Safety of Advanced Metering Infrastructure in Victoria

31/07/2012

Preface

On 22 February 2012, a "Whistleblower" contacted a Melbourne radio station to discuss a spate of smart meters failures, which he alleged were "blowing up" in the Pascoe Vale area.

"John" claimed to be a distribution company employee and said at least half a dozen meters had "exploded" since Christmas, including one that exploded on 21 February at the home of 91-year-old Brenda. John claimed the explosion endangered Brenda, who was just out of hospital and suffering a heart condition, and two workers who were replacing a fuse near the meter when it blew up on activation.

John alleged the explosions could cause a fire and that nothing was being done to rectify the problem. He also said the issue was being covered-up. Brenda's story received widespread media coverage on radio, television and in newspapers. The ETU was vocal in questioning the safety of the meters, calling for the government to suspend the rollout program until the safety issues were resolved.

The meter problems were initially linked to a High Voltage (HV) injection associated with recent lightning strikes, but it was subsequently determined that the failed meters in the Pascoe Vale and surrounding areas had all been subjected to acts of criminal damage. The matter was referred to police and the investigation was announced by Jemena on 1 March. The investigation is continuing.

These incidents and the continuing media coverage have caused a great deal of unwarranted public concern and worry, especially for the elderly and vulnerable. Throughout this period, Energy Safe Victoria (ESV) has consistently stated that in relation to electrical safety all available evidence confirms that smart meters are safe and if they fail, they fail safely. They do not explode and have not spontaneously caught fire, apart from two incidents related to production faults out of 1.2 million meters already installed.

This report has been developed to provide the detailed and specific evidence, presenting the result of ESV's investigations, which back up our public statements on the matter. It also addresses a number of related safety issues raised, such as the safety of meter boards and distributor procedures following HV injections – either as a result of lightning, car accidents or vegetation bringing down powerlines.

This report follows a similar investigation and review into the safety of the smart meter program that was conducted by ESV in 2011. It found that meters were being installed by qualified people and that they were being installed safely.

ESV previously released this report in draft to provide the public and industry stakeholders with an opportunity to assess the evidence and make comment prior to ESV concluding its position and publishing this final report. Consistent with meeting its statutory obligations, ESV will continue to closely monitor the rollout of smart meters. Where necessary, ESV will investigate incidents and enforce compliance with regulations so that the risks to public safety are minimised to the lowest practical level.

Paul Fearon
Director of Energy Safety
31 July 2012

Executive summary

In 2006, the Victorian Government committed to rolling out the installation of electrical meters that are remotely readable and controllable (smart meters) as part of the Advanced Metering Infrastructure (AMI) program to all residential and small businesses in Victoria. The planned rollout of smart meters to approximately 2.6 million customers is well advanced and expected to be completed by the end of 2013.

Throughout the smart meter rollout, a number of mostly unwarranted concerns have been expressed about the safety of smart meters.

ESV is responsible for regulating electrical and gas safety in Victoria. In 2011, ESV undertook a review that focused on whether smart meter installation practices were safe for both workers and the public. Overall, the review concluded that the public should have confidence that the meters were being installed safely and by qualified and trained people.

Since then, concerns have continued to be expressed by community groups, unions and the media about the safety of smart meters. Much of this concern has followed a number of smart meter incidents that have occurred during the past six months in Pascoe Vale and surrounding areas (particularly in Jemena's distribution area). Initially those incidents were thought to be linked to the meters being exposed to a higher than normal voltage caused by lightning strikes (HV injection), and there were exaggerated reports that smart meters were exploding as a consequence. More recently, it has become apparent that all of those smart meter incidents have been the result of criminal damage, none of which have resulted in injury or significant damage to date. As of mid-July 2012, approximately 90 smart meters have been subjected to criminal damage in Pascoe Vale and surrounding areas, none of which have been reported as having caused a house fire.

Nevertheless, ESV believes it is important that the public receives informed and independent information so they can continue to have confidence that smart meters are safe. It is also important for the public to know that when the meters fail, they do fail safely. In this report ESV has sought to answer many of the questions that have been raised in the past months.

ESV's conclusions are based on research, specific enquiries and investigations that it has undertaken. ESV's main conclusions are:

- When smart meters fail, they fail safely and potentially reduce the risk of personal damage and injury.
- The reported meter failures since December 2011 in Pascoe Vale and surrounding areas are attributable to criminal damage rather than HV injection.
- There is no evidence to suggest that the safety risks associated with smart meters are any greater than older style electronic or electromechanical meters.
- There is no evidence to suggest that smart meters are exploding or causing fires.
- The Metropolitan Fire and Emergency Services Board (MFESB) Fire Investigation and Analysis Unit found that the number of switchboard/meter box related fires are

trending down and that no evidence has been found, at this stage, to indicate that fires can be directly attributed to an electrical malfunction of a smart meter.

- The electricity companies are following Victorian Electricity Supply Industry (VESI) minimum procedures for responding to a HV injection when it occurs, which includes requirements to inspect metering equipment and conduct testing as required.
- The smart meters being installed in Victoria meet current Australian Standards including those related to safety, and those standards are robust and appropriate.
- The procedures that describe what is acceptable in relation to the condition of boards and panels prior to meter installation were found to be appropriate and suitable for the purpose.
- While it is generally the responsibility of customers to replace boards/panels that have been damaged or deteriorated as a result of inadequate weather protection, more than 40,000 boards/panels have been replaced by the electricity distribution businesses during the rollout at their cost.
- In addition to the replacement of meter boards/panels, the smart meter rollout has identified over 10,000 safety defects since it began, which have been or are being rectified.
- Electrical Inspectors are required to carry test equipment when they inspect and test meters.

ESV previously released this report in draft to provide an opportunity for public comment to ensure that it addressed the key issues of concern to the community about smart meters.

1 About this report

1.1 The Victorian Government's smart meter rollout program

In February 2006, the Victorian Government announced that it would require electricity distribution companies in Victoria to install advanced electrical meters (smart meters) to all small business and residential customers as part of the Advanced Metering Infrastructure (AMI) program. The program involves replacing existing electricity meters with digital electricity meters that record energy consumption every half hour and can be remotely read and reset via wide area network communications.

The electricity distribution companies have forecast that they will install more than 2.6 million smart meters over four years. The rollout of the smart meters commenced in September 2009. As of July 2012, more than 1.2 million have been installed, which is approaching half of the total.[1] The rollout is expected to be completed by December 2013. New South Wales is also in the process of installing smart meters, but is less advanced with the rollout, and to date has installed around 600,000 smart meters.

