

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

<b>1</b>	<b>GENERAL .....</b>	<b>2</b>
1.1	Scope .....	2
1.2	Application .....	2
1.3	Objective Of This Standard .....	2
1.4	Referenced Documents .....	2
1.5	Definitions.....	3
1.6	Risk Identification and Management .....	4
1.7	Copyright .....	4
1.8	Document Owner.....	4
<b>2</b>	<b>SYSTEM REQUIREMENTS .....</b>	<b>5</b>
2.1	Inverters .....	5
2.2	Grid Protection Devices .....	5
2.3	Overvoltage Protection .....	5
2.4	Metering.....	6
2.5	Access .....	6
2.6	Interruptions / Temporary Disconnection from the Network .....	6
2.7	Permanent Disconnection .....	6
2.8	Signs or Labelling .....	7
2.9	UPS Installations .....	7
<b>3</b>	<b>THE CONNECTION PROCESS .....</b>	<b>7</b>
3.1	Consumer Application for Connection.....	7
3.2	Approval of Design.....	8
3.3	Retailer Contractual Agreement.....	8
3.4	Connection .....	8
3.5	After Connection .....	8
<b>4</b>	<b>APPENDICES .....</b>	<b>9</b>
4.1	Appendix A: Wiring Guidelines .....	9
4.2	Appendix B: Warning Tags for DG Circuits.....	10
4.2.1	Switchboard Warning Signs .....	10
4.2.2	Powerco Network Warning Signs.....	10
4.3	Appendix C: Application and Connection Process .....	11
4.4	Appendix D: Connection of Distributed Generation of 10kW or less in total.....	12
4.5	Embedded Generation Plant & Commissioning Report.....	14
<b>4.6</b>	<b>DOCUMENT REVIEW HISTORY:.....</b>	<b>15</b>
<b>5</b>	<b>POWERCO STANDARD - DOCUMENT CHANGE REQUEST .....</b>	<b>16</b>

---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

**1 GENERAL****1.1 Scope**

This standard covers the implementation of micro embedded generation.

Micro embedded generation is defined by Powerco as being embedded generation up to 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 Powerco's electricity network. It should be applied in conjunction with the methodologies outlined in Powerco's *173S003 Distributed Generation Policy*.

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 Powerco 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 Powerco'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)

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

Electricity Industry Participation Code 2010

Electricity Act

Electricity (Safety) Regulations and pursuant Codes of Practice

100R001 Risk Management Charter

170S001 Powerco Permanent Disconnection Standard

170S003 Powerco Distributed Generation (DG) Policy (Refer Powerco website)

393S007 Powerco Electricity Network Connection Standard

---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

**1.5 Definitions**

<b>Certificate Of Compliance (Electrical)</b>	Means a form that provides a statement of compliance with Regulation 39 of the Electricity (Safety) Regulations 2010.
<b>Consumer / Customer</b>	This term has the same definition and meaning as defined in the Electricity Act 1992, namely “... <i>any person who is supplied, or who applies to be supplied, with electricity.</i> ”
<b>DG</b>	Distributed Generation. A synonym for Embedded Generation.
<b>Energy Retailer (of Electricity)</b>	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.
<b>Embedded Generation</b>	Generation connected to a (Powerco) 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.
<b>Grid</b>	For the purposes of this document, Powerco’s network.
<b>Grid-Tied</b>	Grid-Tied – An embedded generator electrically connected to, and operating in parallel with the network.
<b>ICP</b>	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.
<b>Inverter</b>	An electronic device intended to convert DC into AC.
<b>Micro Embedded Generation</b>	A generator system connected to Powerco’s network not exceeding 10kW, either single or three phase.
<b>Modified Sine-Wave</b>	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.
<b>Net Metering</b>	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. <b>This practice is illegal in New Zealand.</b>
<b>Network (The)</b>	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 Powerco’s network (or Powerco’s works as defined in the Electricity Act 1992).
<b>RCD</b>	Residual Current Device. A type of circuit breaker that is triggered by 30mA of current flowing back through earth.
<b>Service Main</b>	For the purposes of this standard a Service Main has the meaning as defined in the (now revoked) Electrical Supply Regulations 1984, namely; “... <i>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.</i> ”

---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

**1.6 Risk Identification and Management**

A systematic method of identifying all risks shall be applied to all design, construction, maintenance and operation activities undertaken on Powerco's networks, generally as required by Powerco's *100R001 Risk Management Charter*. Appropriate risk elimination, mitigation or reduction methods shall be implemented before work commences on any network asset.

