Metering Safety

GOOD PRACTICE GUIDE

Developed by the Metering Safety Working Group

August 2011

ENA

eea
Electricity Engineers' Association

Foreword

This good practice guide was commissioned as an initiative of the Electricity Industry CEO Forum, the Electricity Networks Association and the Electricity Engineers' Association in 2010. Its goal is to document safety-related good practice in installing, upgrading and maintaining customer metering installations. While it has been developed at a time when there is a significant amount of installation upgrade work progressing, with a widespread rollout of advanced metering technology underway, it has been written to have general application.

The guide has been developed by experienced metering technology and work practice professionals working currently within New Zealand's electricity metering sector. The supporting organisations are:

Advanced Metering Services	ARC Innovations
Contact Energy	Genesis Energy
Meridian Energy	Metrix
Orion	TrustPower
Vircom	WEL Networks

The guide emphasises safety in design and the complementary good work practices that seek to achieve:

- safe electrical installations for the owners and occupiers of premises;
- secure and reliable metering installations that perform to customer expectations over the long term; and
- a safe working environment for electrical workers operating on metering installations and nearby electrical equipment.

While the guide exists within a comprehensive legislative framework that, through the relevant statutes, governs the generation, transport, sale and use of electricity in New Zealand, it uniquely documents good practice relating to the safety of electricity metering installations and is highly recommended for study and adoption by architects, designers, retailers, distributors, metering equipment providers and providers of metering field services.

Disclaimer

This document has been prepared by representatives of the electricity industry to provide guidance on general safety practices for use by the industry. In some instances procedures will need to be developed in order to implement those practices.

This document is recommended as good practice by electricity industry representatives, but is not a substitute for legislative or other regulatory requirements. If there is uncertainty as to what guidelines or legislative requirements apply in any particular situation, specialist advice, including legal advice, should be sought. The electricity industry representatives involved in preparing this document accept no liability or responsibility for any error or omission contained in this document, or any injury, loss, damage (including indirect or consequential loss or damage), or any other claim arising from any reliance on, or failure to rely on, the contents of this document.

This version of the guide has an "interim" status, meaning it has been completed to the satisfaction of the MSWG members. Views and input from any interested party are welcome at any time and should be provided to the Executive Director, Electricity Engineers' Association, contact details see http://www.eea.co.nz or the Chief Executive, Electricity Networks Association, contact details see http://www.electricity.org.nz .

Guideline highlights

This good practice guide contains specific recommendations in the key risk areas that have significantly contributed to actual accidents, incidents and near misses relating to metering installations.

This section highlights these areas and summarises the approach taken by the MSWG in formulating the recommendations found in the body of the guide.

Equipment standards

Practical issues arise over the lifetime of metering installations due to risks that are "designed in" to the installation from the outset. The design choices made in respect of the metering enclosure are important to this. The main areas for attention here are choices made around the:

- **location of the metering enclosure** – an exterior location is required that affords easy access for installation, maintenance and replacement of components and provides adequate clearance from the ground, external obstructions and, if fitted, gas installations.
- **design and manufacture of the metering enclosure** – the enclosed electronic components require a secure, weather and moisture-proof housing, dimensioned to provide uncongested mounting of the initial and reasonably foreseeable components. Specific design features are provided in this guide that should ensure long and trouble-free life of the metering installation and any other electrical fittings jointly housed.
- **suitability of existing installations for upgrade of metering equipment** – the nationwide rollout of advanced metering raises the frequency with which substandard existing metering installations are encountered. A comprehensive pre-upgrade assessment is required to identify high-risk issues. Upgrades are not to proceed until issues are resolved by the owner. Serious hazards that are not remedied by the owner are to be referred to the Energy Safety Service and temporary disconnection of the premises on safety grounds must be considered.

Metering wiring configurations

A variety of approaches have been adopted over time and across regions. The selection of the neutral connection option for meters is critically related to safety outcomes, particularly relating to the possibility of accidental transposition of the phase and neutral connections that would raise a serious hazard for occupants of the premises.

The guide discusses the wiring configuration options commonly encountered in New Zealand metering installations and requires the adoption of the **shunt neutral** configuration, including a requirement to rewire all existing installations to the shunt neutral configuration wherever they are discovered during metering maintenance or replacement work.

The split neutral alternative, preferred in the past by some authorities for its perceived revenue security benefits, is explicitly banned by this guide.

A further requirement relates to the provision of an isolation point on the network side of the metering installation. An isolation point connected in this way provides an immediate method for de-energising an installation, making it safer to work on the metering equipment.

A suitable isolation point must be provided on all new installations and on existing installations being upgraded where the existing isolation point is being removed from its mounting or the mains are being removed from the isolation point terminals. The practice is also strongly recommended wherever it is practical as part of any other electrical work being carried out.

A final item in this area relates to the requirement to provide electrical protection of supply feeds to all load control devices by fitting a suitable breakdown fuse.

Worksite practices

The onsite work practices of metering technicians are strongly linked to safety outcomes for premises occupiers, the general public, the technicians themselves and the fittings that are part of the electrical installation. The guide sets out specific requirements across a range of topics, including:

- preliminary requirements – which are the conditions and activities that precede any work commencing
- work flow – that sets out minimum safety-related work practice requirements
- minimum tests and procedures – to ensure the installation performs as expected after the work is complete and is left safe in all respects
- detailed requirements for making wire/cable terminations – terminations are a common point of failure in electrical installations and improperly made terminations are a potential serious safety hazard
- a set of minimum requirements in respect of auditing.

Accident, incident and customer management

Finally, the guide sets out the requirements of an accident, incident and customer management programme, which all metering practitioners are required to have in place. This ensures that there are explicit processes in place for managing accidents and incidents and that all facets of customer management are undertaken within a planned framework.

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Glossary

CoC	Certificate of Compliance
DoC	Declaration of Conformity
ESR X	Regulation X of the Electricity (Safety) Regulations 2010 (ESRs)
HRC	High Rupturing Capacity
IP Rating	Ingress Protection Rating
MSWG	Metering Safety Working Group
MEN Point	Multiple Earthed Neutral point. The point within an electrical installation where the main incoming neutral is linked to the earth. The MEN System is defined within the Electricity (Safety) Regulations 2010.
P, N, E	Phase, Neutral, Earth. Note that Regulations and Standards may refer to the phase conductor as the active conductor.
PEW	Prescribed electrical work
PPE	Personal protective equipment
PVC	Polyvinyl Chloride
RCD	Residual current device
TPS	Tough Plastic Sheathed
UV	Ultra violet (light)
XLPE	Cross-linked polyethylene

References

Electricity Act 1992
Electricity Industry Act 2010
Health and Safety in Employment Act 1992
Electricity (Safety) Regulations 2010
Electricity Industry Participation Code 2010
AS/NZS 3000:2007 plus Amendment No 1
NZS 6206:1980
The New Zealand Building Code: Clause G9 Electricity
AS/NZS 3100 & 2312
IEC 60664-1:2007

1. Introduction

Background

New Zealand is in the process of a widespread replacement of its electricity revenue meters with both advanced metering systems being installed for all customer types and existing legacy metering being upgraded. This greatly increased level of activity has resulted in a number of safety-related incidents, including minor switchboard fires, phase/neutral transpositions and other safety-related problems. Experience shows that these incidents are not necessarily due to faulty new meters or issues directly relating to the metering installations themselves; a wider set of circumstances typically applies.

Any safety-related incident can have a potentially significant negative impact on customers and on the industry. It is in the best interests of customers and all sectors of the industry to ensure that good practices are consistently applied to the design and installation of metering equipment.

Evolving concerns

There has been considerable change in the ownership of metering assets over the past decade. This has led to evolving concerns over communication among retailers, distributors and metering equipment asset owners over standards and installation practices. While the volume of safety-related incidents has been low relative to the level of activity, the industry is always concerned where the safety of customers, the public and its staff is at stake.

There is evidence of a multi-tiered industry knowledge gap amongst industry participants. Participants need to be better informed of what other parties along the chain are doing and agree how to manage shared interfaces and joint activities to a high standard. Processes need to provide consistency and clarity of approach so that authoritative information can be provided to other parties – for example, from regulatory bodies and to customers. In addition, there are regional differences in network connection requirements; these cause frequent confusion for installation contractors as important disparities exist between local networks, and over the ‘standards’ adopted, the Building Code, AS/NZS 3000:2007 plus Amendment No 1 (the Wiring Rules) and the Electricity (Safety) Regulations 2010 (ESRs).

There are a variety of company and individual risk profiles and assumptions operating within the industry. Contractors tend to focus on short-term risk, to ensure that health and safety incidents do not occur during the job. However, the industry must consider a longer-term risk envelope that encompasses future service providers, occupiers of premises and the wider public. It is possible that practices that have few short-term consequences may lead to significant issues in the longer-term. This relates to areas such as worksite practices, standards and whole-of-life design.

Consequently, there is a need to define responsibilities and requirements for all industry stakeholders and a need to provide a consistent definition as to what constitutes good industry practice as it relates to the design, installation and upgrade of metering installations.

Metering Safety Working Group: Terms of Reference and approach

The electricity industry CEO Forum has become concerned over a number of recent metering incidents. The forum has sought to establish an open information sharing forum comprised of metering specialist personnel and to task this group with establishment of a good practice guide that focuses on safety-related outcomes for customers, the public and metering technicians.

Accordingly, the Metering Safety Working Group (MSWG) has been established, facilitated by the Electricity Networks Association (ENA) and supported by nominated distributors, retailers, metering equipment owners and providers of field services. It has been administered by an independent facilitator who reported to the ENA Board.

What this good practice guide is and isn't

This good practice guide has been developed from contributions from MSWG members. It has significantly benefited from debate and discussion amongst the group at a series of working group meetings held throughout the second half of 2010. In general, a strong consensus has been reached in each of the subject matter areas covered by the guide.

The guide is intended to be a good practice guide covering the installation of meters and associated equipment and the processes associated with the delivery of electricity to a customer's premises. It covers:

- relevant statutes
- equipment standards
- aspects of design
- wiring configurations
- worksite practices
- auditing
- incident and customer management.

Collectively, these topics are treated with the objective of delivering safe and reliable metering installations in both the short and longer terms. The measure of success for the guide is that it becomes widely adopted across the industry, reviewed at appropriate times in the future when new or changed circumstances apply and, ultimately, that, as a result of the application of the guide's recommended practices, there are no new safety-related incidents involving metering installations that could have been avoided or substantially mitigated.

This guide is subordinate to legislative and gazetted industry requirements. It references existing standards rather than proposing new standards. The guide is intended to be adopted by participants as a set of minimum requirements, with individual companies free to apply their own company policies and network agreements that are more rigorous than this guide and that provide additional depth of application detail.

2. Industry roles and relationships

Key industry organisations

This section briefly introduces the industry organisations that play a role in electricity metering.

Retailers

Retailers have the primary relationship with customers for the supply of electricity, which includes metering and billing. For metering, retailers contract with metering equipment providers and field services providers to perform metering related services for their customers. Some retailers have their own metering equipment provider divisions in-house.

Distributors

Distributors own the local distribution networks that carry electricity from the national grid (Transpower) to residential, commercial and industrial end users. Their primary role with respect to metering is to authorise the livening of new connections after the metering installation is completed and certified. Connection practices can vary across different network areas; in some areas, distributors or their agents inspect the completed installation and issue a Certificate of Compliance (CoC) for the new connection. In addition to their primary role, some distributors also own metering assets and customer load control relays.

Metering equipment providers

Metering equipment providers are generally the owners of metering assets and are typically contracted by retailers to manage the provision and maintenance of customer metering installations. They usually also own load control relays and other equipment associated with the metering function. Some metering equipment providers perform additional services for retailers and distributors. Metering equipment providers contract with field service providers to carry out their field work.

Field services providers

Field services providers perform metering-related field work. They are usually an Authorised Test House and are responsible for the installation and certification of metering at sites. They also perform inspections and connections for distributors in some areas. Generally, field services providers contract with metering equipment providers to provide an installation and maintenance service for metering assets.

Electricity Authority

The Electricity Authority (the Authority) is an independent Crown entity responsible for the efficient operation of the New Zealand electricity market. The Authority succeeded the Electricity Commission on 1 November 2010, as one of a number of sector changes introduced under the Electricity Industry Act 2010. The Authority is the primary technical regulator for the electricity industry, being responsible for developing and administering the Electricity Industry

Participation Code 2010 (the Code). Part 10 of the Code, together with its own Codes of Practice, sets out certain obligations on participants in relation to metering standards.

Ministry of Economic Development

The Ministry of Economic Development contributes to Government's goal of growing the economy by improving the quality and reliability of key infrastructure services that support growth. In addition to the Energy and Resources Branch's role in developing and implementing policy for the electricity sector, the Energy Safety Operations team works with industry to promote and, where necessary, enforce high safety and quality standards in electricity networks, installation systems and products.

Energy Safety administers the mandatory reporting requirements around electrical accidents and incidents. These are addressed later in this guide.

Electrical Workers Registration Board

The Electrical Workers Registration Board, established by statute in 1992, is responsible for the on-going competency of registered electrical and electronic workers in New Zealand. It also promotes electrical and electronic safety to the public.

Electricity Engineers' Association

Operating for over 75 years, the Electricity Engineers' Association (EEA) is committed to providing the New Zealand electricity supply industry with leadership, expertise and information on technical, engineering and safety issues affecting the electricity industry.