1.2 Recent smart meter incidents

On 28 December 2011, Jemena (the company responsible for distributing electricity to more than 319,000 homes and businesses in the north west of Melbourne) reported incidents involving smart meter failures in the northern suburbs.

The initial incidents followed lightning strikes on the electricity network during December and January, and it was initially thought that HV injection had affected the new meters.[2] This gave rise to some concerns about how effectively the new smart meters were able to handle a HV injection, and the extent to which the electricity companies were responding appropriately to HV injection events when they occurred.

More recently, it has emerged that almost all of Jemena's reported smart meter incidents in the Pascoe Vale and surrounding areas appear to be the result of criminal damage, and the company referred evidence to Victoria Police for investigation.[3]

ESV has reviewed information provided by each of the Victorian electricity distribution companies in relation to the recent meter failures arising from criminal damage and HV injections. Of the AMI rollout meter failures reported or examined, they all failed safely. A non-AMI meter failure resulting from a HV injection was also noted. This incident occurred in a rural area to a third party installed contestable meter. It was subjected to an extreme level of energy generated by a lightning strike that greatly exceeded the design tolerances for the

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1 As at 31 May 2012, 1,221,497 smart meters had been installed in Victoria.

2 HV injections generally occur as a result of high voltage being introduced to low voltage powerlines. For example, when lightning hits low voltage powerlines or when HV lines make contact with LV lines due to storm damage or car accidents. This can result in a power surge into consumers' properties.

3 Jemena, Media releases, 'Police asked to investigate smart meter criminal damage', 1 March 2012, and 'Smart meter criminal damage confirmed', 22 March 2012

equipment and an uncontrolled failure resulted. In a case such as this, every type of meter would be expected to fail uncontrollably.

Notwithstanding such a failure, from the evidence examined by ESV, if a smart meter is affected by a HV injection or criminal damage the failure has been contained within the meter, thereby limiting any consequential damage from the meter itself. This is in accordance with its design, which ensures it meets specific safety standards.

1.3 Nature of issues raised

While most of the recent incidents now appear to be the result of criminal damage, ESV believes it is important to answer the additional questions that have emerged in relation to the safety of smart meters.

Most of the issues raised have been put forward by the Victorian Branch of the Electrical Trades Union (ETU) and Stop Smart Meters Australia, who have questioned the safety of smart meters. The media has reported the concerns raised by these key stakeholders, resulting in a great deal of largely misplaced community concern.

A summary of the key issues and assertions raised include:

- There has been a massive increase in meter failures since the smart meters were rolled out.
- Smart meters cause fires and explosions.
- All smart meters that are affected by a HV injection on a circuit need to be replaced to ensure safety.
- Smart meters need to be installed on non-flammable backing board to ensure safety.
- Smart meters are being installed on deteriorated backing boards.
- Energy companies have not followed appropriate procedures for testing of smart meters following a HV injection.
- The smart meters that are being installed are poor quality and unsafe.
- Smart meters are emitting a coloured liquid that is unsafe.

This report seeks to address the various issues raised, and presents the available evidence that ESV has reviewed in the preparation of this report.

1.4 Previous ESV review of smart meters

On 21 January 2011, a Highett resident received an electric shock as a result of a smart meter that was incorrectly installed with reversed polarity.[4] The incident triggered a great deal of media and political interest in the safety of the AMI program. In response, ESV commenced a formal investigation into the incident, together with an audit of meter installations of the AMI

[4] The installer, Nileshkumar Patel, was subsequently charged with installing equipment that was unsafe and not testing. He appeared in the Moorabbin Magistrates' Court on 2 May 2012. He pleaded guilty and received a 12-month bond, without conviction. He was ordered to pay $500 to the Royal Children's Hospital, to undertake $1500 in additional TAFE training and to pay costs of $1592.96.

programs more broadly. Following a request by the Minister for Energy and Resources, ESV also undertook a general review of the qualifications and training of installers.

The review[5] concluded that the public should have confidence that smart meters are being installed safely by qualified and trained people, and proposed some measures to ensure that the highest standards of safety are achieved and maintained through the rollout. The audit found:

- The regulatory regime established for the safe installation of meters and for the training, qualifications and competency of installers was comprehensively developed and unanimously agreed to by all stakeholders including unions, industry and training providers.
- The specific AMI installation training programs developed and accredited by the Victoria Registration and Qualifications Authority (VRQA) exceeded the minimum qualification requirements set out in the relevant Order-in-Council establishing the rollout processes.
- The distribution businesses follow their management systems to ensure that installers are only employed who possess the qualifications, experience and training required under the Order-in-Council.
- Even though the regulatory regime does not require installers to be licensed and requires qualifications and training that is specific and fit for purpose, in practice the distribution businesses mostly employ licensed electrical workers to install meters.
- In relation to work practices, specifically sub-contracting and concerns about piece work, meters are being installed safely and in accordance with regulations including the requirement to test.

Some opportunities for improvement were identified and subsequently addressed by the distribution businesses:

- Reporting of non-conformance to procedures that may allow installers to avoid sanctions under the "two strikes" policy that some distribution businesses implement.
- Review written procedures (as distinct from practice) to ensure conformity to strict compliance with the Victorian Electricity Supply Industry (VESI) test procedures.
- Checking specifically that installers hold a Certificate III in Electrotechnology rather than relying on an assumption that all categories of electrical licences require a Certificate III. In a very small number of cases some installers who hold supervised electrical workers' licences and who had been employed as installers did not have the Certificate III.
- Issuing an advice card to the customer signed personally by the installer that the installation had passed all of the required tests and complied with the requirements of the Electricity Safety Act 1998 and regulations. All businesses have adopted these cards, which are left at premises when the new meters are installed.

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[5] The report can be viewed at the ESV website: www.esv.vic.gov.au.

1.5 Purpose of this report

The purpose of this latest review is to examine the new issues raised around the safety of smart meters. The scope is broadly to:

- Investigate and report on the circumstances giving rise to the smart meter failures that have occurred in recent months.
- Address the specific concerns and issues raised about the safety of smart meters including the impact of a HV injection.
- Consider the merit of the different safety procedures for identifying and replacing metering panels/boards in the AMI rollout.
- Consider whether the current regulatory framework provides a robust basis for ensuring that smart meters are designed and manufactured to operate safely and, if they fail, that they do so safely.

