Security and Reliability Council

Reliability implications of reduced use of high voltage live line work techniques

Why health and safety decisions may reduce use of HV live line work and what this means for reliability of electricity supply

28 July 2017

Note: This paper has been prepared for the purpose of discussion. Content should not be interpreted as representing the views or policy of the Electricity Authority.

Contents

Executive summary

High voltage (HV) live line work has been undertaken by network businesses—Transpower and distributors—since around the early 1990s. Network businesses typically undertake a relatively small portion of their HV line work live, using well-established, specialised techniques and equipment. They use live work to maximise maintenance windows while maintaining supply security and reliability.

The Health and Safety at Work Act 2015 (HSWA) came into effect in April 2016. With the passing of the HSWA and in light of informal guidance from Worksafe New Zealand (Worksafe), many network businesses initially changed their practices to do more of their HV line work de-energised. Some stopped live line work altogether. The overall effect has been that network businesses have paused to thoroughly review their current approach and worksite practices related to live line work.

Less live line work generally results in increased planned SAIDI and SAIFI for distributors and decreased circuit availability for Transpower, which in some cases requires outages at grid connection points. Supply *security* decreases with increased planned outages in parts of networks that have redundant circuits. Supply *reliability* decreases in parts of networks that do not have redundant circuits. Quantification of the impact on security and reliability does not yet exist.

Coordinated and published by the Electricity Engineers' Association (EEA), network businesses developed a guideline that sets out a risk-focused decision-making framework governing HV line work.

This paper describes the relevant regulatory context within which network businesses operate, how network businesses have responded to the new HSWA and how security and reliability might change.

At this time, the Electricity Networks' Association (ENA) is gathering information from distributors to quantify their changes with respect to HV live line work and the impact on security and reliability. Collection of this data will assist network businesses and policy-makers to make evidence-based decisions.

The secretariat recommends that the Security and Reliability Council (SRC):

- consider whether network businesses, when making choices about whether to work live or de-energised on HV lines, face any perverse incentives that are likely to lead to either unsuitable outcomes or overly-narrow decision-making processes
- direct the secretariat to discuss with the SRC Chair in December 2017 what evidence is available at that time and the merits of bringing another paper on this topic to the SRC.

1 Introduction

1.1 This paper addresses an open SRC action item relating to the potential reliability implications from reduced use of HV live line work

1.1.1 This paper outlines and discusses potential supply reliability implications arising from recent changes to health and safety legislation, specifically the Health and Safety at Work Act 2015 (the HSWA).

1.1.2 At its meeting on 15 March 2016, the SRC requested the secretariat to:

> *"Secretariat to provide the reliability-related findings from the Electricity Engineers Association report on the implications of the Health and Safety at Work Act."* (Action item #4 as at 28 July 2017)

1.1.3 This action item did not accurately record the SRC's intention at the time. In particular, there is no such Electricity Engineers' Association report on that topic. The secretariat has instead focussed on the reliability implications of reduced use of HV live line work.

1.1.4 To provide much of the information in this paper, the secretariat has met and discussed relevant matters with a range of stakeholders. The secretariat thanks the following organisations for their assistance:

a) the Electricity Engineers' Association (EEA)

b) the Electricity Networks' Association (ENA)

c) the Commerce Commission

d) Transpower

e) Wellington Electricity

f) LineTech Consulting.

1.2 What is HV live line work and why is it undertaken?

HV live line work means work on overhead lines with voltage greater than 1 kV

1.2.1 This paper adopts the common industry jargon that:

a) lines are overhead conductors, typically pole- or pylon-mounted

b) cables are ground-level conductors, typically trenched, buried or in a tunnel.

1.2.2 Live work on cables is not undertaken for safety reasons. This paper is concerned only with live work on high voltage (HV) lines.

1.2.3 HV is above 1 kV and low voltage (LV) is 1 kV and below. Commonly, HV means 11 kV distribution voltage and above and LV refers to the 400/230 volt network that connects most consumers to networks.

HV live line work began in New Zealand in the late 1980s

1.2.4 While LV live work has been routinely carried out from the earliest days of publicly-available electricity supply, live work on HV lines is a more recent development.

1.2.5 Transpower investigated—and its contractors adopted—live overhead line work techniques in the late 1980s. HV live line work experts from Duke Energy in the USA introduced Transpower

engineers and contractors to the planning, training, techniques, tools/equipment and system operating precautions necessary to safely undertake HV live line work.

1.2.6 HV live line had been practised in the UK since the late 1970s. New Zealand distributors adopted live work practices from the early 1990s.