Electricity and Gas Complaints Commission

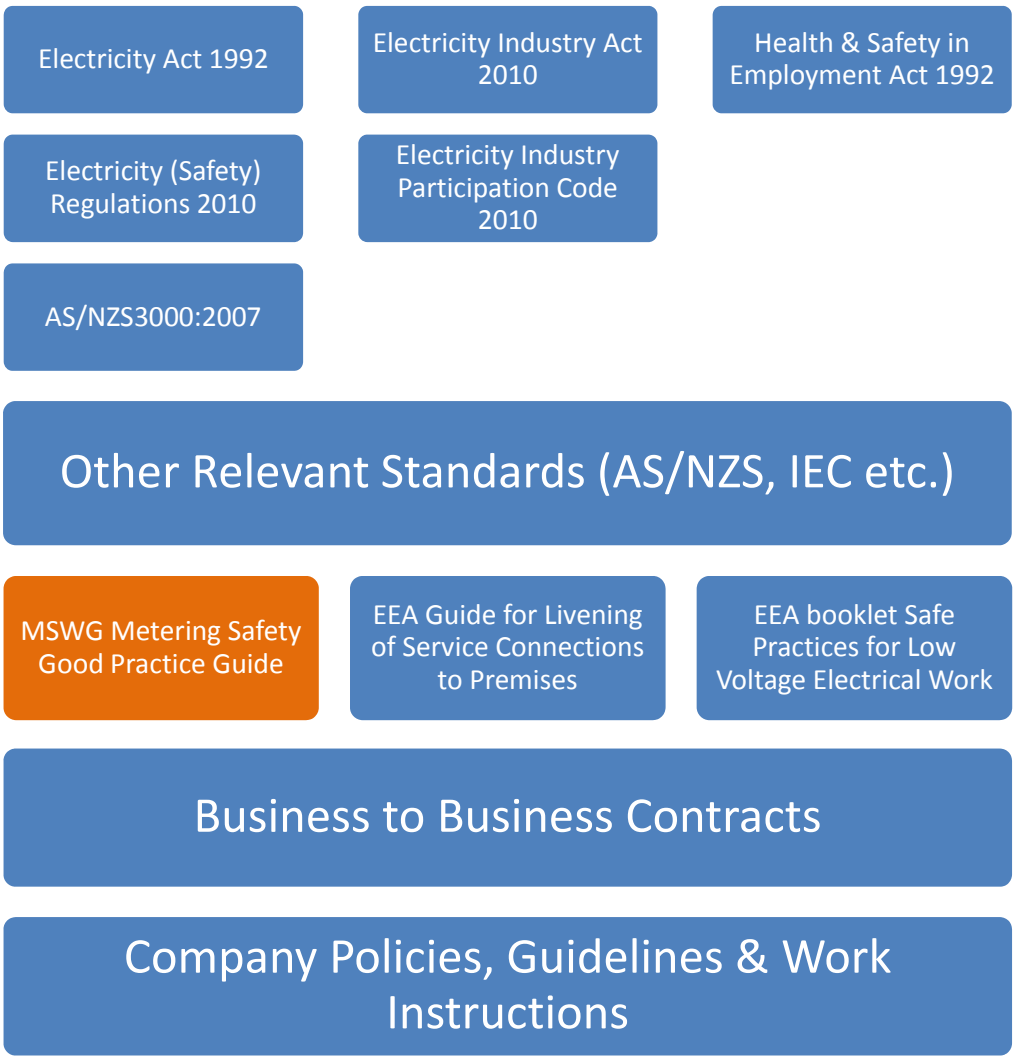
The Electricity and Gas Complaints Commissioner's office provides a free and independent complaint handling service for electricity and gas complaints by consumers.

3. Legislative framework

This section sets out the primary Acts, regulations and codes pertaining to governance of the electricity industry that have particular relevance to the safety of metering installations.

Governance hierarchy

The following diagram depicts the hierarchy of statutes, regulations, standards, guides, contracts and codes that relate to metering safety. It shows where this guide fits within that hierarchy.



Summary of relevant legislation

Electricity (Safety) Regulations 2010

On 1 April 2010, the Electricity Regulations 1997 were replaced by the Electricity (Safety) Regulations 2010 (the ESRs). The ESRs are made under the Electricity Act 1992.

The ESRs introduce several changes from their predecessors, the main one being the recognition of a spectrum of risk in the degree of electrical safety provided. The new approach to risk affects appliances, installations and works (including electricity distribution systems). The requirements of the ESRs apply particularly to electrical workers, appliance importers and retailers, and electricity generators and distributors.

The ESRs must be understood in full by parties carrying out or managing electrical work. Energy Safety has produced a guide to the ESRs available on its website at: http://www.energysafety.govt.nz/upload/76990/Installation_Guide_Electrical_Gas_Final.pdf

Electricity Industry Participation Code 2010

The Electricity Industry Participation Code 2010 (Code) and the Electricity Industry (Enforcement) Regulations 2010 came into effect on 1 November 2010. The Code is largely based on the Electricity Governance Rules 2003, the Electricity Governance (Security of Supply) Regulations 2008 and the Electricity Governance (Connection of Distributed Generation) Regulations 2007.

With respect to metering installations, Part 10 of the new Code, administered and amended by the Electricity Authority, provides for:

- the allocation of responsibility for providing quantification of electricity at points of connection (most commonly provided through a metering installation)
- a requirement that metering installations comply with specified Codes of Practice (CoPs – which require that certain information is affixed to or adjacent to the metering installation), set out as Appendices to Part 10
- the testing and certification of metering equipment and installations for revenue purposes

Part 10 was under review at the time this guide was written with possible amendments targeted for introduction in late 2011.

Health and Safety in Employment Act 1992

The object of the Health and Safety in Employment Act 1992 (HSE Act) is to promote the prevention of harm to all people at work, and others in, or in the vicinity of, places of work. The HSE Act applies to all New Zealand workplaces and places duties on employers, the self-employed, employees, principals and others who are in a position to manage or control hazards.

The emphasis of the HSE Act is on the systematic management of health and safety at work. It requires employers and others to maintain safe working environments and implement sound practice. It recognises that successful health and safety management is best achieved through good faith co-operation in the place of work and, in particular, through the input of those doing the work.

The Department of Labour administers and enforces the HSE Act in most workplaces. The HSE Act was first passed in 1992, but was reviewed and substantially amended in 2002.

4. Equipment standards

Meter board enclosures and mounting panels

This guide details requirements surrounding the environment for installation of domestic meters. It does not replace or change the requirements of any existing standards or rules; any new installations are required to conform to AS/NZS 3000:2007, NZS 6206:1980 (where a hinged panel design is used) and The New Zealand Building Code Clause G9 Electricity.

These requirements apply to domestic electricity meter enclosures and panels installed to house the metering equipment either with or without provision for customer switchboard equipment. The provisions of this document apply to all installations requiring a connection to the network. *There is no requirement for existing installations to be upgraded to comply with this document unless major upgrades or relocations are being under taken.*

The requirements contained within this guide are to be regarded as a description of good practice. Departures from these requirements will not necessarily result in a refusal for electricity supply to be made available, but connection will be dependent on the relevant electricity distributor and retailer being satisfied that the installation meets the required levels of electrical safety, access and space being provided for metering equipment. Compliance with the provisions of this guide will ensure that such requirements are met.

Site suitability for installation

Site location

The meter must be installed in a position that can be easily checked, maintained and replaced. It is acknowledged that there are several options due to site specific requirements and these will be addressed at the time of application.

It is important that all applications or proposals requiring electricity supplies are discussed with the local distributor and/or an electricity retailer prior to the build process to avoid unnecessary delays and frustrations.

The metering enclosure must be installed in an exterior wall of the dwelling or associated garage or other outbuilding. The bottom of the enclosure must be a minimum of 1.2 metres above the finished ground/floor level. If the metering installation is mounted on a main switchboard, the maximum height is set by the requirement in the Wiring Rules that the main switch is not more than 2 metres above the platform of surface on which anyone operating it is standing. If not mounted on a main switchboard, the maximum height is not stated but consideration must be given to the need to easily read the meter registers.

The customer must ensure that access to the metering enclosure is provided and maintained in accordance with the customer’s retail agreement.

No permanent obstructions such as walls, fence, trees or bushes shall be placed in front of, beneath or adjacent to the metering enclosure such that they obstruct, or have the potential to obstruct, clear unrestricted access.

In other circumstances where the premises are located within restricted areas closed off to the general public, arrangements for access for routine maintenance or emergencies shall be made with the electricity retailer and distributor prior to supply being connected.

Notes:

1. These requirements shall apply even if the metering equipment installed in the enclosure is read remotely and does not therefore require regular visits by a meter reader.
2. A further consideration is the need to provide an appropriate separation of gas and telecommunications installations from enclosures and associated wiring systems.

Manufacture

The meter enclosure must provide appropriate protection to allow for the metering equipment to operate within its intended design parameters and also be designed and manufactured so that the design lifetime of the installation is sustained.

The meter enclosure must consist of four sides, a back and a front cover and all corners shall be square or tight rounded. Provision shall be made for locking facilities (but note that where a main switch is fitted, the enclosure itself must not be locked).

The enclosure must be manufactured from aluminium, hot dipped galvanised steel, glass-reinforced plastic or other suitable rigid non-combustible material and, where required, made UV light resistant. The enclosure must be constructed free of burrs and sharp edges.

When closed, the meter enclosure must have an IP rating of not less than IP44 and the enclosure may have a side-hinged or top-hinged door with a viewing panel. The hinges for the door must be of the 'lift-off' type. For top hinge type, a means must be provided to prevent the inadvertent removal of the door.

The door must be provided with a means to retain it in both the open and closed positions, as appropriate. The enclosure may be fitted with a latching device that engages automatically to hold the door firmly closed.

The enclosure must provide close fitting entry/exit apertures at the bottom that afford the protection of cables against abrasion or chaffing. The apertures shall be of a standard size to accommodate proprietary metric cable glands or fittings. Cable access facilities shall be so designed as to enter behind the hinged panel and maintain a minimum compliance with IP44, in accordance with the requirements of AS/NZS 3000, for the full design service life of the enclosure.

The enclosure must be ventilated in a manner that will prevent condensation and thermal build up. This ventilation may be achieved by providing a suitable clearance between the door and the enclosure body. Provision shall be made for draining moisture that might collect within the enclosure.

The meter panel must be constructed of rigid, non-combustible (fire retardant) material and hinged for rear entry terminations. The installation of the panel shall not compromise the IP rating of the enclosure.

Note:

1. Any sealant used for the purpose of sealing apertures shall be of a type that is non-degrading to PVC cables and sheaths and made of a non-combustible material.
2. As an alternative to providing a hinged panel, a standards-compliant system of mounting rails fixed internally to the cabinet rear may be substituted.

Dimensions

The following minimum enclosures sizes (all lengths expressed in mm) apply to enclosures manufactured to NZS 6206:1980:

- Standard residential house – single phase supply L 600 x W 400 x D 280
- Standard residential house – Multiphase supply L 600 x W 600 x D 280
- Meter board panels L 595 x W to fit x D 5

The dimensions of the enclosure shall be sufficient to accommodate the revenue meters, control and communication devices, terminal blocks and earthing and neutral connection equipment, as required.

There must be a minimum clearance of 180 mm in front of the panel to the front door of the enclosure. The minimum clearance behind the panel shall be in accordance with the requirements of AS/NZS 3000 for hinged switchboard panels.

Notes:

1. Any mechanical strengthening used within the enclosure shall not in any way reduce the required minimum internal dimensions.
2. By agreement with the electricity distributor or retailer, the above dimensions may be varied to accommodate the particular requirements of an installation. Where a rail mount system is used, the enclosure depth may be reduced accordingly. Since all the interconnecting wiring is exposed to touch with this enclosure type, interconnecting wiring must be made in single core TPS of the appropriate size so that, together with the use of long terminal covers on meters and load control devices, it is not possible to touch either any live terminals or primary insulation.
3. All dimensions for the enclosure stated have a tolerance of ±5 mm.

Durability (age and degradation)

The meter enclosure shall be designed and constructed in a manner and of materials suitable to provide a design service life of not less than 20 years.

When finished in box form, the meter enclosure shall:

a) be coated on the inside and outside surfaces with a material giving a hard, durable finish providing a design service life of not less than 20 years; or

b) have all welds and worked surfaces painted with a good quality corrosion resistant galvanising paint or other durable finish, providing a service life of not less than 20 years and be manufactured of compatible materials that are not reactive to each other, or isolated from each other, so as to prevent corrosion from occurring.

Where materials other than steel are used, they shall have performance characteristics that comply with the requirements of AS/NZS 3100 and 2312 for conditions of exposure.

Compliance standard marking

Where a compliance standard is claimed by the manufacturer, the meter enclosure shall be clearly and indelibly marked with the name, trademark or other means of identification of the manufacturer or of the responsible vendor, including IP classification, Compliance Standard and Manufacturer's Type references.

Note:

1. Manufacturers making a statement of compliance with AS/NZS 6206 on a product, packaging or promotional material related to that product must ensure that such compliance is capable of being verified.

Cable

All conductors used in the electrical installation must be constructed from annealed stranded copper and be PVC insulated and sheathed where required. Examples of this include TPS, Neutral Screen, XLPE and single PVC insulated conductors (conduit wiring) where installed within conduits or trunking enclosures.

Conductors inside the meter box enclosure shall be PVC insulated throughout up to their final termination point. All joints, for example connector strips or neutral studs, must be fully insulated and not exposed to touch. All cable entry holes, greater than 5 mm diameter, must be sealed to prevent the spread of fire.

Any conductors that may be exposed to touch must be either (a) double insulated or (b) covered and rendered inaccessible without use of a tool. This will require the use of long terminal covers on meters and load control devices (which must not be cut to fit within the available mounting space). Long covers are required in any case to comply with any double insulation certification of the meter or load control device and will also provide compliance with the IEC test finger touch tests of live parts.

Fusing

Protection

Unless otherwise stated by the distributor, the customer's incoming supply cable (Consumer Mains) is only afforded short circuit protection.

Where overload protection is not adequately provided by the distributor's pole/pillar/pit fuse, a device such as a circuit breaker or a High Rupturing Capacity (HRC) fuse link must be installed on the line side of the metering equipment to provide overload protection for the

installation, rated to ensure appropriate protection co-ordination with the distributor's fuse and other current protective devices in the installation (which must also have protective devices co-ordination).

Terminating the service

Unless otherwise approved by the distributor, the incoming supply cable entry to the metering enclosure for a standard installation shall be through the base of the enclosure on the left-hand side as viewed from the open cover. The outgoing cables shall exit through the base of the enclosure on the right-hand side. This may be reversed depending on situation.

This arrangement affords the maximum protection from both water ingress via the supply cable sheath and possible spread of fire originating within the enclosure to the premises. Water ingress via a supply cable exposed to the weather may also be inhibited by arranging an 'upwards hoop' in the cable near the point of connection with the network.