**1.7 Copyright**

The copyright of this publication is the property of Powerco Limited. No part of this publication may be reproduced by photocopying or by any other means without the prior written permission of Powerco Limited.

**1.8 Document Owner**

Contact Person: Technical Services Manager

---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

**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 AS4777 shall be used in order for the generation system to meet the performance and protection requirements deemed as necessary to connect to the Powerco 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 AS4777 Part 3 specifications for anti-islanding and reconnection.

Powerco’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*, Powerco 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.
- 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

---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

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 Powerco (at Powerco's request) interval data and cumulative data recorded by those meters.

## 2.5 Access

The Consumer shall provide Powerco, or a Powerco 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 Powerco network.
- Powerco shall make a written request to the Consumer to access the site for scheduled works.
- Powerco, or a Powerco authorised service provider may not interfere with the Consumer's equipment without their express permission. This does not include methods of isolation.
- Powerco 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). Powerco shall inform the Consumer of the circumstances and events as soon as practicable.

## 2.6 Interruptions / Temporary Disconnection from the Network

Powerco 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 Powerco's *393S007 Distributed Generation (DG) Policy*.

## 2.7 Permanent Disconnection

Permanent disconnection of the ICP should comply with the requirements of Powerco's *170S001 Permanent Disconnection Standard*.

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.

---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

- 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 Powerco or an authorised Powerco 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 *4.2 Appendix B: Warning Tags for DG Circuits* 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 Powerco about the connection of embedded generation in accordance with the requirements of Powerco’s *173S003 Distributed Generation (DG) Policy*.

The application must include the following information: -

- Location – i.e., the physical address of where the generation is to be installed.
- Contact details of both the owner and installer of the equipment.
- The invoicing address for the application fee.
- Power – the maximum AC generation (expressed in amps per phase) that will be injected into Powerco’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 AS4777 specifications. Other types may have special requirements.

---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

- 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 Powerco 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.

### **3.4 Connection**

The Consumer must provide a Certificate Of Compliance and a completed commissioning test statement, signed by the registered electrician installing the embedded generation or a licensed inspector, to Powerco, verifying that the installation complies with the requirements of Powerco's *Electricity Network Connection Standard (393S007)* plus all other network requirements and is electrically safe (i.e., the installation fully complies with the requirements of AS/NZS 3000– Wiring Rules). Powerco may then approve the plant for connection to The Network.

### **3.5 After Connection**

The Consumer shall provide as-built information including drawings and schematics to Powerco following connection of the embedded generation to the network.