HV live line work was adopted to reduce planned outages and improve safe working practice

1.2.7 The primary drivers for adopting HV live line work practices were:

a) avoiding the need for circuit outages for many routine HV overhead line maintenance activities, thereby:

   i) increasing the flexibility to complete planned maintenance activities by avoiding the need to arrange (frequently scarce) outage windows

   ii) on parts of the network with circuit redundancy, retaining "all circuits in service" levels of system security while planned maintenance is carried out

   iii) in locations subject to single-circuit supply security, avoiding the need to interrupt supply to consumers

b) *improving* the safety of line maintenance workers (line mechanics), through training using highly specialised work techniques, equipment and tools.

Anecdotally, there have been very few safety-related incidents from live work

1.2.8 There is little historical data available related to safety incidents while using live work practices. In some of the handful of cases, working live on overhead lines has been recorded as the cause of the accident. On review, the cause was usually related to failure to adequately prevent accidental re-energisation when work was undertaken de-energised in the vicinity of live network equipment.

1.2.9 EEA personnel the secretariat spoke with could recall only one event in 25 years of live line working that resulted in a fatality and this incident had other factors—related to the physical and mental state of the worker—that led to the event. The secretariat is aware of a second fatality where a line mechanic was connecting a cable to a live HV line. The secretariat was informed that, in this incident, the cable sheath was not disconnected from earth and the line mechanic was not wearing insulated gloves, presumably contravening work procedures.

2 Regulatory context

2.1 Health and safety regulation does not prohibit HV live line work

2.1.1 The main purpose of the HSWA is to provide a balanced framework to secure the health and safety of workers and workplaces by protecting workers and other persons against harm to their health, safety, and welfare by *eliminating or minimising* risks arising from work.

2.1.2 In furthering this purpose, electrical workers and other persons (i.e. members of the public) should be given the highest level of protection against harm to their health, safety, and welfare from hazards and risks that arise from electrical work or from specified types of electrical plant *so far as is reasonably practicable*.

2.1.3 The duty imposed on a person by or under the HSWA requires the person to eliminate risks to health and safety, so far as is reasonably practicable. If it is not reasonably practicable to

eliminate risks to health and safety, then the duty is to *minimise those risks* so far as is reasonably practicable.

2.1.4 The Electricity (Safety) Regulations 2010 (ESRs) came into force on the 1st of April 2010, revoking the Electricity Regulations 1997. The ESRs promote the health and safety of members of the public in connection with the supply and use of electricity in New Zealand, and promote the prevention of damage to property in connection with the supply and use of electricity in New Zealand.

2.1.5 ESR Regulation 102 deals with work on live HV electric lines and provides that such work must be carried out in accordance with Electrical Code of Practice (ECP) 46.

2.1.6 ECP 46, approved on 19 March 2003, sets out the minimum industry standards for HV live line work. Users may enhance or supplement the principles set out in ECP 46 provided this does not result in reduced safety standards.

2.1.7 In combination, the HSWA, the ESRs and ECP 46 provide the legal framework governing HV live line work. There is no prohibition on HV live line work within any of this health and safety related regulation. In addition, EEA's practice note *ECP 46 High Voltage Live Line Work Industry Practice Note* (May 2017) enhances and supplements ECP 46.

2.1.8 More detail on this health and safety context is included in Appendix A.

2.2 Worksafe consider EEA's Guide to be good industry practice

2.2.1 WorkSafe made a keynote presentation at the recent EEA conference titled *EEA 2017: Electricity Challenges: Industry Solutions* held in Wellington, 21 – 23 June. The points from that address of most relevance for this paper were that Worksafe:

a) wished to correct the widely-held perception that it had issued a blanket-ban on live line work

b) were supportive of the EEA's *Guide for the Assessment of Work Methods to Undertake High Voltage Overhead Line Work* and considered it to be good industry practice (EEA's Guide).

2.3 The Commerce Commission's price-quality targets for distributors are based on historic performance that was achieved while using HV live line work

2.3.1 Individual distributor quality (essentially, reliability) thresholds for SAIDI and SAIFI are set under price-quality path regulation administered by the Commerce Commission. Individual distributor SAIDI and SAIFI thresholds have been set against individual historical quality performance. The quality thresholds thereby directly incentivise distributors to maintain existing quality levels and indirectly incentivise distributors to embed current work practices (such as HV live line work) that contribute to maintaining historic levels of quality.

2.3.2 If distributor live work practices materially change from historic levels, assuming the same level of maintenance work is carried out, this will flow through to the number and duration of planned outages required to complete HV line maintenance programmes. This will impact both supply security and reliability.