The Consumer Mains shall be terminated at the line side of the circuit breaker or HRC fuse of the installation or on the line side of the isolation point if the enclosure is treated as the main switch board.

The method of mounting equipment shall be such that later reconfiguration of the arrangement to accommodate changed supply arrangements may be readily carried out.

Note: Metering and associated equipment installed, such as communication devices or contactors, shall meet an appropriate standard such as IEC 60664-1:2007 (category 4).

Upgrades to existing installations

For existing installations, consideration must be given to ensure any conductors and equipment in the vicinity of the existing enclosures and boards will either meet the current regulatory requirements or are not electrically unsafe (the ESRs provide that conductors, plant and equipment that were installed to the requirements of earlier regulations and codes may continue to be used provided they are not electrically unsafe). The standards and regulatory requirements that were in place at the time that many enclosures or meter panels were installed may be such as to require hazard and risk assessments to be undertaken prior to any new work being commenced.

The risk assessments shall ensure that any changes or modifications to the existing installation seek, in general, to enhance its safety. This may require replacement of some wiring, installation of additional electrical/fire insulation or agreements with third parties regarding their equipment. In particular, where the primary wiring or insulation is exposed to casual touch, e.g. by the use of short terminal covers on existing meters or load control devices, measures must be taken to remove such exposure, including by the use of long terminal covers and single core TPS.

Any issues raised must have a risk assessment completed – the remedies that eventuate may range from a simple tidy-up of wiring or existing equipment through to more substantial upgrading of the installation. However, any major safety issues that are not easily remedied

must be brought to the customer's attention, including (when known) the likely cost implications that are associated with the work required.

In some circumstances that are considered serious, and where the customer disagrees that the identified site-specific issues warrant such remedies, new work should not be undertaken and the matter referred to the attention of Energy Safety for review. In this case, the customer must be advised that, due to the circumstances involving a serious safety hazard, a disconnection of the supply may result until the issues are remedied. ESR 19 is relevant to this situation.

5. Metering wiring configurations

Neutral configuration

Historically, two methods have been used for connecting the supply neutral to the meter:

a) the main neutral is wired through the meter (referred to as “split neutral”); or

b) the main neutral is wired to the MEN point and a separate neutral wire run from the MEN point to the meter (referred to as “shunt neutral”).

These configuration options are shown in Figure 1 and Figure 2. Note that the phase connections (that would be connected to terminal marked P on the meter) are omitted from the diagrams for simplicity.

Safety Note:

Please note that the diagrams in this guide show a left-to-right P – N – N – P terminal configuration for the meters represented, viewed from the front of the meter. This represents the common physical terminal sequence of most meters deployed in New Zealand.

However, an alternative terminal configuration of P – P – N – N may also be encountered.

Correctly identifying the terminal configuration of every meter during installation is clearly a critical safety concern. Positive identification of terminals should be established in every case and no assumptions should be made based on experience with other meters.

FIGURE 1 - SPLIT NEUTRAL

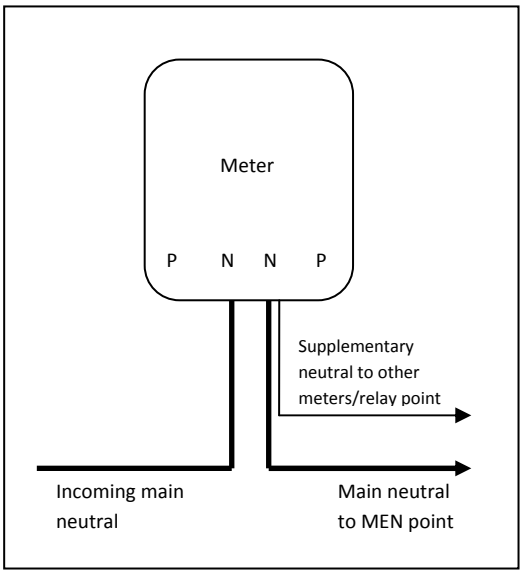
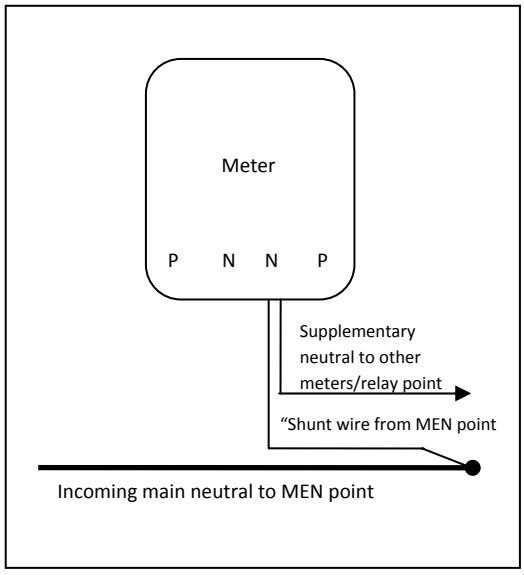


FIGURE 2 - GOOD PRACTICE: SHUNT NEUTRAL



Split neutral connections have been used in almost all network regions at some time and are still used in a few network regions. This configuration was sometimes mandated by the local

electricity distributor as a way of reducing meter tampering (by neutral removal). There are several safety-related concerns with the split neutral configuration option:

- The phase and neutral conductors can become transposed during meter changes. If the earth return path has an insufficiently low resistance for the main fuse or MCB to operate, then this condition will render all earthed metal within the installation alive with respect to an adjacent earthed surface (although at less than full voltage), introducing a dangerous shock hazard throughout the premises.
- Breaking the neutral at the meter introduces two joints in the main neutral at the two terminals. Joints in conductors inherently have a higher resistance than an unbroken conductor – eliminating the joint increases the ability of the neutral to safely carry load and fault currents.
- Having two additional terminations doubles the risk of a loose termination, which can cause subsequent safety hazards from overheating and possible fire.
- Water can enter the mains cable through faulty or deteriorated insulation at the point where the cable is stripped for termination at the pole, or if water enters the mains entry box. This is prevalent where there is no loop in the cable or where insulation tape or other insulation means have deteriorated through exposure to UV and the elements. Gravity (and/or capillary action) forces water out of the cable into the terminals and into the meter itself, possibly leading to a meter failure.

Good practice neutral configuration

This guide requires that the supply neutral shall be configured as a shunt neutral.

The incoming main neutral shall be connected directly to the MEN point without interruption. The shunt neutral running to the meter shall be a minimum 2.5 mm^2 conductor and shall be connected directly to the MEN point. This will usually be achieved by inserting the shunt neutral conductors into the same crimp lug as the main neutral conductors.

Existing installations must be converted to a shunt neutral when the meter is changed. If it is not possible to run the shunt wire to the MEN point (because the MEN point is located on a separate switchboard), then the shunt wire should be terminated in the crimp link used to re-join the main neutral (see Figure 4). The crimp link, or other suitable jointing device, should be installed in accordance with the manufacturer's specifications and strain relief should be provided as required[1].

[1] Wiring Rules clause 3.7.1 refers

FIGURE 3 - SHUNT NEUTRAL METHOD 1

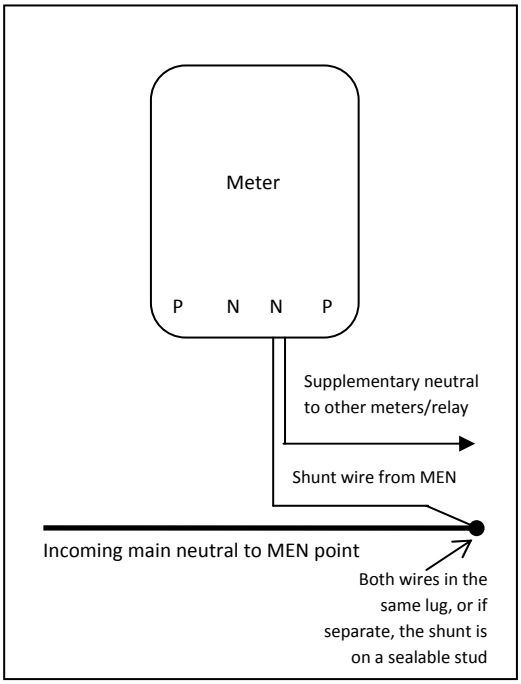
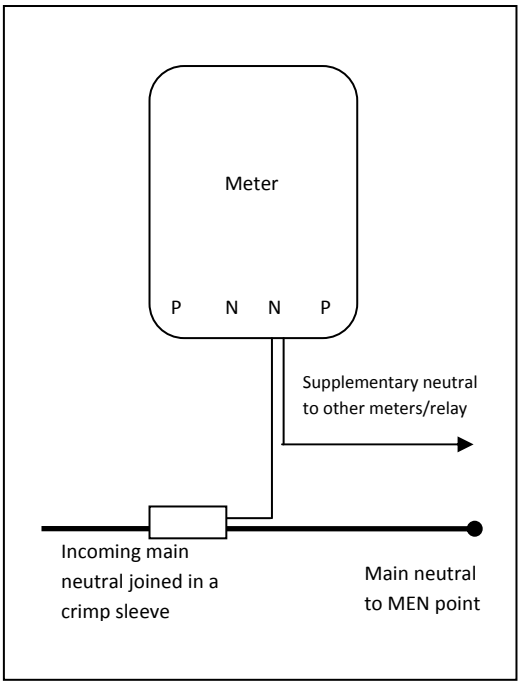


FIGURE 4 - SHUNT NEUTRAL METHOD 2



The safety advantages of eliminating split neutrals greatly outweigh the increased risk of meter tampering.

Isolation point placement

There are two places the installation isolation point can be provided – either electrically 'ahead' of the metering equipment (allowing the isolation point to isolate the metering equipment from the network) or electrically 'after' the metering equipment. Placing the isolation point after the metering means the metering always remains energised unless the property is disconnected at the network connection point.

Isolation point placement has historically been specified by the local electricity distributor and the common practice operating within a network region in 1992 has tended to continue since that time. In some network regions, isolation points were mandated to be placed after the metering as a way of reducing meter tampering (by meter bypass directly into the isolation point).

The Electricity (Safety) Regulations 2010 (and the earlier 1997, 2003, and 2007 versions of the Regulations) classify metering equipment as fittings that are part of the electrical installation. They therefore need to be able to be isolated by an easily accessible isolation point. In addition to this regulatory requirement, there are safety reasons for placing the isolation point electrically on the network side of the metering equipment.

There are two safety-related issues associated with placing the isolation point electrically after the metering equipment:

- The isolation point cannot be used to electrically isolate the metering equipment for maintenance. This means there is a need for the metering technician to coordinate de-energisation with a distributor-approved person. The difficulty of coordinating these two tasks often leads to the metering technician working on the metering whilst it is still energised. Although metering technicians are trained to work on live equipment, there is an increased risk of an electrical accident.
- In the case of an emergency, where the electricity needs to be quickly isolated (especially a fire), the isolation point is unable to isolate the entire electrical installation. This means the customer (or the fire service) must wait until the distributor's faults staff arrives to disconnect supply at the point of connection to the network.

Good practice isolation point placement

The isolation point shall be placed electrically on the network side of the metering installation to enable it to isolate the metering equipment. This practice shall be followed on all new connections and on all switch board and meter board upgrades where the existing isolation point is being removed from its mounting or the mains are being removed from the isolation point terminals. The cover (or fuse carrier, if a fuse is used) must be sealed to deter meter bypass.

It is strongly recommended that this practice is also followed whenever it is practical as part of any electrical work not described above.

Note that the neutral connections (that would be connected to terminal marked N on the meter) are omitted from the following diagrams for simplicity.

FIGURE 5 - METERING NOT ISOLATED

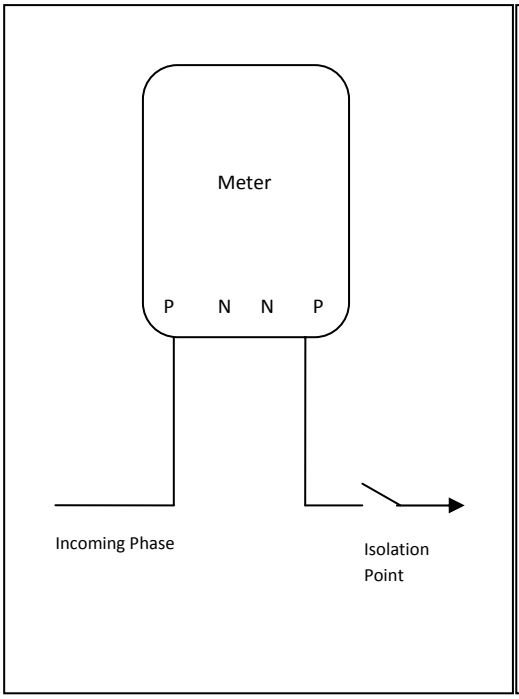
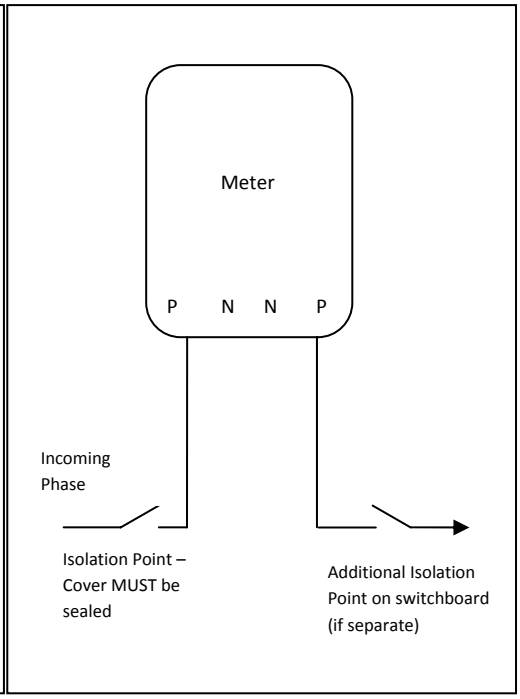


FIGURE 6 - GOOD PRACTICE: METERING ISOLATED



Other recommendations

1. It is recommended that the meter board be made the MEN switch board. This can be done in one of two ways:

   i) Make this board the switch board for the installation and install all circuit breakdown protective devices (RCDs, fuses and circuit breakers) at this point. This usually has the added advantage of reducing overall cost by eliminating one switch board.

   ii) Install a neutral and earth bar (and MEN link) in the meter board and run the earth lead to this board. The outgoing cable from the meter to the next switch board would become a sub-main.

