comply with the requirements of either AS4777.3 or UL1741 or IEC61727 specifications. Other types may have special requirements.
- Schematic diagram distinctly showing the relevant existing circuits and the intended generation.
- The intended time frame for connection.

3.2 Approval of Design

The approval process shall begin once the Consumer has supplied satisfactory information about the intended connection to NWL including relevant drawings and protection details.

3.3 Retailer Contractual Agreement

The Consumer shall achieve an agreement with their Energy Retailer for the export of energy. There will be no additional charges from NWL for the export of energy.

3.4 Inspection & Testing

The final step before achieving the connection is inspection and testing. The Customer must provide adequate notice of this (at least two business days for Part 1A Process) and, (within a reasonable time frame specified by NWL for Part 1 Process) 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, the Customer must provide NWL with a written commissioning report that includes suitable evidence that the metering installation complies with required standards and rules.

3.5 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.

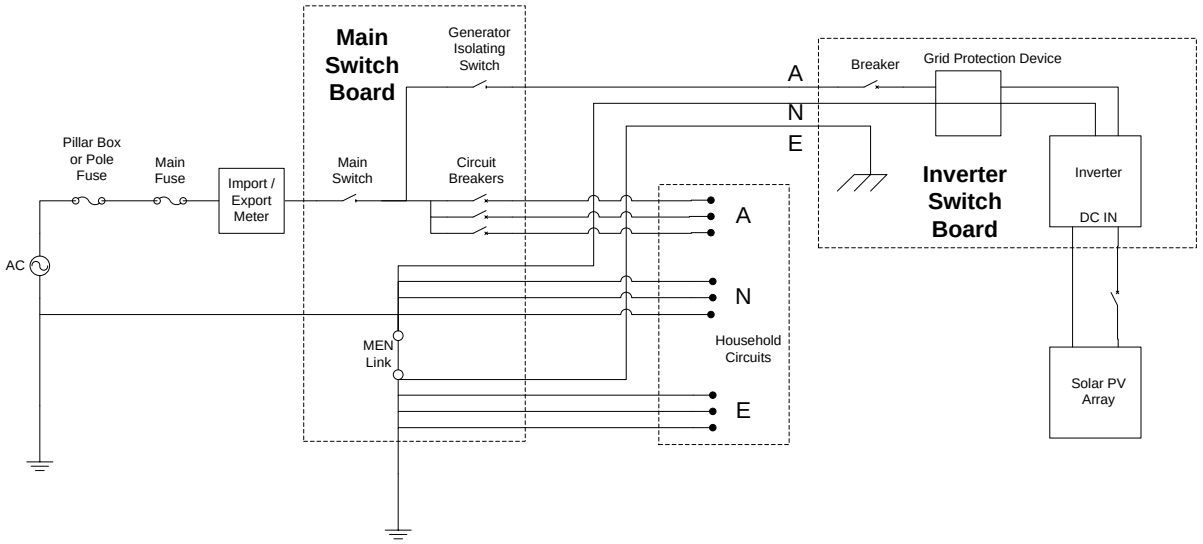
3.6 After Connection

The Consumer 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.