There are a number of issues that are beyond the scope of this report but are mentioned for completeness, these include:

- The practices, training and qualifications of smart meter installers – this was the subject of the 2011 Energy Safe Victoria review that concluded that meters were being installed safely as part of the AMI rollout[6].
- The potential health effects of smart meters – this is the subject of separate regulatory arrangements administered by Australian Communications & Media Authority (ACMA), which incorporates exposure limits developed by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and has also been subject to a Victorian Government review.[7]
- Issues related to the current Victoria Police investigation of alleged criminal damage of smart meters.

1.6 Our approach to this review

ESV has consulted extensively with key stakeholders to understand the issues that they see as being important to be addressed as part of this review. This has included discussions with the Electrical Trades Union, the Metropolitan Fire Brigade, each of the five electricity distribution companies operating in Victoria, and the main manufacturers of smart meters being installed in Victoria (SECURE and Landis & Gyr).

ESV has investigated the circumstances surrounding the smart meter incidents that Jemena reported during past months and analysed historical data for smart meter failures across all electricity distribution companies. Jemena has investigated the circumstances surrounding the recent smart meter installation failures and provided Energy Safe Victoria with copies of its incident investigation. A summary of its main findings is contained in Appendix A. ESV investigators have attended the incidents as well as examining a number of meters that have actually failed.

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[6] Energy Safe Victoria 2011, *Safety Aspects of the Victorian Advanced Metering Infrastructure (AMI) Program Meter Deployment Activities*

[7] Further details can be found at the DPI website: www.dpi.vic.gov.au

ESV also sought information from the other electricity distribution companies about their investigations of HV injections associated with electricity meters over the past few years. A summary of their reported findings is also contained in Appendix A.

ESV has also reviewed the detailed procedures and practices that the electricity distribution companies have put in place to respond to a HV injection event and meter testing arrangements.

ESV has sought detailed information and evidence from the electricity distribution companies and the manufacturers of the smart meters in relation to the number of failures (including post HV injections), the extent to which these meters comply with relevant International and Australian/New Zealand standards, the certification processes, quality control and testing procedures.

On the basis of this information, this report sets out our findings and recommendations in relation to safety associated with Victoria's smart meters. ESV previously released this report in draft for public consultation to ensure that all of the relevant safety concerns related to smart meters were addressed, and to ensure that all the relevant and available information had been assessed. ESV reviewed all submissions received during the consultation period and the input was helpful in producing this final report. No new evidence was presented and that gives ESV confidence that all the major issues have been addressed.

1.7 Structure of this report

The remainder of this report is structured as follows:

- Section 2 provides an overview of the safety regulatory framework for smart meters in Victoria.
- Section 3 addresses a number of issues that relate to the question of whether smart meters are safe. This includes issues such as what happens when smart meters fail, do smart meters exposed to HV injection suffer from latent failure, how do distributors respond to a HV injection, are smart meters built to standards, do smart meters cause fires or explosions, emit toxic or harmful chemicals.
- Section 4 addresses a number of issues that relate to whether smart meters are being installed appropriately. This includes issues such as are smart meter installers appropriately qualified, are meters installed on boards/panels that are safe, who is responsible for replacing backing boards/panels, do the Electrical Inspectors attending a HV injection have the correct test equipment and what happens if the installer comes across wiring issues.

2 Overview of safety regulatory framework for smart meters

The safety regulatory framework for smart meters comprises a number of different elements including safety regulation of smart metering equipment, safety requirements/procedures related to the installation of smart meters and other electrical equipment, and reporting of safety related incidents. This section summarises the current arrangements.

2.1 Smart meter equipment safety

The *Electricity Safety Act 1998* (the Act) establishes the safety regime for the Victorian electricity supply industry. Electricity smart meters are subject to the same safety regime as other electricity meters.

Section 54 of the Act requires that a person must not supply or offer to supply electrical equipment unless the equipment complies with the minimum standards prescribed for equipment of that class.

There are a number of Australian and other standards that apply to various forms of electrical equipment. The most applicable standards relating to fixed wired electricity metering equipment (including smart meters) are:

- AS 62052.11:2005 - Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 11: metering equipment.
- AS 62053.21:2005 – Electricity metering equipment (AC) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2).
- AS 62052.21: 2006 - Electricity metering equipment (AC) – General requirements, tests and test conditions - Part 21 Tariff and load control equipment.
- AS 62054.21:2006 - Electricity metering equipment (AC) – Tariff and load control – Part 21 Particular requirements for time switches.
- AS 62053-23:2006 - Electricity metering equipment (AC) – Particular requirements - Part 23 Static meters for reactive energy (class 2 and 3).
- NMI M6 – July 2004 Pattern approval and initial Verification of Electricity Meters and Associated Transformers: Definitions, Metrological and Technical requirements. Certificate of Pattern Approval 14-2-42 issued on 27/05/2009.

Among other things these standards include requirements related to flammability, particle and water ingress (Ingress Protection or IP rating), access to live parts when installed, temperature rise tests, abnormal tests, high voltage withstand tests and high current withstand tests.

2.2 Electricity Safety Management Schemes

The Act requires all electricity distribution companies to develop and comply with an accepted Electricity Safety Management Scheme (ESMS) for its network.

The Electricity Safety (Management) Regulations 2009 specify that the ESMS must cover all of the electricity distribution company's operational activities and includes detail specifically on the meter deployment activities.

Each of the electricity distribution companies has developed its own ESMS. Following review, ESV has accepted each of these ESMSs, which are audited for compliance every year. The distribution companies continue to bear responsibility for the safety of their operations.

2.3 Installer qualifications and testing

An Order-in-Council issued by the State Government establishes the minimum qualifications required for electrical workers who perform limited and ancillary electrical installation work that is necessary as part of the metering work on electrical installations, used for metering or the control or protection of metering circuits, and equipment connected or to be connected to metering owned by the electricity distribution company.[8] The Order also identifies the testing required when such work is carried out to ensure the electrical safety of the work and installation.

To maintain the integrity and safety of the customer's electrical installation the work must be carried out by a person who:

- Possesses the qualifications, proficiency, competency and experience to at least Certificate III level or equivalent as a lineworker, meter technician or electrician and has been properly trained in the safety aspects and limitations in relation to that work.
- Has satisfactorily completed a course and practical assessment in accordance with the Certificate III ESI Distribution (Power Line) Metering Installations Unit or demonstrated equivalent competency or is working under supervision as allowed under section 39 of the Electricity Safety Act.
- Undertakes testing in accordance with the VESI Installation Supply Connection Tests & Procedures manual to ensure integrity of supply to the customer's main or occupancy switchboard or equipment to be supplied and the correct operation of metering equipment.
- Prior to enabling the electrical installation to be used by the customer, verifies as far as practicable that the installation is safe to energise.