2. As discussed above, good practice is to have a readily accessible isolation point on the network side of the metering installation. An alternative to using a main or master switch is to install another type of isolation device. This could be a fire protection RCD, main fuse or main circuit breaker.

Load control device protection

Many load control devices (such as injected signal relays, pilot relays and time switches) are not protected by a breakdown fuse and thus are only protected by the point of connection fuse, which is commonly rated at 63 amps. This introduces a safety hazard in that an internal relay fault will not clear until current in excess of the fuse rating is drawn or the device is destroyed.

Load control devices must be protected by a breakdown fuse with a suitable rating.

There are many possible variations in wiring load control devices. Good practice is that all supply feeds to the relay signal circuitry shall be protected with a suitable fuse.

FIGURE 7 - NO PROTECTION OF RELAY

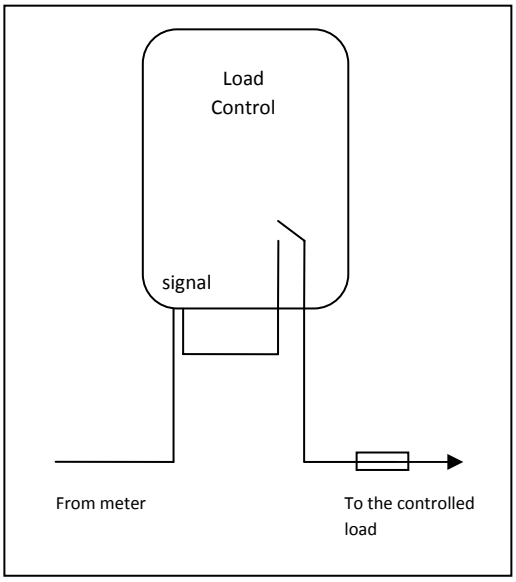


FIGURE 8 - GOOD PRACTICE: METHOD 1

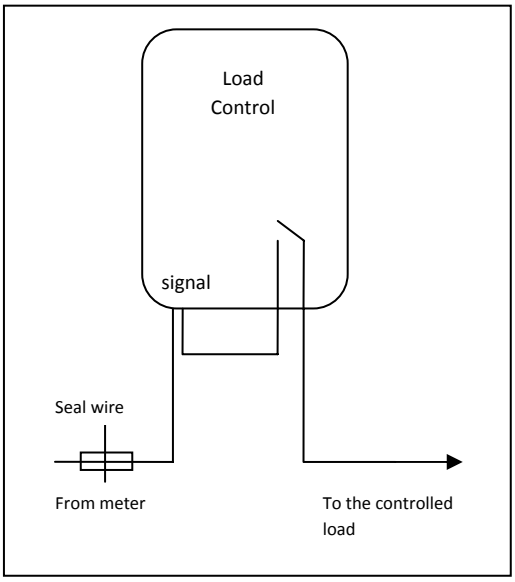


FIGURE 9 - GOOD PRACTICE: METHOD 2

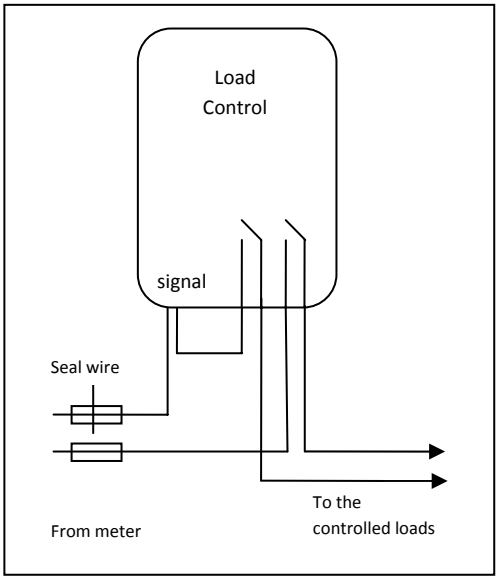
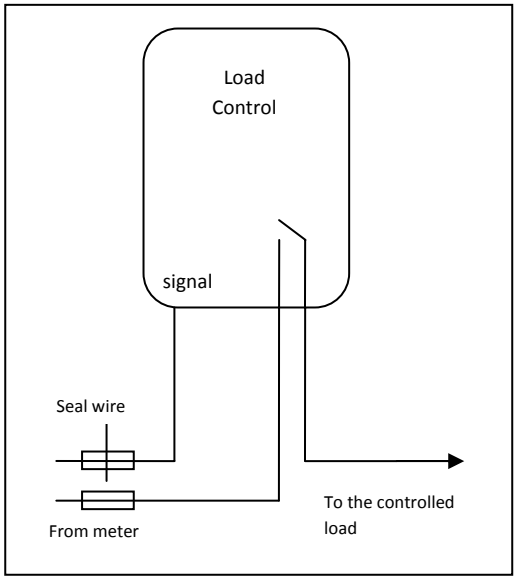


FIGURE 10 - GOOD PRACTICE: METHOD 3



6. Worksite practices

Introduction

This section sets out a series of guidelines relating to worksite practices. The objective is to establish a consistent set of relevant guidelines and to additionally provide (in an appendix) a more detailed worksite instruction as an example of the application of the guidelines. The guidelines are primarily focused on safety outcomes and risk mitigation: safety of the metering technician carrying out the work, of the premises' occupants, of the general public and of the metering equipment that makes up the electrical installation.

Failure to correctly connect a meter can result in the metering technician or the premises occupants being exposed to hazardous voltages. An example of a hazardous situation resulting from incorrect connections is where the exposed conductive parts of an installation become energised when a phase and neutral connection are transposed. In this situation, in a MEN system, the earthed metalwork, such as taps, can become energised. This can cause serious or even fatal injuries.

This guide details, amongst other things, methods to avoid this occurring. The table in Appendix 1 sets outs suggested detailed steps and methods to achieve the objectives.

Guidelines

Preliminary requirements

The following general requirements precede every job:

1. Only metering technicians who have been deemed competent by the relevant Authorised Test House may perform metering equipment alterations, removals and installations.

2. All metering technicians must bring to the work site the appropriate insulated and calibrated tools, fit for the tasks being performed, and be clothed in the personal protective equipment (PPE) that is both appropriate for the work type being performed and that has been checked for conformance.

3. Available site hazard information shall be reviewed prior to accessing the site.

4. Before beginning any activity, the metering technician must first determine that they are at the correct site and have identified the electrical equipment associated with the correct ICP. The metering technician must check the address, ICP number and general asset information on the work instruction against the information observed on site for the property and the metering location.

5. The metering technician must note whether or not it is possible to isolate the electrical installation by means of a mains switch or mains fuse installed upstream of the metering equipment. If on-site isolation is not possible, the options are to either request the distributor to isolate the electrical installation at the network connection point or else to undertake the work with the installation energised. Note that where the live working

option is selected and the neutral is to be worked on, it will not necessarily be continuously connected to the consumer's earth so should also be regarded as being live. During live working, the use of a safety observer, fully competent to carry out any required rescue and resuscitation, is a prudent measure.

6. The metering technician must carry out the customer interaction protocols set down by the relevant retailer, including conforming to relevant codes of behaviour.

Work flow

When the preliminary requirements have been completed, the usual minimum sequence of work for a meter replacement is as follows:

TABLE 1 - WORK FLOW

Step	Tasks	Outcome
1	Perform 'preliminary requirements steps' listed above	Job can move to the next stage
2	Perform a Hazard Assessment. Visually inspect for safety of the property and meter board Ensure the equipment and meter board meet the conditions of the Equipment Standards section of this guide	Hazards and impediments to safe conduct of the work are identified and awareness of all onsite personnel is raised
	Self-assess competence to complete the work	Access support if required or abort / reschedule the work
3	Confirm polarity and load	Correct polarity confirmed
	Remove meter terminal cover	Terminals exposed
4	De-energise the electrical installation, confirm it is de-energised and remove the old meter	Electrical equipment to be worked on is made safe Old meter removed
5	Hang new meter	New meter hung
6	Confirm new meter terminal layout and connect new meter to the installation	Terminals positively identified and correct connections securely made and tested
7	Liven installation and new meter	Premises livened and tested, particularly for correct polarity
8	Commission meter	Meter commissioned

	Post-job safety checks, including checking of the other ends of the meter leads	Meter, affected infrastructure within the general metering environment checked and adjusted/tightened as required
9	Finish site field work	Work site made tidy and secure, all surplus equipment and waste removed from site
	Notify customer of any issues observed	Customer made aware of potential issues so they can initiate follow-up action as needed
10	Complete paperwork, including DoC and CoC as required for the specific work undertaken	Paperwork correctly completed, including the completion of information and declaration stickers required to be left on or adjacent to the metering equipment (ESR 66(3)(e) and Code of Practice 10.3), and requirements forwarded to office

Note:

1. The above high-level workflow is indicative of a meter change only. Metering technicians will at times perform other work types – these should start and finish with similar processes.

A comprehensive sample work instruction based on this work flow is included in Appendix 1 as an example.

Minimum tests and test procedures

The Electricity (Safety) Regulations 2010 contain specific requirements relating to the inspection, testing and certification and of prescribed electrical work. All new electrical installations and any alterations, additions or repairs to electrical installations shall, prior to being placed in service or use, be inspected and tested to ensure that the installation is electrically safe, and that the work done does not reduce the safety of an existing installation. This includes the Customer Service Mains from the point of supply to the main switch of the MEN switch board, the MEN switchboard itself, the Earth Installation and Retailer Metering and associated Equipment.

The Wiring Rules outline the minimum standard of inspection and testing that must be achieved to satisfy the fundamental safety principles set out in that standard. The tests must prove that active (phase), neutral and protective earthing conductors are correctly installed and connected.

The metering technician in carrying out testing after the installation of new or replacement metering equipment should carry out the minimum tests set out below to demonstrate the correctness and safety of the installation. More extensive testing will usually be unnecessary unless the situation dictates otherwise.

1. The inspection of low voltage electrical installations shall be undertaken as far as it is practicable to achieve.
2. The mandatory tests to be carried out on low voltage electrical installations are:
    - i) Continuity of the earthing system – these are individual tests to establish the resistance of the main earthing conductor, protective earthing conductors and bonding conductors
    - ii) Insulation resistance
    - iii) Polarity
    - iv) Correct circuit connections
    - v) Verification of earth loop impedance required for automatic disconnection of supply
    - vi) Operation of RCDs.

Notes:

1. The supply may be temporarily energised to perform some of the tests.
2. Precautions must be taken to ensure the safety of persons and to avoid damage to property.
3. Electricity Engineers' Association Guide for Livening of Service Connections to Premises (November 2010) provides information to assist metering technicians and service providers required to do this.

The minimum steps taken in testing an installation should include proving that the correct electrical potential exists between:

- Phase(s)
- Neutral
- Earthing, bonding conductors or both; and
- A known reference point, such as an 'independent earth'.

Within the test procedure, an indication shall be given as to what the test is proving. The metering technician following the procedure must be able to clearly identify exactly what they are testing for and what the expected results are.

As a minimum, the installation earthing system should not be used for tests to earth unless the insulation between the neutral and earthing system has been proven to be acceptable. A known reference point, such as an 'independent earth' may be used.

Terminations - minimum requirements

The minimum requirements for terminations are as follows:

1. Terminations shall be appropriate for the wiring/cables to be terminated; otherwise proprietary, appropriately-sized crimp ferrules or cable shoes shall be used. If required, they are to be of the type that provides moisture barriers to limit moisture ingress and tracking.
2. Phase and neutral meter terminals must be positively identified in every case, by referring to the terminal labels and terminal identification diagrams incorporated on the meter body. Make no assumptions of the physical sequence of terminals based on experience gained with other meters.
3. Meter terminals must be tightened firmly but not over-tightened. Over-tightening may cause terminal failure. Where the manufacturer specifies the tightening torque for a terminal, a torque wrench must be used to tighten the terminal.
4. Conductors shall be of sufficient diameter to fill the meter or fuse terminals. It is acceptable to use 'doubling' (i.e. bending back the cut tip) of some or all conductor strands to achieve the required diameter.
5. Conductors shall be twisted where pinch-screw terminals are used.
6. Conductors shall not be twisted for clamp type terminals
7. No metallic conductor shall be visible.
8. Aluminium conductors must not be terminated directly into a meter. Only copper conductors shall be terminated directly into a meter.
9. Any joint installed between conductors must be insulated to full working voltage.
10. All alterations to wiring, including the lengthening or replacement of conductors, shall be completed to accepted practices detailed in the Wiring Rules.
11. The minimum conductor size for metering wiring is 2.5 mm^2.
12. When terminating existing wiring, the wiring shall be checked for condition and evidence of any prior issues – e.g. oxidation due to heat or water – and appropriate action taken.
13. All terminal screws shall make firm contact with the conductive surfaces of the conductor. No contact is permitted between the screw and the insulation or other non-conductive surfaces.
14. Where more than one conductor is terminated in a terminal housing, protect any smaller diameter conductors by ensuring they are placed behind the larger diameter conductors. A conductor housing must not be over-filled with conductors; the manufacturer's instructions must be followed in this regard and an appropriate connector block used to mitigate the issue if a larger than normal number of customer load-bearing conductors is present.

15. Where a two-screw termination fixing method is employed for the terminal housing of the meter, the top screw (i.e. the screw closest to the cut end of the cable being terminated) shall be tightened first.

16. Flexible cable must be connected to the terminals using a termination method that has been approved by the manufacturer of the meter.

17. As a further step, the terminals and their conductors must be re-checked for mechanical integrity prior to putting the terminal cover back onto the meter. This check must be performed *after the meter is fixed to the wall*. Any movement of the meter or cables after the cables are secure may cause the terminations to loosen.