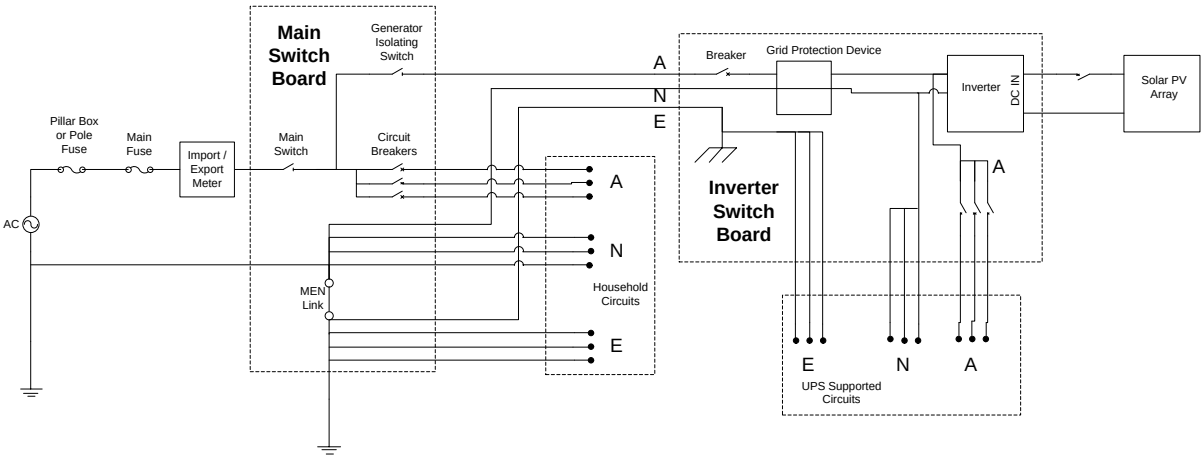
APPENDICES

3.7 Appendix A: Wiring Guidelines

The following diagram shows a typical grid tied solar PV array connected through a domestic site. Wiring topologies may vary considerably. Refer to AS 4777 for more detailed guidelines.



A UPS type system with appliances connected between the inverter and the grid protection device. In a UPS circuit, no residual current devices shall be placed between the point of supply and the inverter. The same is true for any protection device that breaks the Neutral conductor.



Appendix B: Warning Tags for DG Circuits

3.7.1 Switchboard Warning Signs

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

WARNING

DUAL SUPPLY

ISOLATE BOTH NORMAL AND GENERATOR SUPPLIES BEFORE WORKING ON THIS SWITCHBOARD

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

WARNING

DUAL SUPPLY

ISOLATE GENERATOR SUPPLY AT DISTRIBUTION BOARD DB01

Example stickers, on a yellow background, to be placed over the generator isolating switch:

SOLAR SUPPLY

3.7.2 NWL Network Warning Signs

Example tag to be tied to the fuse holder of an underground pillar box or overhead service main connection point.

WARNING

THIS ICP CONTAINS EMBEDDED GENERATION. TEST AND PROVE DE-ENERGISED AFTER ISOLATING.