2.4 Reporting electrical safety incidents

ESV is responsible for investigating events or incidents that have implications for electrical safety and for advising the electrical industry and the community in relation to electricity safety.

ESV keeps a record of all electrical incidents reported. The information gained from these reports, and subsequent investigations, is used to determine the cause of an incident and to implement remedial action to reduce future risks. The remedial action may include the revision of regulations, providing information and guidance to special interest groups or the public in general, or the establishment of special committees to set rules for improving safety.

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[8] Published in Government Gazette (G33), 13 August 2009.

The *Electricity Safety (Installations) Regulations 2009* and the *Electricity Safety (Management) Regulations 2009* require reporting of any electrical incident that causes or has the potential to cause:

- Death or injury to a person.
- Significant damage to property, or serious risk to public safety.
- Involves accidental contact with any electrical installation.
- Electric shock as a result of direct or indirect contact with any electrical installation.

ESV has established reporting guidelines to assist major electricity transmission and distribution companies to classify reportable incidents and to provide an outline for statistical reporting.

Under the current electricity distribution business electrical safety reporting guide, distributors must report to ESV as soon as practicable when a HV injection causes property damage. However, if a meter failure is unrelated to a HV injection it is unlikely the meter failure will be reported to ESV unless it has a related electrical safety issue or is likely to attract community attention.

In the context of this report, a HV injection incident is an event or events that results in an injection of electrical energy (at high voltage) into an electrical conductor that is not designed and constructed to operate at that level of electrical energy.

From 1 July 2008 to 9 March 2012, the electricity companies reported a total of 255 HV injection incidents to ESV. This equates to approximately 70 HV injection incidents each year across the entire Victorian electricity network.

Reported HV injections – 1 July 2008 to 9 March 2012

	2008 - 09	2009 - 10	2010-11	2011 - 9 Mar 2012
Number of HV injections	79	82	61	33

The most common causes of reported HV injections are:

- Adverse weather (including lightning and falling tree branches).
- Vehicle collision with power poles.
- Work on or near electricity supply networks.
- Electrical asset failure.

The VESI Installation Supply Connection Tests and Procedures Manual (section 4.17) has specific minimum standards for the industry to respond to HV injections. Each electricity distribution company has developed its own procedures that build on section 4.17 of the manual as their standard for safe connections to electricity networks.

When the cause of the recent smart meter failures was thought to be HV injection, several electricity distribution companies (including Jemena and United Energy) revised their procedures to require all smart meters on the low voltage circuit affected by HV injections to be replaced. However, they subsequently decided that this was not required following further investigations of the failures that confirmed that the cause was not due to

HV injection. Jemena and United Energy now require their workers to inspect smart meters by removing the terminal cover looking for damage to contacts and terminal screws.

ESV has reviewed each of the electricity distribution companies' procedures. ESV's review confirms that their procedures are all consistent with the minimum requirements set out in section 4.17 of the Installation Supply Connection Tests and Procedures manual.

To ensure continual improvement ESV requested that the VESI committee responsible for Section 4.17, High Voltage Injections, of the VESI manual meet to review the procedure and identify any areas that may require refinement in light of emerging evidence and experiences. In June 2012, a minor change was made to the VESI procedure, warning of the need to visually inspect metering equipment with the terminal cover removed and any damaged metering equipment to be replaced prior to energisation.

3 Are smart meters safe?

This section focuses on a number of key issues that relate to whether the smart meters are safe, including:

- What happens when smart meters fail?
- Do smart meters exposed to HV injection suffer from latent failure?
- How do distributors respond to a HV injection?
- Are smart meters built to standards?
- Do smart meters cause fires or explosions, emit radiation or other toxic or harmful chemicals ?

ESV's findings related to these key questions are discussed below.

3.1 What happens when smart meters fail?

Meters can potentially fail for a number of reasons, which may include internal component failure, installation faults, terminal block manufacturing issues, or environmental contamination. They may also fail as a result of a HV injection that occurs when a HV powerline comes into contact with a low voltage powerline, a lightning strike hits a powerline, or a car crashes into a power pole. Approximately 70 HV incidents across the state's electricity network are reported to ESV each year (see section 2.4).

As with any electrical or mechanical equipment, all meters whether 'smart', older electronic or electromechanical are susceptible to damage if exposed to a HV injection. When the meter has a significant failure in these circumstances, the fuse servicing the installation operates as required to safely de-energise the equipment.

Irrespective of the cause of the meter failure, when meters fail they are designed to fail safely. This means that if the smart meters are affected by a HV injection or other form of fault, the failure is typically contained within the meter. There may be a flash, some noise and smoke but, based on the evidence provided to ESV, it is extremely unlikely that they explode or spontaneously catch fire (see section 3.5). Under circumstances where customers' properties are subject to an extreme level of energy generated by a HV injection that greatly exceeds the design tolerances for the equipment, uncontrolled failure of all types of meters may result.

On 21 February 2012 it was reported in the media that a smart meter exploded in front of a 91-year-old woman who felt "terrified, threatened, and endangered". She had just come home from hospital to find she had no power in her house and contacted the distribution company to rectify the situation. The incident received considerable coverage with the media also reporting that the two power company workers who were replacing the fuses narrowly escaped injury when the meter blew up upon activation.

A whistleblower talking to a Melbourne radio program attributed the explosion to a manufacturing issue, believing the meter explosions could easily start a fire. The whistleblower also noted that six other houses had their meters explode and that one had the meter explode twice.

From the subsequent incident investigation, it was determined that despite the meter having been the subject of criminal damage it still failed safely without a fire start. The main service fuse had initially operated when subjected to the criminal damage (explaining why there was initially no power to the house) and again when replaced by the power company workers, thus protecting the house. The power company workers had followed procedure in restoring power to a meter that had no obvious signs of failure while ensuring the house's main switch was isolated. The meter did not catch fire and failed safely in spite of the dramatic and unsettling nature of the failure.

In contrast to traditional analogue meters, the new smart meters are designed with built-in overvoltage protection that may actually reduce the likelihood of power surges entering the home, damaging appliances and potentially giving residents an electric shock. This is supported by anecdotal evidence from distributors based on insurance claims.