18. Finally, the far end of the conductors that have been terminated must be checked to ensure that they remain secure.

Audit

To ensure consistency and quality of work at a site, good practice requires that organisations shall have processes in place to ensure that metering installations are installed and maintained in a safe and compliant manner. These processes collectively form a Quality Assurance Programme for field installation and maintenance work.

Metering installations are typically a frequently accessed area of a customer's electrical installation and require high and consistent standards to ensure that work activity at the site is completed in a safe manner for the customer and metering technician and the site is left in a state that ensures the on-going safety of the site.

Audit programme objectives

A Quality Assurance Programme must ensure that formal reviews are in place to ensure that:

1. **Processes** are followed prior to attending a site and metering technicians review hazards, work instructions and adhere to the customer interaction protocols set down by the relevant retailer;

2. **Processes** are followed at site to ensure that:

    i) installations are completed to a high standard and comply with relevant regulations; and

    ii) instructions and outstanding issues are resolved – this includes a corrective actions process that allows for escalation, peer review and completion within a defined timeline.

3. **Tools** and **equipment** are used to ensure that work is completed in a safe manner. This includes the use of PPE by metering technicians and the appropriate and effective use of authorised tools;

4. **Field work** is of a high standard and meets all regulatory and organisational requirements; and

5. **The site** is safe, particularly from a long-term perspective.

To meet the objectives, a regular programme of audits or reviews must be in place, consisting of or including reviews that assess working practices, compliance and quality.

Audit types

To ensure that the objectives of the Quality Assurance Programme are met it is likely that a number of audit types will need to be implemented. These may include:

1. **Self assessment:** checks and reviews by the metering technician at site to ensure that the installation is safe and compliant.
2. **Working practice:** reviews by an appropriate assessor of work as and when it is being completed to ensure that metering technicians follow procedures and requirements, and to ensure they are working in a safe manner (this is also known as a "live audit").
3. **Post activity:** reviews by an appropriate assessor of work completed by metering technicians to ensure that standards and requirements are met.
4. **Containment audits:** reviews by an appropriate assessor of work following up field incidents or audit results, as appropriate.

Key audit characteristics

Audits or reviews must have the following characteristics so as to ensure maximum effectiveness:

1. **Timely:** reviews and audits must be completed, analysed and corrective action identified in a timely manner so that a metering technician's behaviour can be modified and/or controlled.
2. **Representative:** reviews and audits must be representative in terms of ensuring that samples correspond to the quantity and type of activities performed, and the location and site configuration, e.g. single phase, three phase, inside meter board, outside meter board etc.
3. **Multi-dimensional:** there must be multiple views of metering technicians' work to ensure that safe working practices are used at site, that work completed at site is of the required standard and that the site is left in a safe and compliant manner.
4. **Consistent and transparent:** The review and audit process must be clearly documented and communicated. Auditors must be trained in the relevant processes and standards. Moderation controls must be in place to ensure that there is consistency in outcomes across all auditors.
5. **Monitored:** Audit results must be categorised and monitored to ensure that performance is of the required standard, overall trends are identified and addressed and corrective action is effective.

6. **Actioned:** Non-conformances found must be actioned in a timely and robust manner to ensure that issues do not grow.

7. **Targeted:** The audit processes must ensure that known areas of risk are targeted. The processes and procedures implemented must effectively assess whether or not that risk is evident at site.

A sample audit plan is provided in Appendix 3.

Other recommendation

Expanding on the theme in item 5 above regarding monitoring and trend analysis, the industry might consider mechanisms for sharing safety-related experience and trends across businesses. The MSWG process has brought significant synergies in this respect in the development of this good practice guide document.

7. Accident, incident and customer management

To ensure consistency in the capture, management and resolution of all customer, metering technician and third party service provider events relating to health and safety, good practice requires that organisations shall have processes in place to ensure that accidents and incidents are systematically reported and resolved. These processes collectively form an Accident, Incident and Customer Management Programme for field installation and maintenance work.

An accident is defined as an unplanned event resulting in loss. An incident is an event that, under different circumstances, could have resulted in an accident (i.e. a near miss).

A notifiable electrical accident is one that results in serious injury or death and/or significant damage to property. For example, a notifiable electrical accident may involve an electric shock or a metering enclosure fire. Notifiable electrical accidents are defined in section 16 of the Electricity Act 1992.

Accident, incident and customer management objectives

The outcome required is the implementation of a documented, robust end-to-end process that ensures common sense is applied in the reporting and safe resolution of customer, metering technician and third party service provider health and safety issues, accidents and incidents. The key features required of such processes are as follows:

1. Processes must be followed to ensure an integrated and coordinated approach to the capture, management and resolution of all customer safety issues. This will reduce the likelihood of injury to metering technicians, customers and the general public, of damage or loss of property and it will mitigate the risk of industry reputational damage.

2. All industry participants must have processes in place to manage customer complaints (including where the EGCC becomes involved in complaint resolution), industry regulatory issues and legal issues. It is not the intention of this Accident, Incident and Customer Management Programme to replace existing processes; moreover, these can feed into those processes through the capture of an issue or incident.

3. *All industry participants must fundamentally develop and support a culture centred on safety.* This requires that:

    i) the safety of customers and members of the public at a site where issues of safety have been raised is paramount and, as such, clear safety instructions must be given at first contact with customers and/or members of the public to ensure their safety is not compromised; and

    ii) the safety of metering technicians, whether acting for distributors or retailers is also paramount and, as such, distributors and retailers must instruct appropriately trained and experienced metering technicians not to compromise their own safety when attending sites to resolve or investigate a safety issue.

Incident management process

Table 2 provides process detail relating to the management of incidents.

TABLE 2 - INCIDENT MANAGEMENT - PROCESS DETAIL

Step	Description	Responsible Party	Notes/Examples
	Stage One – Capture		
1	Issue/incident occurs at customer premise		Customer gives notice in a number of ways – directly or through a third party. This could be at the time of the issue/incident or hours/days/weeks/months later
2	Person receiving the information assesses the nature of the issue/incident and ensures that it is placed in the correct resolution process and within prescribed timeframes.	All e.g. Customer Services Representative, Account Managers, Metering Manager, Complaints Manager	If there is any doubt as to appropriate resolution process then the person receiving information must discuss with peers and/or immediate manager and implement appropriate response.
3	Incident Management Process triggered	Person receiving information and/or manager	
	Stage Two – Assessment		
4	Any person receiving information makes an initial assessment based on prescribed categories and definitions.	All	Where there is any doubt as to what the next step is, the decision must be escalated to that person's manager.
5	Confirmation of assessment of incident against defined criteria.	Peer Review or Manager	

6	Depending on seriousness, start incident log for management and reporting purposes	Manager or delegate	
7	May discuss classification and appropriate actions with own manager and yet-to-be assigned Incident Manager	Manager	
	Stage Three – Assignment		
8	Incident assigned to Manager for resolution	Manager	May delegate tasks
9	Record additional information in any compliance management system	Assigned Incident Manager	
	Stage Four – Notification		
10	Depending on seriousness of the incident, notice may have already been communicated informally to various parties throughout the retailer's business. However, this process requires that a "formal notice" is provided to different parties depending on the seriousness of the incident.	Duty Incident Coordinator; Incident Manager	The Duty Incident Coordinator working with the assigned Incident Manager is responsible for this communication
11	Depending on seriousness, record in own reporting systems and activate own internal notification process	Manager	
	Stage Five – Resolution		
12	Resolution starts at time of first contact with the customer. As a general principle, resolution is focused on ensuring the customer's concerns and/or safety are addressed in the shortest time possible. Raise jobs to have contractors and or emergency services attend, as appropriate.	Assigned Incident Manager	Assessment and Assignment stages ensure that the "incident" is placed with the right person and in the right process for resolution.

13	Optionally, second staff to assist and/or engage external experts to provide advice, or to conduct any formal investigation	Assigned Incident Manager	In some cases it may be useful to engage an independent expert to provide a report on what occurred. Engagement of investigation specialists may also be of value where there is a wide variance of opinions as to the cause of the incident or if the incident has raised public awareness (e.g. through media interest).
	Stage Six – Reporting		
14	Provide reporting as required, including mandatory reporting where required by statute. The Incident Manager must provide comprehensive updates as appropriate.	Assigned Incident Manager	Effective reporting and analysis forms the basis of continuous improvement and the identification of recurring issues/trends for corrective action.
	Stage Seven – Closure		
15	Once an issue has been resolved, the issue is reviewed and assessed for lessons to be learned and root cause.	Assigned Incident Manager	Engagement with multiple parties.

Table 3 provides a set of definitions that categorise various incidents by seriousness criteria. This categorisation must be used in incident management and reporting to ensure consistency.

TABLE 3 - PRIORITY DEFINITIONS

Term	Definition	Examples
Priority 1 Incident	An incident that meets one or more of the criteria detailed below:	• Smoke or fire from meter or appliances • Shocks received from appliances /

	• Causes or could have caused death or a serious injury • Immediately or potentially life threatening • Immediate or potential risk of substantial property damage • Required assistance from the emergency services • Substantial risk of negative media coverage.	metal surfaces especially if a recent electrical change made • Cables down on property • Strong smell of Ozone or "burning fish"
Priority 2 Incident	An incident that meets one or more of the criteria detailed below: • Causes or could have caused harm or injury • Requires immediate action • May require multiple actions to be coordinated e.g. detailed follow up of a fault investigation • Immediate or Potential Risk of Property damage • Potential risk of negative media coverage.	• Crackling or arcing sounds from meter • Discoloration to metering equipment or abnormal heat • Noise from meters or other switch board equipment
Priority 3 Incident	An incident that meets one or more of the criteria detailed below: • Causes or could have caused minor injury (e.g. requiring first aid) • Needs more attention than a fault or additional resources to be applied • Recurring pattern of events that may need more investigation • Issue that requires monitoring over a period of time.	• Recurrent light bulb blowing or other signs of a possible power quality issue • Problems with meters after installation / upgrade • Unexplained patterns of events

Mandatory accident and incident reporting

Customers who believe their installation or any appliance within it is dangerous should immediately turn off the appliance or power supply and contact a licensed energy worker. More information on living safely with electricity is available at the Energy Safety website at http://www.energysafety.govt.nz/.

Metering technicians working on a customer installation who identify an immediate, existing danger (that is, where the actual danger to life or property, if not averted, would result in harm to people or property in the immediate future) must report it. In such situations, the metering technician must immediately inform the owner or occupier and take immediate steps to make the scene safe. Only then should they report the situation to their manager, who must ensure that regulatory reporting processes are implemented.

Energy Safety provides an online mechanism to report all accidents and incidents that fall in the above category.

If an accident or incident relates to a staff member of an organisation, the Department of Labour must be notified. Further information is available from http://www.osh.govt.nz/.

Sample incident processes and forms

Sample incident process diagrams and reporting forms are attached as Appendix 4.

Appendix 1 Minimum installation steps

Introduction

This Appendix presents a detailed sample which must be read in conjunction with Section 5 of this guide.

Notes

1. Only those metering technicians who have been deemed competent by the Authorised Test House they are installing under may perform metering equipment alterations, removals and installations.

2. All metering technicians must have the appropriate insulated and calibrated tools that meet the requirements of the tasks being performed.

3. Before beginning any activity, you need to have first determined you are at the correct site and then correct ICP. Check address, ICP, and general asset information on the work instruction to the information you can see in front of you for the property and the metering location.

4. Carry out the customer interaction protocols for the retailer that you are performing the work for.

Special Note: A 'Neon Screwdriver' (test) is a tool/test method that should be used as an 'Indication Only' and shall not be relied on as a means of providing an absolute source of proof.

Table 4 below illustrates the minimum installation objectives (including the minimum tests) required for removal, installation and alteration of metering equipment. Please note that it is not the intention of this guide to describe exactly how each of the minimum tests will be carried out – this is the responsibility of the Authorised Test House (ATH) you are working under. The metering technician should consult with their primary office contact (or the ATH) if ever they are uncertain as to what to do when on site.

Please note that when the load control relay is also being replaced, the minimum electrical tests are required on the load control relay as well.

Appendix 2 outlines acceptable test results.

For clarity: These steps are a minimum requirement. Additional tests or tighter acceptance limits may be outlined by either the ATH or from the experience of a competent metering technician. All results of additional tests should be included in the paperwork associated with the Works Order.

Special Note: A 'Neon Screwdriver' (test) is a tool/test method that should be used as an 'Indication Only' and shall not be relied on as a means of providing an absolute source of proof.

TABLE 4 – MINIMUM INSTALLATION OBJECTIVES

Step	Task	Minimum guidelines	Minimum test required
1	Once you have performed the initial steps detailed in 5.1 to 5.4 of this guide and then perform a Hazard Assessment. Visually inspect for safety of the property and metering board.	Is the site suitable for installation? Any issues with the switchboard, its materials or the fittings on it? Are conductors in a state permitting movement to the next step in the process? Is the earth, neutral and phase accessible for installation and testing? Is it possible to isolate on-site the metering equipment by opening a main switch or withdrawing a main fuse upstream of the equipment? If not, arrange with the distributor to isolate the service line or cable at the appropriate point in the procedure and re-liven it similarly. Note that the remainder of these Objectives presume the work site is isolated and that live work is not undertaken. Is the metering installation the same as described by the Works Order? Ultimately, are there any safety issues associated	Should you find any wiring, fixtures or fittings, or metering equipment in a state that does not meet the '*Equipment Standards'* section of this guide then you are to either remedy the situation (where practical and in accordance with the agreement you are working under) or close the job appropriately and note the issue. Where the issue is of an immediate and real 'HSE' risk, then the supply should either be isolated, remedied or tagged appropriately and the customer informed. Other external parties, such as the retailer and/or distributor may also require notification.