3.8 Appendix C: Application and Connection Process

Part 6 of the Electricity Industry Participation Code 2010

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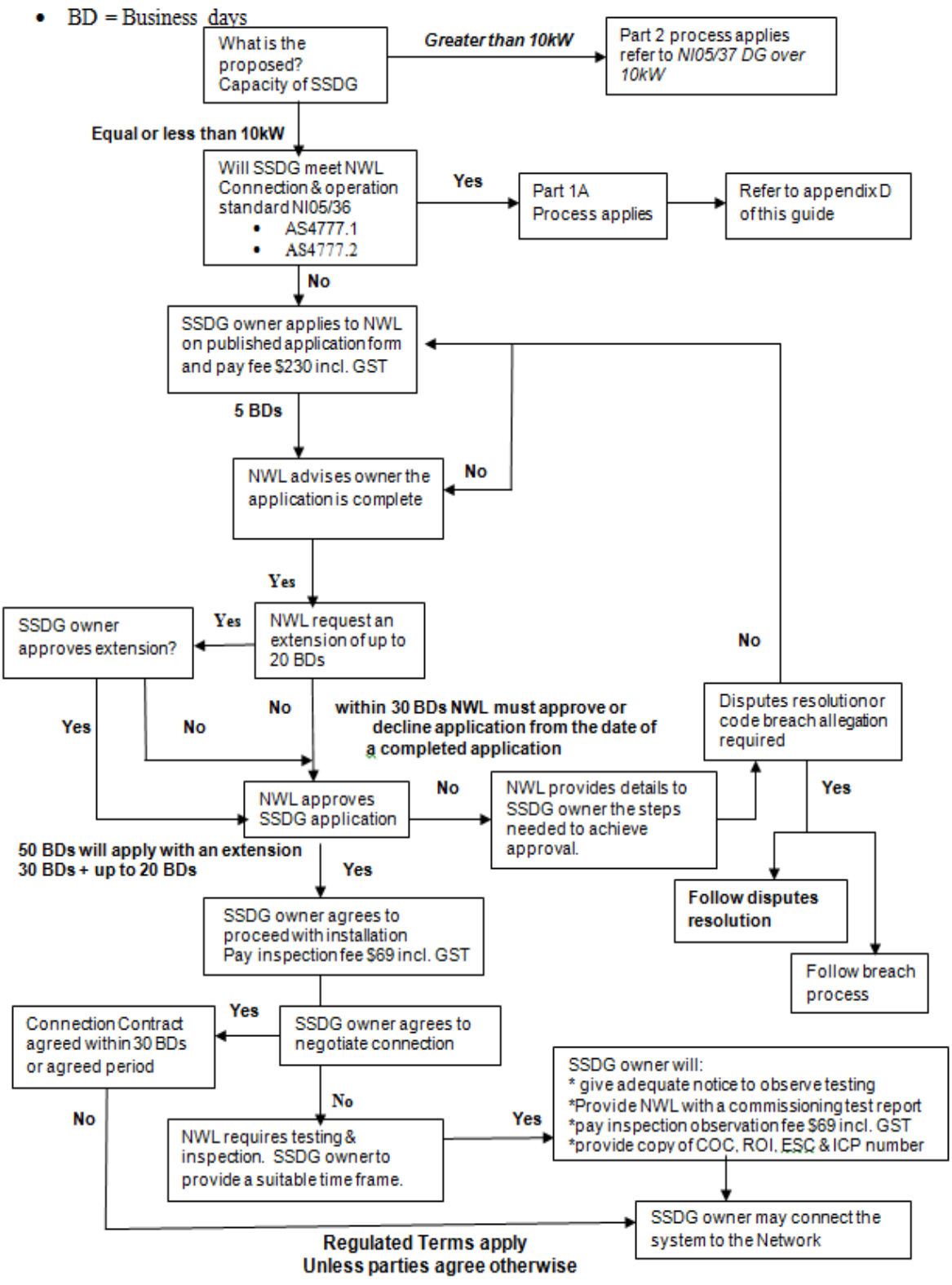
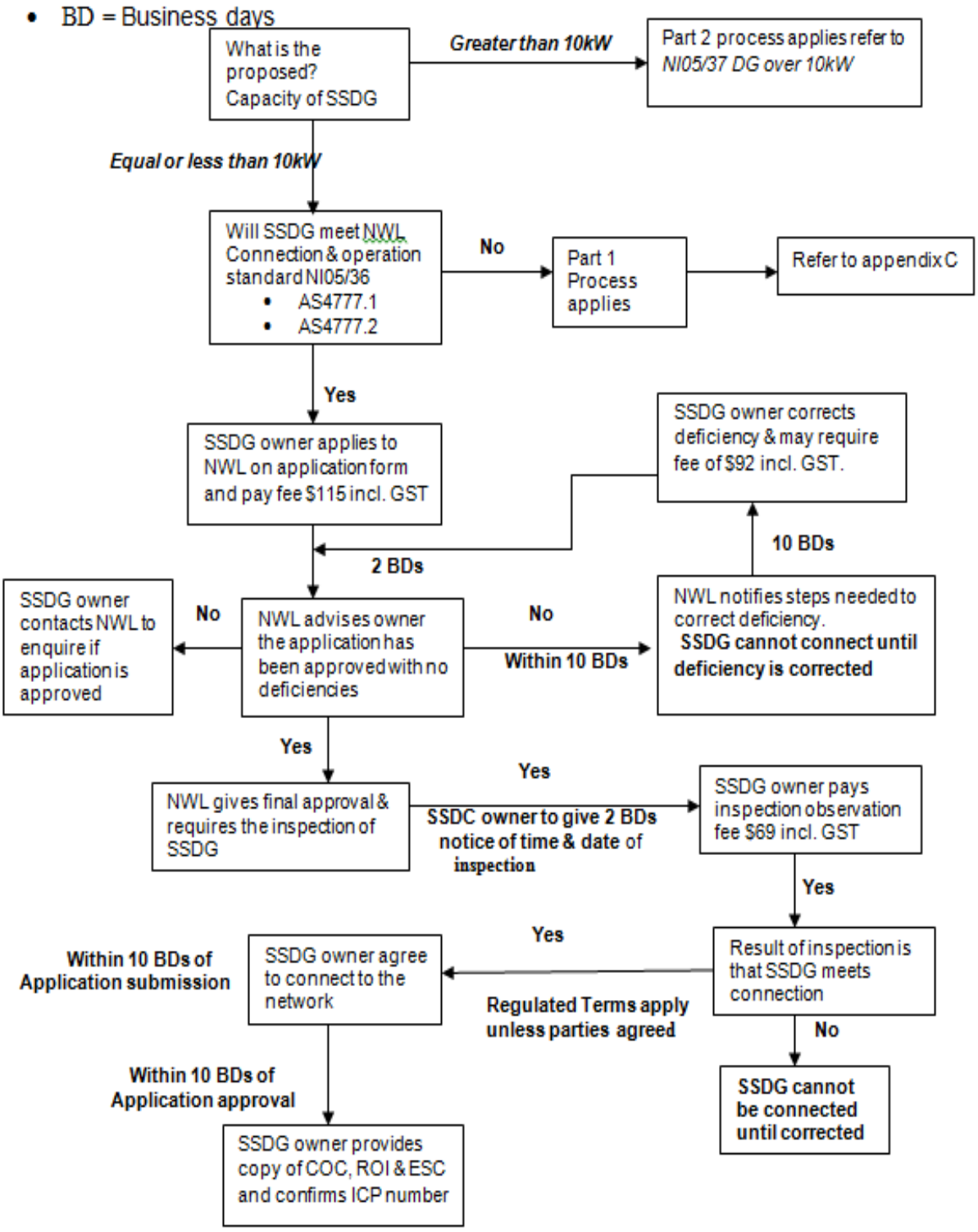
Appendix C. Part 1 Process - Flow diagram for Small Scale distributed generation (Equal to or less than 10 kW total capacity)