Damage due to a HV injection can sometimes only be identified by close inspection of the meter after removing the terminal covers. HV injections are readily identified by evidence of a flashover at the terminals or smoking under a clear case cover. In some cases, the smart meter may be damaged internally by a HV injection and the display becomes unserviceable or a service icon is displayed indicating that the meter needs to be replaced.

Electricity distribution companies have well-established procedures to deal with the immediate and possible consequential damage caused by HV injections (see section 3.3).

Overall, smart meters are designed to fail safely to reduce the risk of personal damage and injury when they do fail, and all the evidence provided and available to ESV supports this.

3.2 Do smart meters exposed to HV injection suffer from latent failure?

One issue raised has been whether smart meters that experience a HV injection may fail some time after the HV incident (i.e. latent defect). This concern has arisen because some of Jemena's meter failures since December 2011 in the Pascoe Vale and surrounding areas appeared to occur sometime after a lightning strike on their electricity network. However, the evidence now points to criminal damage as the cause of these failures and the nature of that damage as the reason for latent failures sometimes occurring.

ESV sought evidence from the manufacturers about the extent to which they had tested the smart meters for the impact of high voltage conditions. Laboratory tests were undertaken that tested the meters to a 10,000 volt impulse voltage to simulate a high voltage transient fault at the meter terminals. This testing suggests that the smart meters perform in a safe manner when subject to transient high voltage, and supports the argument that latent failures are unlikely in these circumstances. As noted previously, under circumstances where customers' properties are subject to an extreme level of energy generated by a HV injection this situation will exceed the design tolerance for all types of meters, old and new, and an uncontrolled failure may result.

ESV is not aware of any other information to suggest that there is a risk of latent failure but will continue to monitor the rollout and any ongoing investigations being carried out by the distributors.

3.3 How do distributors respond to a HV injection?

VESI specifies procedures for responding to suspected HV injections, which includes inspecting premises by a Licensed Electrical Inspector and testing metering equipment (section 4.17). The procedures do not explicitly require all meters that have been exposed to a HV injection be replaced.

At the time that ESV became aware of Jemena's meter failures in the northern suburbs, the electricity distribution company's practices varied in terms of whether meters subject to a HV injection were replaced or alternatively tested or inspected in accordance with VESI procedures.

As an early response to the failures, Jemena issued a memorandum to its employees advising that any electronic meters on the low-voltage circuit affected by a HV injection should be replaced. ESV understand that Jemena (and United Energy) introduced this practice on the basis that it was concerned that its meters may have been failing some time after the suspected HV injection. It also reflected the advice of SECURE (one of the smart meter manufacturers), which recommended that where a HV injection is known to have occurred, all meters on the low-voltage segment affected should be removed and returned to SECURE for diagnosis and re-verification.

As noted previously, it has now become apparent that the latent meter failure was resulting from criminal damage rather than a HV injection. In light of this, ESV understands that SECURE has now released further advice to suggest that local visual inspection can identify damaged meters sufficiently so that removal of all meters is no longer necessary.

ESV's view is that the practice of inspecting and testing metering equipment at all premises that have been exposed to a HV injection (as specified by the VESI procedures) should be sufficient to ensure that the risks associated with HV injection are identified and managed. ESV is not aware of any evidence that suggests that all meters on a circuit that has been exposed to a HV injection would need to be replaced.

3.4 Are smart meters built to standards?

A number of issues have been raised about whether the smart meters that have been installed are safe and meet appropriate safety standards. For example, representatives from Stop Smart Meters Australia asserted that the smart meters are of inferior quality and are "shoddy, cheap, faulty and made in India". It has also queried why the smart meters do not carry a compliance sticker or tag (which other electrical equipment is required to carry). Similarly the Electrical Trades Union has queried what standards smart meters are required to meet and whether specifically Jemena's smart meters meet the required standards.

ESV sought documentation from both SECURE and Landis & Gyr demonstrating that its smart meters comply with the current Australian Standards described in Section 2.1. Each of the

manufacturers provided reports from either a NATA accredited test laboratory or an accreditation body that has a mutual recognition agreement (MRA) with NATA certifying that the meters comply with the applicable clauses of the standards outlined in section 2.1, including the requirements related to safety.

In relation to the concerns that the smart meters are "shoddy, faulty, cheap and made in India", regardless of where the meters are manufactured or what it costs to produce them, ESV is satisfied that on the evidence to date they are fit for purpose and meet the necessary standards.[9]

In relation to compliance sticker/tags, section 57 of the Electricity Safety Act requires prescribed electrical equipment to display an approval number. However, electrical meters (including smart meters) are non-prescribed and hence it is not mandatory for the smart meter to be certified and marked with an approval number.[10] The following link to the ESV website identifies equipment declared as prescribed:

http://www.esv.vic.gov.au/Electricity-Professionals/Electrical-equipment-and-appliances/Definitions-of-equipment-classes

Fixed wired metering, as would be the case for much of the equipment used in networks, has never been classified as prescribed electrical equipment. This is due to:

- The low number of incidents related to this type of equipment.
- The general compliance of metering equipment to the relevant Australian Standards.
- This product is not generally purchased or specified by the householders or public.

If it was at some stage considered that fixed wired metering equipment was required to be prescribed due to, for example, a significant increase in number of incidents or a lack of compliance to the standards, the Electrical Regulatory Authorities Council (ERAC) may request an amendment to AS/NZS 4417.2 to have it included in Annex B (regulator definitions). The equipment listed in this standard is identical to the items listed on the ESV website at the above link.

Overall, based on the information provided by the manufacturers, ESV is satisfied that on all existing evidence the smart meters meet current Australian Standards including those related to safety.

3.5 Do smart meters cause fires and explosions?

Aside from the meters subject to criminal damage, there have also been a number of claimed cases of smart meters smoking, causing fires and exploding. Smart meters have also been

[9] The issues of the cost of the smart meters versus what consumers have paid for the meters as part of their bills is a matter for the economic regulator, namely the Australian Energy Regulator.

[10] A list of prescribed equipment is available on the Energy Safe Victoria website at http://www.esv.vic.gov.au/Electricity-Professionals/Electrical-equipment-and-appliances/Definitions-of-equipment-classes

blamed in numerous media reports for recent switchboard fires. In all but two cases, investigation has shown that smart meters had nothing to do with the fire. In some cases, the footage shown by media and others has related to meter or switchboard incidents reported overseas.