Step	Task	Minimum guidelines	Minimum test required
		with the meter board or the installation?	
2	[Site ready to begin 'service action' being performed?] 'Confirm Polarity and Load' Remove meter terminal cover	Confirm wiring of existing meter installation Take "Before" Photo Perform "before" load tests Record all details of the old metering installation as required by the Works Order.	Visually check the wiring of the meter for polarity. Using a Multi Meter test or similar (trailing earth) tests to confirm the 'before removal' meter conductor polarity. Measure the resistance between neutral and the earthed side of the switch board. Measure the load on the phase, the neutral and the earth using a CT clamp test.
3a	Single phase sites De-energise premises and old meter	Please perform in this order: Remove phase load wire, cap and label. Remove phase line wire, cap and label. Remove neutral load wire, cap and label. Remove neutral line wire, cap and label. Remove old meter	Why you need to do this: Capping: for safety Labelling: Conductor colouring issues and the movement of conductors once removed from the meter, mean that it is good practice to do this so that you do not make a mistake when it comes to reinserting them into the new meter or relay.
3b	Multiphase sites De-energise premise and old meter	Please perform in this order: Label conductors to identify correct phases Remove load side conductors cap each one as they are removed.	Why you need to do this: Same as in 3a above; but in this case it is even more important due to the increased voltages here and the extra potential for making a mistake. Safety issues

Step	Task	Minimum guidelines	Minimum test required
		Remove line side conductors cap each one as they are removed Remove neutral(s) cap each one as they are removed	and equipment damage can result.
3c	CT sites De-energise old meter	Please perform in this order: Using the test block de-energise the old meter. Avoid open circuiting CT circuits as hazardous voltages may be present. Clearly identify and label each conductor to aid in reconnection of new meter. Ensure test block is of correct type to meet Code of Practice 10.3 requirements.	
4	Hang new meter	Install new meter in place of the old meter. The meter needs to be installed vertically and in a professional tradesman like manner.	
5a	Single phase sites Connect new meter to the installation	Please perform in this order Connect neutral load wire Connect neutral line wire Connect phase load wire Connect phase line wire	Visual check for polarity – confirm labels Continuity test on phase through meter

Step	Task	Minimum guidelines	Minimum test required
		Check screws are fully tight (including on the neutral and earth bars)	
5b	Multiphase sites Connect new meter to the installation	Please perform in this order Connect neutral load wire Connect neutral line wire Connect phase load wires Connect phase line wires Check screws are fully tight (including on the neutral and earth bars)	Visual check to ensure that neutrals are connected Check with ohm meter to ensure neutral is continuous Visual check to ensure wires are in same phase sequence as per previous.
5c	CT sites Connect new meter to the installation	Please perform in this order Using the labels that identify each conductor Connect neutral(s) Connect red phase CT circuits Connect yellow phase CT circuits Connect blue phase CT circuits Connect red phase voltage circuits Connect yellow phase Voltage circuits Connect blue phase Voltage circuits	Visual check to ensure that neutrals are connected Check with ohm meter to ensure neutral is continuous Visual check to ensure wires are in same phase sequence as per previous. Visual check to ensure that there are no open circuit CTs

Step	Task	Minimum guidelines	Minimum test required
		Check screws are fully tight (including on the neutral and earth bars)	
6ab	Single and multiphase sites Liven installation and new meter	Liven installation to undertake electrical tests Take photo of installation with terminal cover removed	Measure the voltage between phase and neutral, phase and earth and neutral and earth. (Initial check with the Multi Meter test. Follow-up with digital multi-meter using independent earth (trailing earth test).) Measure the resistance of the neutral terminal of the meter to the earthed metal box. Confirm that the main switch is connected to the phase conductor using the trailing earth method in both “ON” and “OFF” position Measure the load on the phase, the neutral and the earth using a CT clamp test. Confirm at a power socket, where possible, that the phase and neutral are connected correctly.
6c	CT Sites Liven new meter	Liven new meter, using test block, for undertaking electrical tests Take photo of installation with terminal cover removed	Perform phase sequence tests Test CT polarity Test voltage and current sequence

Step	Task	Minimum guidelines	Minimum test required
			Test power flow Check neutral continuity
7ab	Commission meter	As per test house requirements Check screw tightness on meter and all attached ancillary equipment using the tug test (as a minimum)	Tests as required by Test House procedures
7c	CT sites	Perform site in situ tests	Tests as required by test house procedures
8	Finish site field work	Replace meter terminal cover and seal as required Take final photo Check tamper flags on Advanced Meters are clear (E5, E12) (if appropriate) Tidy work site & remove surplus equipment & materials Complete retailer door step protocols	
9	Complete paperwork	Complete paperwork for site Send photos	

Special note re relays:

The same tests must be performed for relays. It is important to note when you first arrive:

- The powered state of the relay. Many jobs have left people without hot water or heating because the metering technician failed to ensure that the relay was still energised prior to leaving the site.
- The position of the switches inside the relay. Ensure that when you leave they are in the same position.
- Load wires being controlled are replaced into the same terminals as they were in before your work started.
- The relay installed (should that have occurred) is for the correct frequency, area and programme and is in all other respects appropriate to meet the current (or new) requirements for the installation.

Appendix 2 Acceptable results from electrical tests

This Appendix provides a sample table that details the minimum acceptable results that may be obtained from electrical tests.

TABLE 5 – ACCEPTABLE TEST RESULTS

Step	Test	Minimum acceptable result
5	Visual check for polarity – confirm labels	Confirm that connections into new meter match the labels on the associated wires.
	Continuity test on neutral through meter (only where a shunt neutral design is not able to be implemented at the time of the metering installation work)	Neutral connections are continuous
	Continuity test on phase through meter	Phase connections are continuous
2,6	Perform a Multi Meter test	Ensure that there is: – no voltage on the earth connection – voltage on the phase connection – no voltage on the neutral All voltage measurements should be made with respect to an independent earth.
	Measure the resistance of the neutral terminal of the meter to the earthed metal box	The specific requirement for the neutral terminal to the earthed metal box is 3 Ω or less
	Confirm that the main switch is connected to the phase conductor using the trailing earth method in both “ON” and “OFF” position	Switch “ON” – voltage present Switch “OFF” – no voltage present

Step	Test	Minimum acceptable result
	Measure the load on the line side phase conductor, the line side neutral conductor and the earth conductor using a Current clamp-meter test.	Ideally there should be no discrepancy between the load on the Neutral conductor and the Phase conductor. For the test to pass the discrepancy must be less than 3 Amps and or the discrepancy current less than 5% of the current in the phase conductor

Appendix 3 Audit

This Appendix provides a sample audit plan that defines the detailed steps and processes required as part of a quality management system (QMS). This is provided as a sample only and is particularly relevant to advanced metering installations.

Objective

To outline and define the required elements of a Quality Assurance Programme for field installation and repair work as part of advanced metering platform deployment and operation.

Due to the high load currents carried, metering installations require the highest standards of quality and the objective of a Quality Assurance Programme is to ensure that all sites are installed in a safe and compliant manner ensuring the safety of the metering technician completing the work and those using the site in the future.

An advanced metering provider is often reliant on the field work done by one or more field services providers. Each field services provider may have sub-contracted the work to one or more subcontractors. This can result in a wide range of work practices and standards and the functionality, accuracy and safety of the metering installation may be impacted.

An effective and timely audit programme is required to ensure that field practices conform to the relevant standards. The results of the audits should identify root causes and feed corrective actions into staff training and revised field processes to foster continuous improvement.

TABLE 6 - RISKS AND ISSUES ANALYSIS

Risk	Effect	Mitigated by
Timeliness	If there is an appreciable delay between the completion of initial work, the audit and the implementation of corrective actions for issues discovered, any poor work practice will likely have been repeated at a number of additional sites.	Ensure that audits are scheduled and completed as soon as possible after the work is completed, preferably on a regular (1 or 2 week cycle). In addition, ensure that audits are scheduled to review the actual working practices of the metering technician. This is especially important when metering technicians are newly appointed to ensure that all processes and procedures are being followed. Feed results back as soon as possible after the audit to ensure metering technicians / service providers change behaviour where necessary. Confirm that corrective actions are put in place with clear timeframes set as appropriate to the issue discovered.
Auditor Bias	Different auditors may check to different standards. This is exacerbated when there are different work standards between service providers.	Have a clearly defined and documented audit process, with clear tests and pass / fail criteria. Review individual results to ensure consistency and address any differences in standards with the auditor involved. Compare audits and failure rates from different sources and investigate any discrepancies.

Effectiveness	Audits do not bring about any change in practices or behaviour.	Agree processes for reporting and investigating failures. Agree processes for identifying and implementing corrective actions agreed between service providers and metering providers with clear process for resolving disputes. Implement a collaborative approach to problem solving and continuous improvement of processes. Ensure appropriate corrective actions are in place at any or all of individual, service provider, project or product levels.

Sample selection	Sampling practices are not effective and samples are not managed – for example, some audits have been observed to all take place along one street to save travelling time, or all auditing is of outside infrastructure to avoid access issues. This introduces sampling bias and carries the risk that some types of problems can remain undiscovered until they become widespread issues.	Apply sampling regimes with minimum thresholds. Audits must be representative of the amount of work that is being completed by individual metering technicians. Where smaller numbers are completed, minimum thresholds should be applied to ensure issues are identified in a timely manner. Apply a statistically robust random selection of sites to audit. Define selection processes, taking account of infrastructure type, volume of work at an individual level etc. Minimum thresholds must be applied to ensure that metering technicians are following processes and procedures correctly. New metering technicians must be audited on an agreed percentage of sites that is greater than would be required of an experienced and competent metering technician. An authorised Test House person shall sign off when that metering technician has reached an appropriate standard at which time they can be placed onto the normal 'auditing percentage'. This principle also applies for metering technicians who have been involved in an incident that was of a nature such as to warrant closer monitoring.
Termination practices	The area that carries the greatest risk and causes the most problems is termination methods. This is difficult or impossible to detect in a non-invasive audit.	Assign a portion of audits to be invasive and check how each conductor is terminated. Check that the strands are twisted / untwisted depending on the terminal type, that insulation isn't trapped, that conductors aren't corroded, showing green slime (verdigris) on the conducting surface, or work hardening preventing good contact and other defined tests.

Issues are missed	Audits aren't comprehensive enough and significant issues aren't detected in a timely manner.	Specify a comprehensive set of tests, which inspect the whole of the job with clear pass / fail criteria. Regularly review the specification against audit and field failure results to ensure suitability. Check the customer and network equipment as well as the metering and report major issues to the relevant parties. Monitor results for trends and recurring issues.
Audit induces faults at the site.	The audit may disturb cables or equipment that induces or hastens a failure that otherwise may not have occurred.	Specify a clear audit procedure that includes a check on the terminations one cable back from the equipment being tested. Select and train auditors to an appropriate standard, Auditors should be subject to extra and ongoing training, Working Practice audits to assess work methods and safety, and specific monitoring.
Customer complains about audit	Loss of power or other inconvenience leads to a customer complaint.	Robust lettering process for invasive audits. Clear scripts and procedures for auditors and schedulers. Empower staff able to work with customers to achieve effective audits with minimum disruption.

Audit processes

Audits form the basis of the Quality Assurance Programme as they provide a snapshot of the quality of work completed in the field and the manner in which this work is completed.

TABLE 7 - AUDIT PROCESSES

Type of audit	Performed by	When	Area audited
Self assessment of work	Metering technician / Field Agent	Completion of each job	As per EGR / Test House / Metering Provider requirements
Non-invasive check of installation	Field Service provider	Percentage of each metering technician's work, selected more often (i.e. weekly or fortnightly)	As per site inspection process, remove covers and inspect termination integrity as far as possible without removing cables or interrupting power.
Invasive check of installation	Metering Provider	Smaller percentage of each metering technician's work, possibly selected less often	Power out site, remove terminations and conductors and examine work. Other checks must be completed as per site inspection process.
Working Practices	Trainer / coach	Audit each active metering technician at regular intervals. Site visit to observe and interview the metering technician in action.	Personal Protective Equipment (PPE), Health & Safety, H&S practices, presentation, customer interaction, work methods and standards.
Test House	Test House Agent	As defined by Test House requirements	As defined by Test House requirements
Containment / assessment / remedial audits	Service Provider / Metering provider / Independent Agent	As required	An incident or audit failure may trigger the need to review additional sites which may be impacted with the same issue. A sample would then be selected to assess the extent of the problem. Results would be reviewed to determine if more extensive containment / remedial work is required.

For each type of audit there must be a clearly mapped out array of actions to take for each type of failure.

Scope of Quality Assurance audits

The scope of each type of audit must be clearly defined. The metering installation should be inspected and a general and visual check of the network and customer equipment adjacent to the metering installation must also be performed. Minor issues such as re-terminating or sleeving must be remedied while on site. More major issues must be referred to the relevant parties for their action (distributor, retailer and customer.) Sample checklists are provided later in this guide.

Site inspection process

Clear instructions and tools must be in place to facilitate accurate and consistent recording of the state of each site and action required to remediate if required.

The whole audit process and each check must be clearly document, so that for each item in the checklist the checks required and the conditions which merit a given result (e.g. the pass / fail criteria) are defined.

Photos are an effective way to clearly define the required standard and the conditions that represent a pass or a fail.

This must be done on a check-by-check basis.

Recording of results

An appropriate data capture tool must be provided to the auditor to facilitate consistent capture of results and feedback for further analysis.

To mitigate the risk of an auditor over- or under-reporting, a graduated scale should be used, for example, the results of each check may be reported as pass/fail/advisory. An advisory result would represent a condition that is not materially compliant with a relevant regulation or requirement, but not of sufficient concern to pose an immediate safety risk, although it may become one in future.

Clear instructions must be in place to identify what conditions are reportable to third parties such as the customer, the network or the retailer.

Auditors must capture sufficient evidence of all issues found, to support corrective action in future – for example, photos of the issue that can be shared with the responsible parties.