4.4 Appendix D Application and Connection Process

Part 6 of the Electricity Industry Participation Code 2010.

Appendix D. Part 1A Process - Flow diagram for Small Scale distributed generation (Equal to or less than 10 kW total capacity)



Appendix E: Connection of Distributed Generation up to 10kW total

3.9 Distributed Generation up to 10kW - Commissioning Report (NF05/58)

ICP Number (for existing installations only)	
Installed & Tested by:	Name and registration number
Date Test Completed:	
DG Capacity Confirmed on Site (kW)	kW
Loss of Network Supply auto-isolation test proven:	Yes/No
Auto-isolation disconnection speed: (<2s)	Yes/No
Auto-restoration after specified delay proven (>60sec)	Yes/No
MEN Earth test result (Ohms)	
Protection setting details attach additional details where necessary.	High Volts = High Frequency = Low Volts = Low Frequency =
Electrical Inspection to AS/NZS3000:2007 and Electricity (Safety) Regulations 2010. Certification Requirements (COC. Sighted): High Risk PEW (ROI. Sighted): (ESC. Sighted):	
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:_____Date_____

The completed report including COC,ESC & ROI shall be forwarded to Network Waitaki PO Box 147, Oamaru, 9444, facsimile 03 434 8845 or Email; service@networkwaitaki.co.nz