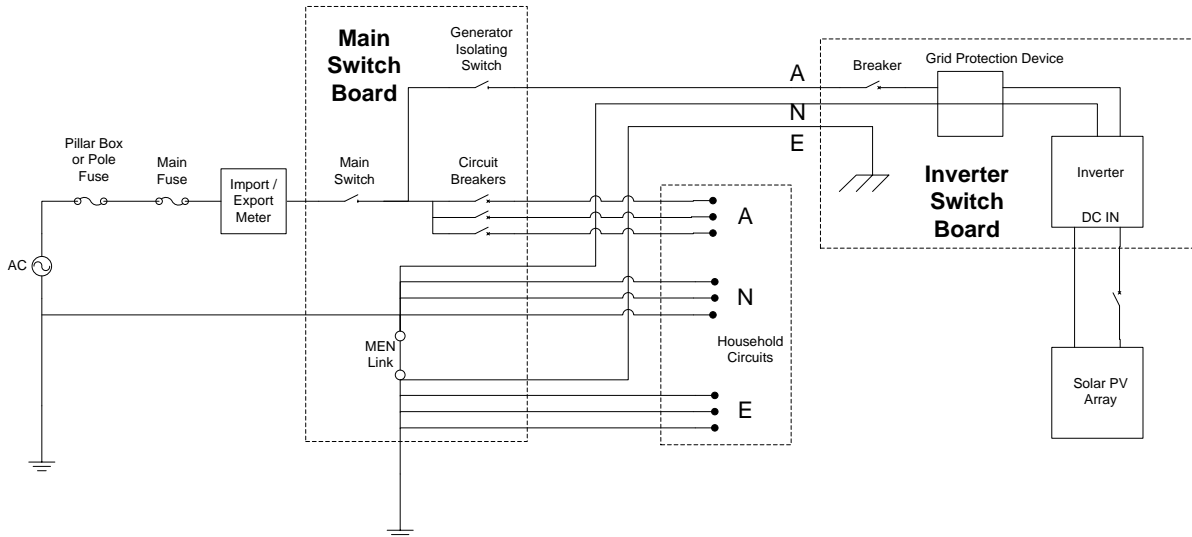


**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

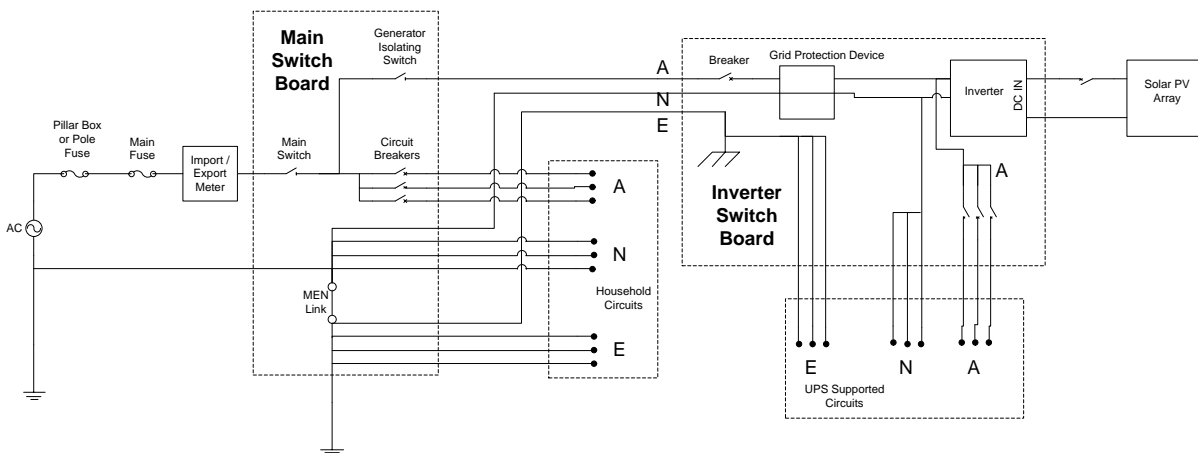
**4 APPENDICES**

**4.1 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. Note the red lines showing the inverter circuit. 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.



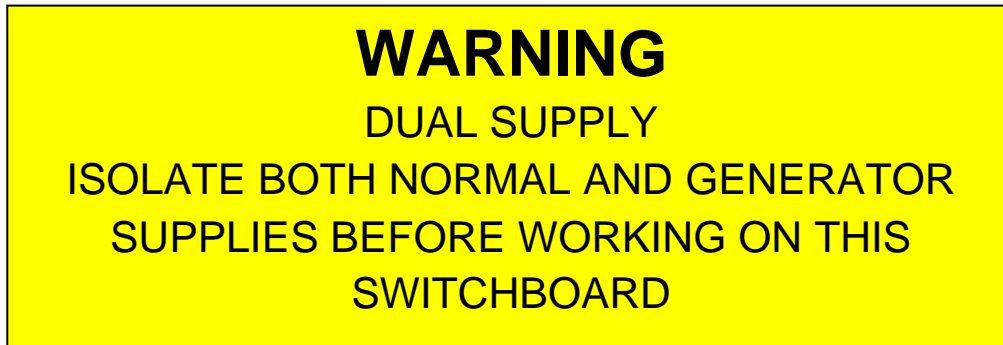
---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

**4.2 Appendix B: Warning Tags for DG Circuits****4.2.1 Switchboard Warning Signs**

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



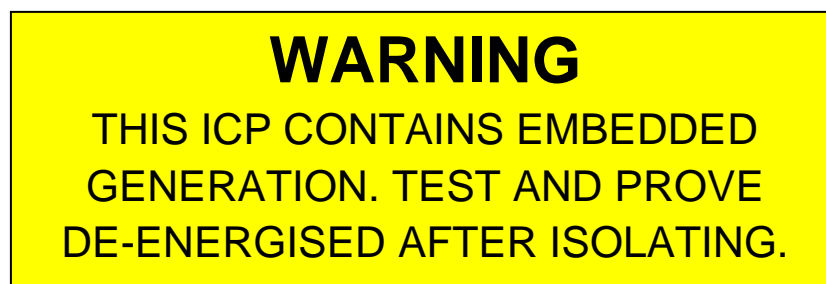
An example sign (in yellow) on all other switchboards within the installation:



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

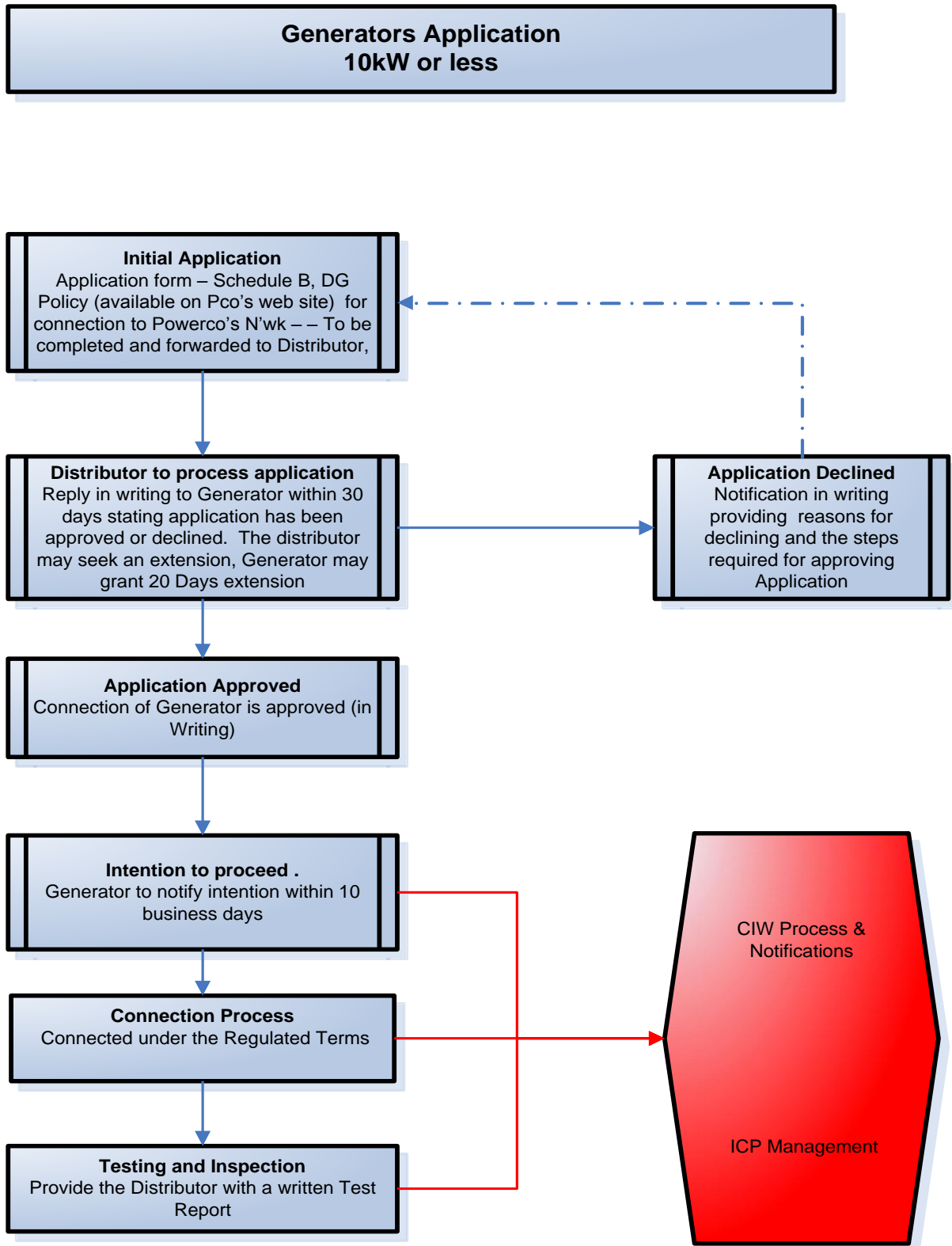
**4.2.2 Powerco Network Warning Signs**

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



**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
 GENERATE - AEN**

**4.3 Appendix C: Application and Connection Process**



**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

**4.4 Appendix D: Connection of Distributed Generation of 10kW or less in total**

**APPLICATION FORM**

Name, address and telephone number of the Customer being the owner and operator of the DG:	
The contact details of the installer, including address, telephone number and email address:	
Application fee invoice address:	
Is this a new installation or capacity increase to existing?	
Generation capacity in kW:	
Type of DG (photovoltaic, wind etc.)	
Proposed connection date:	
Technical specifications of Grid Tie equipment: <ul style="list-style-type: none"> <li>▪ Inverter make and model:</li> <li>▪ Complies with AS/NZS4777.1,2 &amp; 3?</li> <li>▪ The proposed point of connection to the Network e.g., ICP number and street address:</li> <li>▪ Any battery storage?</li> <li>▪ Typical load at the proposed point of connection:</li> <li>▪ Connection voltage – 230V, 415V or other</li> </ul>	
Application under EIPC Part 6	Part 1 or Part 1A (Delete one)
Energy Retailer for load and generation:	

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD**  
**GENERATE - AEN**

**Declaration**

[ \_\_\_\_\_ ], being the applicant for the connection of the DG referred to in this Application to Powerco’s Distribution Network, certify that the above information is true and correct.