Sample checklist

An invasive audit should interrupt power and remove terminations to enable robust inspection of termination condition, quality and workmanship of installation. The audit is suggested to cover (but not limited to) the following areas:

- Asset verification of equipment and Code Certification

- Equipment positioning and mounting
- Signs of tamper
- Supply cable, damaged live conductors, moisture ingress
- Cable jointing
- Cable routing, bending radii
- Metering environment integrity
- Main switch condition
- Fuses
- Non-metering equipment condition
- Un-metered / double metered loads
- Earthing at meter box
- Neutral integrity
- Overloading
- Polarity check – in particular, transposition of phase and neutral connections
- Terminations – remove cables from terminations and check for condition, trapped insulation, twisted or untwisted as appropriate to the terminal type, screw tightness and indents into conductor etc.
- Terminations – integrity of terminations that may have been inadvertently affected by the current installation – e.g. cable movement at terminations that are 'one back' from the installed equipment
- Terminations – that the number, size and orientation of the conductors is in conformance to the equipment manufacturer's requirements for terminating into the terminal housing
- Terminations – that screw heads are not broken or overly burred, such that subsequent terminations would be adversely affected over time
- Wiring and ripple control
- Communication equipment
- Meter covers
- General safety
- General workmanship (e.g. tidiness of meter box, left in a state that ensures reliable functioning of the metering equipment and associated wiring over the longer term).

A non-invasive audit would require completion of all of the above items, with the exception of the removal and visual inspection of the conductors at the terminations.

Seals and covers should be removed to enable robust visual inspection of terminal condition and installation workmanship. This cannot be effectively done without cover removal.

Audit exceptions

Only where the auditor believes that undertaking the test is likely to cause a safety issue to them or to the site will a check list item be omitted.

In this case, the auditor must mark the check as “advisory” and provide notes on why the check could not be completed.

Approved remedial actions

The following are examples of simple remedial actions that must be undertaken as a matter of course by the auditor during an audit:

- Re-terminate cables into non-metering affected breakdown and service fuses where required (all metering affected terminations will be removed/inspected/refinished as a matter of course).
- Secure fuses to boards. Ensure that they are appropriately accessible.
- Fix cable routing/bending issues.
- Label switches where the hot water load bypasses the main switch and it is assessed that this was a pre-existing situation. Reconnect correctly where the assessment is that this was introduced.
- Fix client metering fuse issues where noted.
- Fix external holes in meter box with grommets.
- Fix non-conforming joints.

Associated processes

The following processes must be defined. Auditors and support staff must be familiar with them before commencing an audit. Compliance checks must form part of the working practices audit procedures.

Results capture and moderation

There must be a clear and transparent system to log, track and report on audits results, failures and the associated corrective actions.

Results of all auditing must be effectively moderated to ensure consistency of outcome and subsequent action. Any issues found should be documented, categorised and reviewed to ensure consistency.

This is particularly important where large numbers of audits are being undertaken by multiple auditors, for example in a mass deployment scenario. Photo records should be examined, and the reported fault verified to ensure consistency.

Investigation and corrective action process

Issues should be regularly and formally reviewed and appropriate action taken within a defined process.

There must be clear reporting lines between the metering provider, the service provider and the individual metering technician with defined actions on discovery of a failure and regular summary reports. The actions to be taken for different levels of failure must be defined and agreed.

Communications processes

In addition to customer pre-notification/lettering/access processes and on site interaction standards, the programme should define what audit results should be relayed to the relevant parties, how the information should be presented and when the information should be forwarded:

- **Definitions** of what issues are reportable and to whom.
- **Leave behind forms** are left by metering technicians with the customer. The purpose is to inform the customer of any faults or concerns remaining at their installation and any actions required. The service provider and retailer should also be informed to follow up.
- **Procedures** to inform the distributor of any faults noticed with their network equipment.
- **Procedures and guidelines** on when and how to contact Energy Safety to inform them where required for statutory purposes.
- **Clear timelines and systems** in place to return audit results to the field services provider and metering equipment provider as appropriate.

Auditor selection and training processes

An auditor is required to be able to perform the same level of work as a metering technician as well as being competent to identify and record issues comprehensively and consistently. The auditor must have the training and experience to identify faults with work carried out by others. The selection, training and competence requirements for auditors must be clearly defined and include:

- Completion of prior training on the metering platform concerned and a minimum level of field experience
- Be a registered Electrical Inspector with a current practising licence **or**
- Be a registered Electrician with a current practising licence **and** acknowledge their liability under the Electricity Regulations for the safety of any works undertaken.
- Be approved by an authorised Test House to perform relevant metering installation and/or maintenance works
- Completion of any other in-house training in the auditing process and standards required by the field services provider and/or metering equipment provider

- Pass a positive test of their competence to undertake the auditing process required – acknowledging that the skill set required is increased over that of a regular metering technician
- Complete an induction process in the field through accompanied audits and increased frequency working practises audits in the early stages of undertaking auditing work
- Receive ongoing training and assessment via the working practices audit processes
- Adhere to standards regarding work standards and have strong communication skills.

Site safety

It is important to recognise that properly conducted auditing can entail many or all of the same risks as conducting an audit of the original electrical works. As such, a range of standard procedures continue to apply – for example:

Statutory duties

Any audit process is not intended to replace or relieve auditors of their statutory or regulatory duties as registered Electricians. The auditor must also be cognisant of their duty under regulation 19 of the Electricity (Safety) Regulations to report immediate, existing danger to Energy Safety. The following text is taken from the Energy Safety website:

"If you are an energy worker and you believe you have identified an installation where there is an immediate, existing danger (that is, where the actual danger to life or property, if not averted, would result in harm to people or property in the immediate future) then you have a duty to report it.

In such situations, the energy worker should immediately inform the owner or occupier and seek permission to make the scene safe. They should only then contact Energy Safety."

This text and an online reporting form is available at:

http://www.energysafety.govt.nz/templates/PDFForm____22165.aspx

Health and Safety processes

All relevant Health & Safety and hazard management procedures should be documented and provided to field staff. Field staff should ensure they are familiar and follow these procedures in the field. Working Practice Audits should include a review of these procedures to make sure they are understood and appropriately applied.

Isolation

There must be clear procedures and checks for establishing and checking that the site has been isolated prior to commencing an invasive audit. Where isolation is not possible or practical, the auditor must be empowered and trained to decide whether to abandon the audit or to use an appropriate defined live line work procedure.

Site hazards

The audit job issued to the auditor must include notes regarding any previously recorded site hazards (e.g. dogs, previous reports of dangerous infrastructure etc.) and customer notes (e.g. medically dependent or priority supply).

All previously identified hazards, and any other identified or observed hazards, should be noted and managed on site, including but not limited to:

- Tough Rubber Sheath ("TRS") and other aged wiring
- Asbestos switch boards
- Switchgear containing Polychlorinated biphenyls (PCBs)
- Dogs
- Unstable or aggressive customers
- Slippery or unstable footing.

Any new hazards must be reported and site records updated.

Hazard records must be persistent and provided to the next person undertaking work at that site.

On-going site safety

The audit process must be designed and the auditors sufficiently trained and competent such that the audit does not induce or hasten the development of a fault at the site.

In particular, terminals one termination back from the metering equipment should be checked and tightened at the conclusion of the audit to ensure that the disturbance to the cable has not affected the integrity of the termination and introduced the risk of heat damage.

This is a separate activity from checking the integrity of such terminations "as found" at commencement of the audit.

Sample Audit Form

Audit Form – Field Work *(Post Installation)*
Tick all sections applicable and enter comments where suitable

Audit Date | ICP
Address
Location: Inside ◯ Outside ◯ | Site Voltage: Single Phase ◯ Two Phase ◯ Three Phase ◯

Customer Checks
If the customer is present then ask the following questions

Customer on site at the time of the audit?	Yes ◯	No ◯
Were they present at the time of the install?	Yes ◯	No ◯
Did the Agent show their identification?	Yes ◯	No ◯
Was a card left if no one was present?	Yes ◯	No ◯
Any comment made by the customer?	Yes ◯	No ◯

Write customer comments here - continue on separate page if required.

Meter Details
If more than one meter is present please record the details & reads in the notes section.

No: Meter/s Installed | Advanced Meter: Yes ◯ No ◯
Make | Model | Signal Strength
Meter Configuration

Register Reads: Reg 1: | Reg 2: | Reg 3:

Ripple Relay Details
If more than one control device is present please record the details in the notes section.

R/R Installed: Yes ◯ No ◯ | IPR ◯
Enermet ◯ Zellweger ◯ Timeclock ◯

Switch Codes: Switch 1 | Switch 2 | Switch 3

Workmanship Details
Please write additional comments in the notes section or on the rear of this form if required.

Works order instructions followed	Yes ◯	No ◯	All metering equipment fully sealed	Yes ◯	No ◯
Site certification sticker applied	Yes ◯	No ◯	Retailer specific stickers applied	Yes ◯	No ◯
Equipment appropriately & securely mounted	Yes ◯	No ◯	Site left clean	Yes ◯	No ◯
Installation wired correctly	Yes ◯	No ◯	Correct Line / Load polarity	Yes ◯	No ◯
All terminals tight	Yes ◯	No ◯	Terminal screws not burred / broken	Yes ◯	No ◯
Exposed copper present	Yes ◯	No ◯	Correct configuration programmed	Yes ◯	No ◯
Correct ripple relay installed	Yes ◯	No ◯	Ripple LED is pulsing	Yes ◯	No ◯
Standard of workmanship acceptable	Yes ◯	No ◯	Communications provisioning acceptable	Yes ◯	No ◯

Meter Specific Tests

Two element Advanced Meter – Has the additional wire feeding the ripple relay been run?	Yes ◯	No ◯
Three Phase Meters – Are the conductors terminated in the right order?	Yes ◯	No ◯
EDMI Advanced 3 phase meter where (2 Phases are connected) – Are elements 1 & 2 being used? *(Element 3 should not be active)*	Yes ◯	No ◯

Photos Taken: Yes ◯ No ◯ | Commissioning Code | Repairs Made: Yes ◯ No ◯ *If yes then please record in the notes section.*
FSP | Agent | Seal # removed

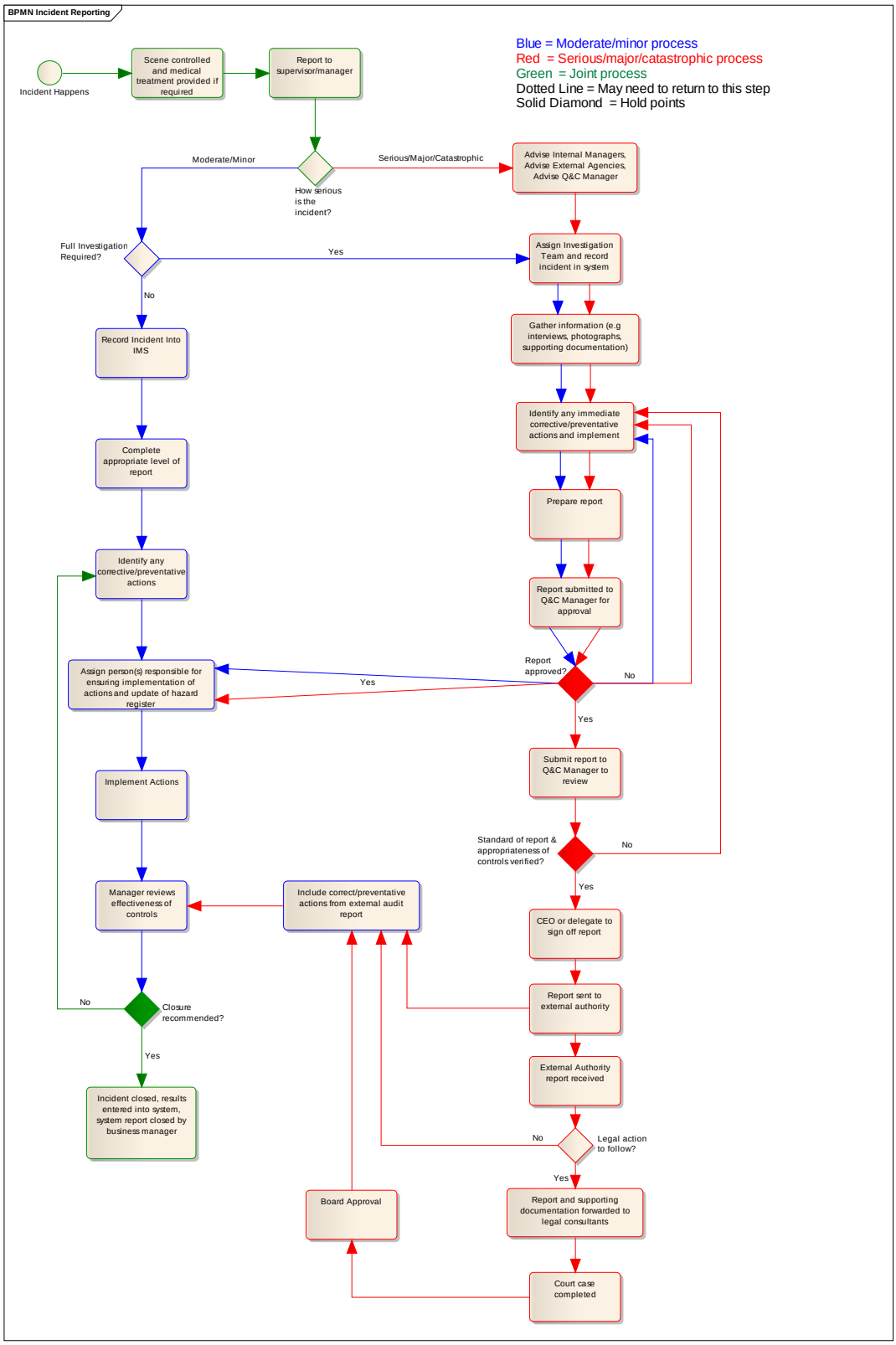
Notes
Please continue the notes section on the rear of this form if required.