Fire brigades respond to hundreds of electrical fires each year and evidence from the Metropolitan Fire Brigade indicates that:

- In 2010, there had been 38 fires that originated in a switchboard/meter box/fuse box with only one of these identified as including a smart meter.
- In 2011, there were 39 fires that originated in a switchboard/meter box/fuse box with three identified as including a smart meter.
- In January 2012, there were three meter box fires and smart meters were present in all of these[11].

The Metropolitan Fire and Emergency Services Board (MFESB) Fire Investigation and Analysis Unit reported that:

> Given the available data (2010/11), we have not recorded an increase in the number of switchboard/meter box related fires and, in fact, the data would appear to be trending down to that which would normally be expected. No evidence has been found, at this stage, to indicate that fires can be directly attributed to an electrical malfunction of a smart meter.[12]

United Energy also advised that its investigations suggest that flashover is more likely to occur in smart meters than in older electromechanical meters following HV injections. The flashover is likely to result in local heating and blackening of parts of the meter and surrounding switchboard panel, *but is unlikely to result in a sustained switchboard fir*e. They also pointed out that the flashover may reduce damage to appliances or wiring by dissipating fault energy at the meter terminals. The statistics collated in the MFESB report support this conclusion.

Switchboard fires can sometimes be caused either by old, degraded wiring or loose contacts and increased loads such as the installation of air conditioners. It can take some time for these problems to become apparent. One of the benefits of the smart meter rollout program has been that a number of power faults and wiring issues have been identified and rectified, which has potentially reduced the likelihood of future power safety issues.

Of the more than 1.2 million smart meters installed since the rollout began ESV is aware of only two confirmed fires caused by a smart meter. These fires were found to be the result of component failure or manufacturing faults within the meters.

As a result, ESV believes there is no evidence or physical design issues to support the assertion that smart meters are and can explode or cause fires.

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[11] With the ever growing number of smart meters in Victoria, it is more than likely that any fire occurring in a switchboard will contain a smart meter.

[12] MFESB Fire Investigation and Analysis Unit 2011, *Investigation to determine if a nexus exists between electrical switchboard fires and 'smart meters',* November.

3.6 Do smart meters emit toxic or harmful chemicals?

Recently there have been concerns about potentially toxic or harmful substances contained within smart meters. The smart meters are similar to other common household appliances whereby standards will generally identify if equipment/appliances are likely to emit toxic or harmful chemicals and specific designs are in place to accommodate these devices. However, no hazardous materials have been identified by the standards for smart meters.

There are very small amounts of chemicals encased in the components in the meter. Under normal operating conditions these chemicals are not accessible by users and the meters have an Ingress Protection rating of IP53.[13] Because the smart meter itself is not a hazardous substance it is not required to have a material safety data sheet (MSDS). This is similarly the case for items like a cordless drill battery charger, which has some similar components to that of a smart meter but with a much higher quantity of lithium ion batteries directly accessible by the user and does not have an MSDS.

In light of the recent criminal damage to smart meters, Jemena has developed a procedure that it implements on arrival at a site where a smart meter is reported to have failed. This is designed to protect its workers and consumers as much as possible from any chemical harm. ESV requested that Jemena share its procedure with the other electricity distribution businesses to ensure that best practice safe smart meter handling procedures are being used.

[13] This means they are protected against access to hazardous parts with a wire, are protected against objects less than 1mm diameter touching internal parts including dust protection to the extent that it will not affect product performance, are designed to resist the ingress of sprayed water (angle up to 60 degrees).

4 Are energy companies installing smart meters appropriately?

As noted previously, ESV has undertaken a review that has focused on the electricity distribution companies' installation practices. However, a number of further queries and issues have been raised about installation practices since, which are addressed in this section. Key issues include:

- Are smart meter installers appropriately qualified?
- Are meters installed on boards/panel that are safe?
- Who is responsible for replacing boards/panels?
- Do the Electrical Inspectors attending a HV injection have the correct test equipment, and what happens if the installer comes across wiring issues?

4.1 Are smart meter installers appropriately qualified?

Following the initial installation of smart meters, there was considerable media interest, union and community concern in relation to public and worker safety associated with the installation of the smart meters.

Much of the earlier concerns focused on two key questions namely:

- Are the meters being installed by unqualified people?
- Are the contracting practices of the electricity distribution companies (e.g. piece work) contributing to or leading to unsafe practices?

In 2011, ESV conducted a review of a number of issues related to the installation of smart meters. This review was informed by the investigation into one serious incident reported to ESV as well as audits into the electricity distribution businesses' systems, procedures and practices and their conformance with relevant safety acts and regulations[14].

Overall, ESV's review found that:

- The regulatory regime surrounding the safety requirements for installation of meters - together with the training, qualifications and competency of installers - was comprehensively developed and unanimously agreed to by all stakeholders including unions, industry and training providers.
- The specific AMI installation training programs developed and accredited by the Victorian Registration and Qualifications Authority (VRQA) exceeded the minimum qualification requirements set out in the relevant Order-in-Council.
- Apart from one issue, the electricity distribution companies have and do follow their management systems to ensure that only installers that possess the qualifications, experience and training of installers required under the Order-in-Council are employed.

[14] Principally the Order-In-Council gazetted on 13 August 2009.

- Even though the regulatory regime does not require installers to be licensed and requires qualifications and training that is specific and fit for purpose, in practice the electricity distribution businesses mostly employ licensed electrical workers to install meters.
- In relation to work practices, specifically sub-contracting and concerns about piece work, meters are being installed safely and in accordance with regulations including the requirement to test.
- There are, however, some weaknesses in the reporting of non-conformance to procedures that may allow installers to avoid sanctions under the "two strikes" policy that some electricity distribution businesses have.
- It is possible for meters to be installed safely in 10 minutes but the actual time to complete the installation depends significantly on location, access and a range of other external influences.
- There are differing standards of qualification and experience required in other states to obtain a licence but, under mutual recognition arrangements, Victoria is required to accept these standards if an application is made to transfer an interstate licence to Victoria. Energy Safe Victoria recommended changes to licensing administration prior to the introduction of the National Occupational Licensing System in 2013 to ensure that a more rigorous "like for like" test is applied.

Overall, the review concluded that the public should have confidence that the meters are being installed safely and by qualified and trained people. However, it also identified some opportunities to further enhance the safety of the program.

4.2 Are meters installed on boards/panels that are safe?

The ETU and a number of media reports have focused on the issue of whether it is appropriate for smart meters to be installed on chipboard backing boards.