**Signed** for/by the applicant:

\_\_\_\_\_

\_\_\_\_\_ [insert name and position]

\_\_\_\_\_ [insert date]

<b>For Powerco Use: Network Approval Confirmation</b>		
Application requirements complete:    Yes/No		
Application approved to progress to installation and testing:    Yes/No		
Signed:		Date:
Network Connection Details		
Zone Substation	Feeder	Distribution Transformer

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

**4.5 Embedded Generation Plant & Commissioning Report**

**EMBEDDED GENERATION - COMMISSIONING REPORT**

Installation tested by:	
Date test completed:	
Loss of network supply auto-isolation test proven	Yes / No
Auto-isolation disconnection speed Sec:	
Auto-restoration if existing after specified delay proven	Yes / No
MEN Earth test results Ohms:	
Protection setting details attach additional details where necessary:	
Electrical inspection to AS/NZS3000:2007 and Electricity (Safety) Regulations 2010 completed	Yes / No
Name of Electrical Inspector:	

**Other tests requested by Powerco to be specified:**


A Certificate of Compliance (COC) from a registered electrician/licensed electrical inspector that the DG complies with the Electricity (Safety) Regulations 2010 should accompany this report.

Completed report including COC shall be forwarded to Powerco Ltd, Private Bag 2061, New Plymouth.

**Report completed by:**

**Name:**

**Address:**

---



---



---



---



---

---

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

---

**4.6 DOCUMENT REVIEW HISTORY:**

Version Number	Reviewed By.	Review Date	Reason
1	S. Hadley-Jones	24/09/07	First issue of document into BMS
2	M. Smith	14/10/08	Inclusion of references to international standards UL1741 and IEC61727 for inverters to enable approval of all compliant equipment. This does not reduce the requirements of this standard. H&S clause replaced. New Environmental and Hazard ID clauses added. Connection to Powerco network to comply with Powerco standard 393S007 requirements. Definitions of (The) Network and ICP redefined. Minimum requirements for grid tied generation connections defined (clause 3.2).
3	M. Smith	17/6/10	Included process diagram for application and connection. Included Plant and Commissioning Report template. Aligned terminology with 393S012 Small Embedded Generation Standard wherever applicable. Deleted H&S clauses (this standard is about setting technical parameters, not work practices outside Powerco network which are covered by other documents).
4	M. Smith	19/04/11	Updated to reflect legislative changes (Electricity Industry Participation Code 2010 and Electricity (Safety) Regulations 2010)
5	M. Smith	11/05/12	Title renamed (previously called "Micro Embedded Generation Standard"). Updated to align with updated DG Policy.
6	G. Vaughan M. Smith	14/ 3/14	Title changed by deleting "Embedded" and adding "Distributed". New added clause 2.3 Overvoltage Protection to prescribe a maximum voltage for back feeding. s4.4 streamlined Application Form. Included reference to application fee mechanism. Added Powerco Network Approval sign off field.
7	M. Smith	09/04/15	Updated application form to meet EIPC Part 6 requirements.

**DISTRIBUTED GENERATION UP TO 10KW CONNECTION STANDARD  
GENERATE - AEN**

**5 POWERCO STANDARD - DOCUMENT CHANGE REQUEST**

**Memo To:**                   **Technical Services Manager.  
Junction Street,  
New Plymouth.**

**Change Details:**  
(Attach separate sheets  
as necessary).

**Paragraphs  
Affected:**

**Priority:**

**Urgent**   
(Within 1 week)

**Routine**   
(Within 12 months)

**Low**   
(Next Review)

<b>Submitted By</b> (Print Name)	<b>Date</b>
----------------------------------	-------------

**Document Change Request - Acknowledgement**

Dear .....

Thank you for your suggestion regarding changes to the above mentioned document.

Your request has been noted and added to our works program. Should we require any additional information regarding your notification then we will be in contact with you.

Thank you for your contribution to improving the quality of Powerco's documentation.

Regards,

.....  
Technical Services Manager

.....  
Date