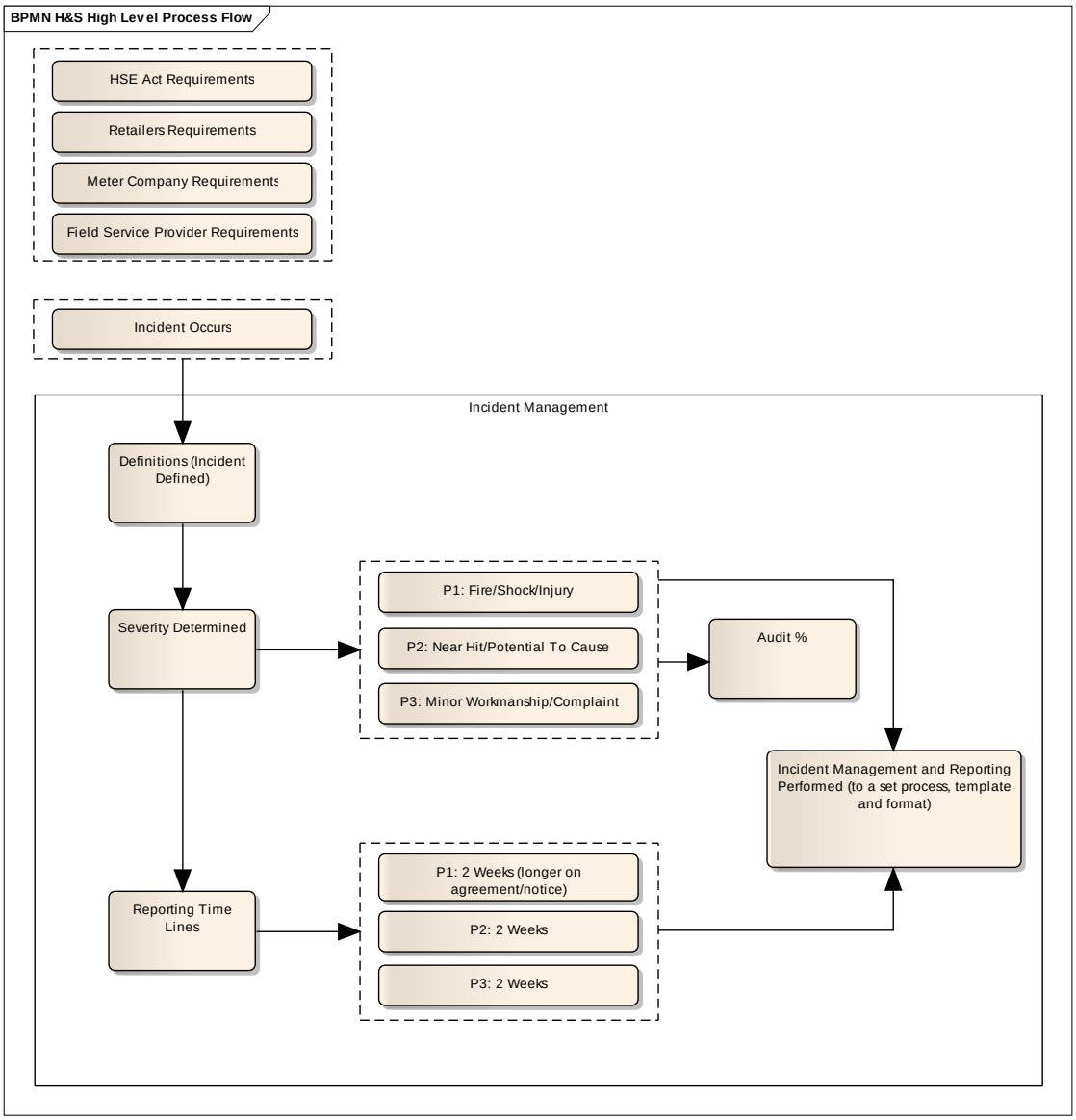
Audit Result: Pass ◯ Fail ◯ Minor ◯ Major ◯ | Would the failure cause a safety issue? Yes ◯ No ◯ *Please record all detail in the notes section.*

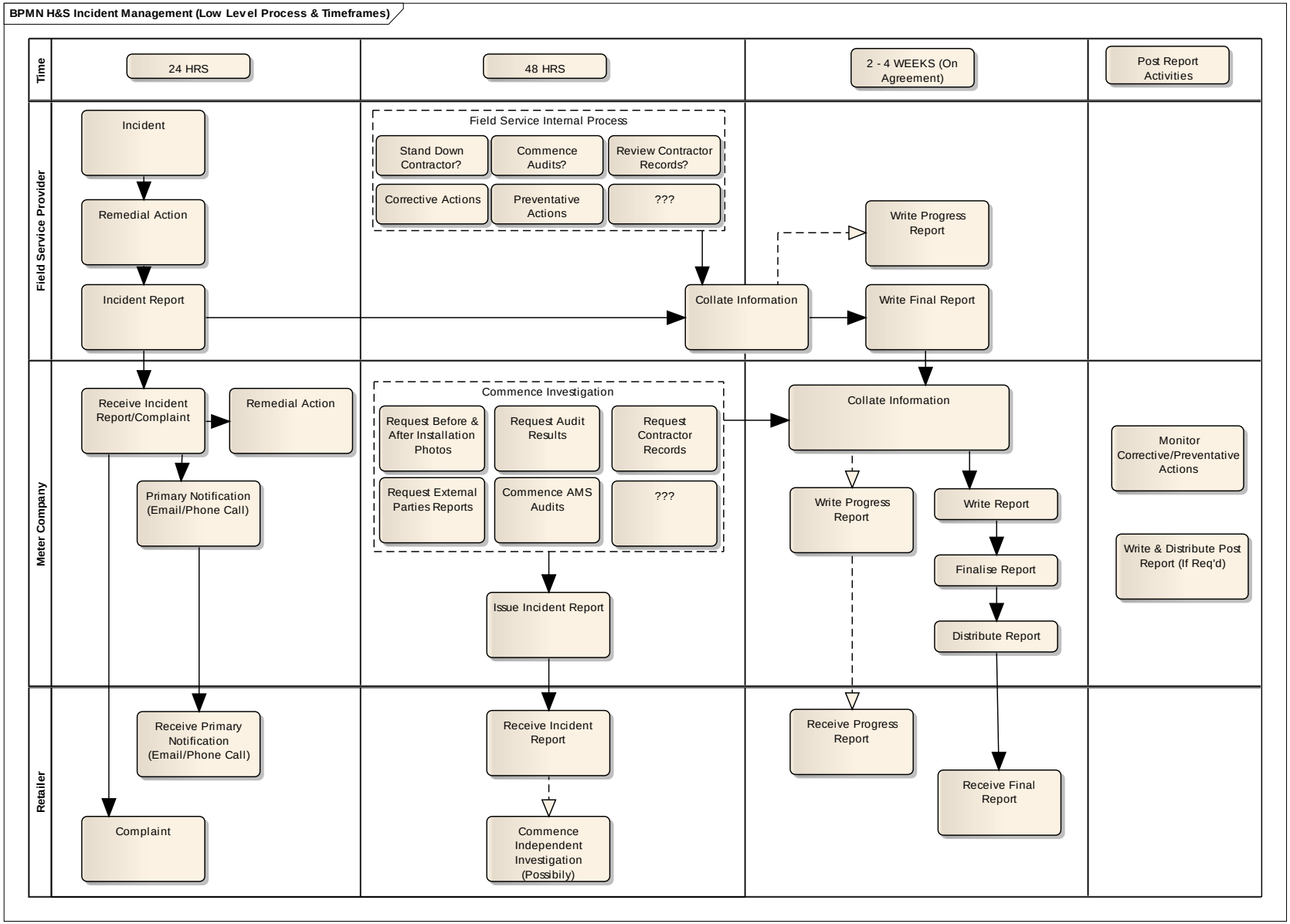
Auditor | Cell phone | Auditors Seal Numbers
Company | Signed

Appendix 4 Accident, incident and customer management

Sample incident reporting process




BPMN H&S High Level Process Flow
HSE Act Requirements
Retailers Requirements
Meter Company Requirements
Field Service Provider Requirements
Incident Occurs
Incident Management
Definitions (Incident Defined)
Severity Determined
P1: Fire/Shock/Injury
P2: Near Hit/Potential To Cause
P3: Minor Workmanship/Complaint
Audit %
Incident Management and Reporting Performed (to a set process, template and format)
Reporting Time Lines
P1: 2 Weeks (longer on agreement/notice)
P2: 2 Weeks
P3: 2 Weeks


BPMN H&S Incident Management (Low Level Process & Timeframes)
Time
24 HRS
48 HRS
2 - 4 WEEKS (On Agreement)
Post Report Activities
Field Service Provider
Incident
Remedial Action
Incident Report
Field Service Internal Process
Stand Down Contractor?
Commence Audits?
Review Contractor Records?
Corrective Actions
Preventative Actions
???
Collate Information
Write Progress Report
Write Final Report
Meter Company
Receive Incident Report/Complaint
Remedial Action
Primary Notification (Email/Phone Call)
Commence Investigation
Request Before & After Installation Photos
Request Audit Results
Request Contractor Records
Request External Parties Reports
Commence AMS Audits
???
Issue Incident Report
Collate Information
Write Progress Report
Write Report
Finalise Report
Distribute Report
Monitor Corrective/Preventative Actions
Write & Distribute Post Report (If Req'd)
Retailer
Receive Primary Notification (Email/Phone Call)
Complaint
Receive Incident Report
Commence Independent Investigation (Possibily)
Receive Progress Report
Receive Final Report

Sample incident reporting form

Incident Notification Form

Tick all sections applicable and enter comments where suitable

Version: 19/11/2010

INCIDENT TYPE: HEALTH & SAFETY ○ OTHER ○

SEVERITY: P1 ○ P2 ○ P3 ○

Incident Sub Type: *Select the appropriate categories* Near Hit ○ (An unplanned event that has a high probability of injury or loss)

Mechanical ○ Security ○ Fire ○ Explosion ○ Procedural ○ Workmanship ○ Injury ○

Cultural ○ Property ○ Vehicle ○ Theft ○ Environmental ○ Supply Loss ○

If the incident caused injury then the injury form must also be completed

ICP: _____ **Multiple ICP's Involved:** Yes ○ No ○ *If yes please list below or on a separate sheet*

Address: _____

Location: Inside ○ Outside ○ **Incident Date:** _____ **Incident Duration:** _____

Weather Conditions: Wet ○ Dry ○ Windy ○ **Incident Time:** _____

Existing Hazard: Yes ○ No ○

New Hazard: Yes ○ No ○

Detail if new _____

Voltage Involved: Nil ○ 11kV ○ 230v ○ 33kV ○ 400v ○ 66kV ○

Which part of the installation was involved? Pole Fuse ○ Switchboard ○ Boundary Box ○ Other ○ Mains ○

If other please give details _____

External Parties Notified: Yes ○ No ○ Fire ○ Ambulance ○ Retailer ○ Energy Safety Service ○

Date Notified: _____ Police ○ Network ○ R/Council ○ Department Of Labour ○

Who discovered the fault? Customer ○ Retailer ○ Network ○ Contractor ○ Audit ○

Other ○ *If other please detail* _____

Were there any witnesses? Yes ○ No ○ Details obtained? Yes ○ No ○ *If yes please list below or on a separate sheet*

Who or what caused/contributed to the fault? _____

Incident Details:

Describe here what happened and what actions were taken post the incident giving as much detail as possible use a further sheet if required.

_____

Was the site left safe? Yes ○ No ○ Photos Taken? Yes ○ No ○ Incident being investigated? Yes ○ No ○

Name: _____

Cell Phone: _____

Company: _____

Hours worked prior to the incident: _____

Incident being investigated by: _____

Report completed by: _____

Position held: _____

Contact numbers: _____

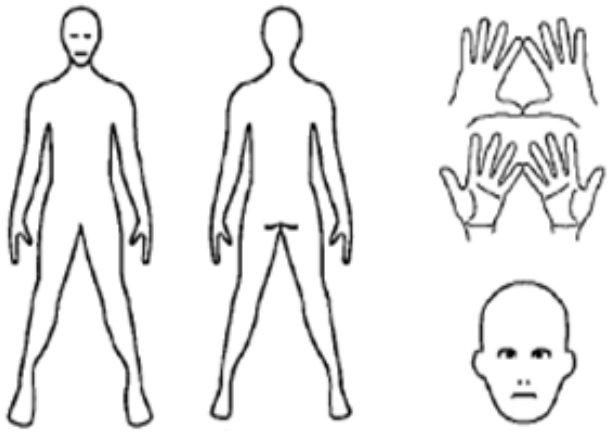
Date: _____ **Signed:** _____

Injury Notification Form

Tick all sections applicable and enter comments where suitable

Version: 19/11/2010

Injury Details – Body Part (Circle the part of the body that is injured)



Internal ☐ External ☐

Treatment: None ☐ First Aid Only ☐ Medical ☐ Hospitalisation ☐

Injury Type: Minor ☐ Serious ☐ Fatality ☐

Injured Body Part

Head ☐	Eyes ☐	Ears ☐
Nose ☐	Mouth ☐	Neck ☐
Back ☐	Lungs ☐	Chest ☐
Shoulder ☐	Arms ☐	Wrist ☐
Hands ☐	Fingers ☐	Abdomen ☐
Legs ☐	Knee ☐	Ankle ☐
Feet ☐	Toes ☐	

What was the nature of the injury? (Tick all that apply)

Allergic Reaction ☐	Confusion ☐	Bruising ☐	Laceration ☐	Amputation ☐
Electric shock ☐	Head injury ☐	Concussion ☐	Dislocation ☐	Fracture ☐
Open wound ☐	Puncture wound ☐	Crushing ☐	Inflammation ☐	Sprain/Strain ☐
Foreign body ☐	Burns ☐	Hernia ☐	Asphyxia ☐	Poisoning ☐
Heart Attack ☐	Dental Injury ☐	Disc Disorder ☐	Skin Disorder ☐	Vision Loss ☐

Cause of the injury: (Tick all that apply)

		Fall/Trip/Slip ☐	Animal ☐	Human ☐
Mobile machinery ☐	Fixed machinery ☐	Hand tool ☐	Power tool ☐	Liquid ☐
Pressure ☐	Sound ☐	Vapours ☐	Environment ☐	Dust ☐

Hitting Stationary Object ☐ Hitting Moving Object ☐ Hit By Moving Object ☐ Extreme Temperatures ☐

Material/Substance ☐

Details of how injury happened:

Describe here in detail what happened and what actions were taken.

What do you think caused or contributed to the injury?

Name: _____ **Company:** _____

Time: _____ **Date:** _____

Cell Phone: _____ **Number of hours worked prior to injury:** _____