In summary, the regulatory requirements related to backing boards are as follows:

- Section 42 of the Electricity Safety Act requires all installations to be wired in accordance with the regulations.
- Regulation 202(b) of the *Electricity Safety (Installations) Regulations 2009* requires compliance with the wiring rules, AS/NZS3000.
- AS/NZS3000 Clause 2.5.5.1 note 1 requires switchboards to comply to AS/NZS3439.1.
- Clause 7.1.1 of AS/NZS3439.1 requires switchboards be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity that are likely to be encountered in normal service.

About 30 years ago the State Electricity Commission of Victoria accepted treated chipboard as suitable for this application. While chipboard is no longer installed, the condition of the board can deteriorate if, for example, the meter box door is left open and the board is exposed to weather. This would be unlikely to be considered 'normal service'.

The electricity distribution companies provide their work teams with procedures that describe what is acceptable in relation to the condition of boards and panels and guide the installer to make an informed decision as to who has responsibility for the replacement. ESV's review of these procedures found the process to be appropriate and suitable for the purpose

and that there is no safety or economic justification for requiring retrofitting of all older-style boards and panels.

SECURE has installation guides for its products that provide basic recommendations of how to install the meters. The meter is designed to be located and installed in compliance with local and national standards, regulations, and the Victorian Service and Installation Rules.

4.3 Who is responsible for replacing backing boards?

The electricity distribution companies have processes to identify substandard metering boards and panels. Between 1 July 2010 to 9 March 2012, 808,575 smart meters were installed in Victoria. In the course of installing these meters, 41,126 meter panels/boards were identified as sub-standard and replaced. As a result, more than 40,000 Victorian customers now have a safer electrical installation due to the government's smart meter rollout initiative.

Customers are responsible for providing a weatherproof enclosure for housing the meters mounted on a meter panel or in many cases for older installations mounted on a meter board under a veranda providing protection from the weather. As part of the smart meter rollout, the electricity distribution companies have assumed responsibility for replacing damaged or deteriorated timber (e.g. chipboard) meter panels or timber meter boards where the meter enclosures are not damaged or deteriorated.

Since the mid 1990s, customers have been required to install meter panels to the new standard (composite panel). These meter panels are owned by the customer and form part of the customer's electrical installation. Customers are legally responsible for replacing any such damaged or deteriorated boards/panels, although businesses have, by custom and practice, replaced them as part of the smart meter rollout.

4.4 Do the Electrical Inspectors attending a HV injection have the correct test equipment?

Each of the electricity distributor companies is required to adhere to VESI procedures, which require Electrical Inspectors to carry test equipment necessary to "ensure electrical integrity and safety of each installation by visual inspection and, if appropriate, testing of wiring and equipment to determine the presence and extent of any damage". This may include testing for anomalies and damage of:

- Point of attachment.
- Service protection equipment.
- Consumer mains connections.
- Metering equipment.
- Mains switchboard equipment.
- Main-earth-neutral connection.

4.5 What happens if the installer comes across wiring issues?

Section 43 of the Act relates to the safety of electrical installations:

(1) A person must not install any electrical equipment which the person knows or should reasonably be expected to know is unsafe or will be unsafe if connected to an electricity supply.

Penalty: 40 penalty units.

(2) The occupier of any premises in which there is any unsafe electrical equipment must—

(a) cause the electrical equipment to be removed from the premises or to be made safe; or

(b) in the case of electrical equipment forming part of an electrical installation, notify the owner of the premises of the unsafe electrical installation.

Penalty: 40 penalty units.

(3) An owner of premises who is notified under subsection (2) must cause the electrical installation to be removed from the premises or to be made safe.

Penalty: In the case of a natural person, 40 penalty units;

In the case of a body corporate, 200 penalty units.

Ultimately, if a person finds an unsafe situation they are obliged to inform the owner who must rectify it if they wish to remain on supply.

In some cases, the electricity distribution company may fix the fault. However, in most cases the safety of the installation is the responsibility of the owner. The electricity distribution company in extreme situations may disconnect supply until the defect is rectified.

The smart meter rollout has identified over 10,000 safety defects since it began, which have been or are being rectified. Examples of identified defect types are:

- Bare and exposed terminals and conductors.
- Unterminated active and neutral cables/wires.
- Failure in customer mains identified by a neutral supply test (NST).
- Deteriorating wiring is found after inspecting the terminal covers.
- Damaged fused main box that won't allow fuse removal safely.
- Deteriorated meter enclosure that does not protect meter.
- Underground consumers mains defect after point of supply.
- Faulty earth connection.
- Faulty neutral link.
- Evidence of overheating on metering cables

5 Conclusions and recommendations

Based on the available information, ESV's conclusions as to the safety of smart meters are:

- Smart meters are specifically designed to fail safely to reduce the risk of personal damage and injury when they do fail, and the evidence provided to ESV supports this.
- The reported meter failures in the northern suburbs are attributable to criminal damage rather than HV injection.
- The electricity distribution companies are following VESI minimum procedures for responding to a HV injection when it occurs, which includes requirements to inspect metering equipment and test as necessary. ESV is not aware of any evidence that suggests that all meters on a circuit that have been exposed to a HV injection would need to be replaced.
- The smart meters being installed in Victoria meet current Australian Standards including those related to safety, and those standards are robust and appropriate.
- There is no evidence to suggest that the safety risks associated with smart meters are any greater than older style electronic or electromechanical meters.
- There is no evidence to suggest that smart meters are exploding or causing fires.
- Evidence shows that smart meters perform in a safe manner when subject to transient high voltage and that latent failures are unlikely in these circumstances.
- The procedures that describe what is acceptable in relation to the condition of meter boards and panels prior to meter installation are appropriate and suitable for the purpose;
- Electrical Inspectors are required to carry test equipment when they inspect and test meters.
- The electricity distribution companies' procedures are all consistent with the minimum requirements set out in section 4.17 of the Installation Supply Connection Tests and Procedures manual.
- To ensure continual improvement ESV requested that the VESI committee responsible for Section 4.17, High Voltage Injections, of the VESI manual meet to review the procedure and identify any areas that may require refinement in light of emerging evidence and experiences. In June 2012 the procedure was updated to insert a relevant statement.
- While it is generally the responsibility of customers to replace boards/panels that have been damaged or deteriorated as a result of inadequate weather protection, more than 40,000 boards/panels have been replaced by the electricity distribution businesses during the rollout at their cost.
- In addition to the replacement of meter boards/panels, the smart meter rollout has identified over 10,000 safety defects since it began, which have been or are being rectified.

A Outcome of incident investigations

ESV asked each of the electricity distribution companies to report to us on the outcome of their investigation of recent smart meter failures. A summary of the key incidents and outcomes of the electricity distribution companies' findings are contained in the sections below.

A.1 Jemena

Between 28 December 2011 and 1 March 2012, a number of customers within a small geographical area in the northern suburbs reported failures of smart meter installations. All of these installations failed safely without any evidence of fire or explosion.

Jemena investigated the circumstances surrounding these failures. Of the reported smart meter failures, all but one showed signs of a significant flashover at the meter terminals.[15] There was no obvious fault with the other installation.

Subsequent laboratory testing confirmed that the principal cause of the meter failures was criminal damage. Jemena has provided this evidence to Victoria Police, which is now investigating.

In response to the incidents, Jemena reissued work instructions to its employees that relate to 'Interim safe work procedures for low voltage electricity meter fault response' and 'electronic meter incident analysis and escalation procedures'.

A.2 SP AusNet

In response to ESV's requests for information, SP AusNet reported seven HV injection incidents that resulted in meter failures within its distribution network between 1 July 2010 and 9 March 2012.

The most recent HV injection incident in SP AusNet's areas occurred on 3 March 2012 and affected 62 houses, where 44 had smart meters installed. Only two of the meters were replaced due to failure [note: damage occurred to customer appliances at 12 houses and eight of these premises had smart meters installed].

A.3 United Energy

Following a recent significant HV injection event in United Energy's geographical area, a number of meters were reported as damaged, it was observed that the new meters behaved in a different manner following a HV injection than older meters, and United Energy

[15] In the context of these failures, a flashover means a significant flow of current caused by a short circuit between the active and neutral connection points.

implemented interim control measures while an investigation into the performance and failure modes of the meters in question was conducted.

On 28 November 2011, a HV injection occurred in and around Racecourse Rd, Noble Park. The HV injection was caused when a truck carrying a large water tank contacted an Optus cable that broke and flicked upwards. This action resulted in a short circuit between the HV and LV overhead conductors and a HV injection occurred on the west circuit of Racecourse-Corrigan substation.

The HV injection resulted in damage to customer appliances at 56 individual premises. The HV injection was attended by licensed electrical installation inspectors and supply restored in accordance with United Energy's procedures.

Although the recorded fault data does not clearly indicate it, experience with HV injections and the extent of damage indicates that this event was more severe than is generally the case.

Eighty-one premises were inspected following the fault. Appliance damage was recorded at 61 of those premises. All of the customer claims for appliance damage were managed by United Energy's customer care processes.

Damage to the metering installations manifested either as:

a) Substantial and readily-visible flashover or heat damage to the meter terminal block and/or the meter casing or

b) A defective operational state of the meter.

The meter faults were initiated in one of three ways:

a) Immediate failure of the internal electronic components due to temporary overvoltage, or

b) Immediate carbonisation due to arcing at the connection terminals, or

c) Failure of the meter following re-energisation.

There were two reports arising from this event that suggested to United Energy that an investigation into the failure mode of electronic meters was warranted. These were:

- One report that there had been fire at the meter board, and that CFA had attended.
- A report that a meter had 'caught fire' on re-energisation.

In the first case, it was reported that CFA had attended. The Licensed Electrical Inspector reported that the HV injection initiated a fire within the meter box that was extinguished by the CFA who attended the site. There was extensive damage to the installation switchboard and smart meter all of which were replaced the same day. Switchboard damage and fire is reported in isolated cases following a HV injection. In this case, there is no evidence that the fire was initiated by the smart meter.

In the second case, the Licensed Electrical Inspector reported that the AMI electronic meter began to heat up after re-energisation and that the meter's internal failure mechanisms operated and produced smoke and possibly internal arcing. There were no flames and the hazard was quickly eliminated by removal of the service fuse. This event was contained to the

meter with no damage to the meter panel, wiring or structure. A fire extinguisher was available but was not used.

The failure mode is consistent with advice from the manufacturer that this is a fail-safe characteristic of the meter.

A.4 CitiPower and Powercor Distribution

CitiPower and Powercor provided meters, photos and other data relating to seven HV injections (which included two lightning strikes) that occurred in 2012 as case studies of the above issues, including the category[16] of meter failure and subsequent failures:

Altona North - 1/2/2012
Woodend - 1/3/2012
Hamilton - 9/3/2012
Dookie (lightning) - 14/3/2012 (single premise)
Eppalock (lightning) - 14/3/2012 (single premise)
St Albans - 1/4/2012
Sunshine West - 9/4/2012

Of the more than 1.2 million meters installed in Victoria, ESV is aware of only two proven cases of a switchboard fire having occurred due to a component failure, manufacturing fault within, or the installation of, a smart meter.

In the first case, which occurred in Maldon in March 2011, a review by CitiPower/Powercor and investigation by ESV confirmed the fire resulted from a manufacturing defect associated with a high resistance joint caused by a loose internal screw. The manufacturing process has since been changed to remove this issue and no other similar incident has been reported since.

In the other case, which occurred in West Brunswick in October 2011, a fire was observed by the occupant of the house coming from the meter/meter board and the Metropolitan Fire Brigade was called. CitiPower/Powercor's investigation is continuing, but has so far identified that either a high resistance joint or the failure of an electronic component caused the fire.

A list of all HV injections back to late 2010 has also been assembled by CitiPower/Powercor. A manufacturer bulletin from PRI/SECURE has also been provided that contains their assessment in relation to the failure mode of their products for the various meter types that have been subject to a HV injection. The investigations and evidence support ESV's public statements that the meters subject to a HV injection have failed without any systemic risk of fire or electric shock.

[16] CitiPower and Powercor placed all the failed smart meters into one of three categories prior to removing the meter covers: Cat3 – external signs of failure, Cat2 – internal component failure with no external signs of failure, Cat1 – no signs of failure apart from the meter not operating properly.

ESV continues to work with CitiPower/Powercor on two other meter failures that occurred in Woodend and Keilor East where there had been a HV injection some months earlier. However, these meter failures did not result in fire and failed as designed in a manner that posed minimal safety risk.

More generally, ESV will continue to work with industry and manufacturers to monitor incidents involving smart meters and identify any trends of failure modes that may offer opportunities to improve procedures, designs and manufacturing processes.