2.3.3 If outage windows cannot be found to complete annual maintenance programmes and work completion rates slip, all else being equal, this will drive poorer average HV line asset condition over time. This should increase the number and duration of unplanned outages experienced and flow through into the SAIDI and SAIFI quality metrics.

2.3.4 These generalities represent qualitative cause and effect; there is no quantifiable information available at this stage but we will revisit this in a later section of this paper. Both generalities contain key assumptions that may not hold in all cases. For example, one of the network businesses the secretariat spoke with now reschedules much of the line maintenance it would have done live to be completed de-energised at the same time they were already scheduled to undertake de-energised line maintenance on related equipment.

3 The industry has responded by reviewing its use and application of HV live line work and what reduced usage would mean for their businesses

3.1 Network businesses have responded in a variety of ways

3.1.1 In general, network businesses initially responded by reducing the amount of live line work they were doing, in some cases eliminating it, while reviewing their approach. Some specific examples follow.

3.1.2 Notably amongst distributors, in late 2015, Vector changed its standard practice of undertaking some HV line work live and adopted a new default stance of prohibiting live work on its network. Vector is understood to allow a very small amount of live work but only where this is absolutely necessary. We understand some other distributors have followed Vector's lead.

3.1.3 Reflecting some other distributor approaches, Wellington Electricity still does live work but has eliminated some of the live work techniques its contractors had been using, retaining only what they refer to as the "core techniques". Wellington Electricity has a relatively high level of redundancy inherent in its network design (eg 400 volt ring feeds around the Wellington CBD and the ability that provides to move load between 11 kV feeders) which means there is already a lot of maintenance it performs de-energised without loss of supply to consumers .

3.1.4 Transpower had traditionally undertaken around 25% of its overhead line work using live line techniques. In its review, Transpower noted that preserving system security was traditionally the main driver for doing maintenance work live. However, its review concluded that for circuits with "n-1" security it was virtually always preferable to temporarily reduce security to "n" and work de-energised. By grouping de-energised maintenance work together, Transpower also minimises the number of hours spent operating at "n" security. Transpower estimated that this changed practice would reduce the circuit availability of its 29 "critical circuits" by 0.1 – 0.2%[1].

3.1.5 For "n" security transmission circuits, Transpower considered that moving to de-energised work would increase the duration of constraints but, again, it would seek to improve its coordination of line work with other planned de-energised work.

3.1.6 Transpower has not banned live line work outright but is now doing considerably less live work than it was doing pre-2015.

3.1.7 Transpower notes its revised approach has reduced the demand on specialised contractor resources to the extent that its contractors cannot economically retain the necessary line mechanic competencies and specialised equipment. Transpower has not finalised its policies yet but considers it is unlikely to change its course.

[1] 0.1 – 0.2% of availability represents about 9 – 18 hours per annum.

3.2 EEA encountered divergent views while developing its guideline

3.2.1 Given the wide impacts of the HSWA, particularly in respect of the need to adopt a robust top-to-bottom risk management framework for assessing the competing demands of health and safety on the one hand and system security and reliability on the other, network businesses engaged through the EEA to produce a guideline for HV line work.

3.2.2 EEA's *National Committee on Live Work:*

a) brought together representatives from Transpower, distributors and their contractors and has included engagement with and participation from WorkSafe

b) sought an accord amongst contributors on the HSWA objective, which imposes a duty on a person:

i) to eliminate risks to health and safety, so far as is reasonably practicable; and

ii) if it is not reasonably practicable to eliminate risks to health and safety, to minimise those risks so far as is reasonably practicable.

3.2.3 As described in section 3.1, network businesses have developed and held a range of views on this question. Resolving divergent views has taken some time, reflected in the time it took EEA to finalise and publish the EEA Guide.

How did EEA approach its review?

3.2.4 EEA published its *Guide for the Assessment of Work Methods to Undertake High Voltage Overhead Line Work* (EEA Guide) in September 2016 and reissued it in May 2017 with some minor improvements.

3.2.5 EEA took a broad look at workplace safety, including practices in international jurisdictions in the UK, Australia and Europe (specifically the UK *Electricity at Work Regulations 1989* – Regulation 14), and developed the view that the safety objectives expressed in the HSWA *must be considered in whole*.

3.2.6 This led to the EEA Guide's underpinning premise that:

> *"no person shall be engaged in any work activity on any live conductor that danger may arise unless—*
>
> *a) it is not reasonably practicable in all the circumstances for it to be de-energised; and*
>
> *b) it is reasonable in all the circumstances for the worker to be at work on it while it is live; and*
>
> *c) suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent harm."*

3.2.7 The Guide takes the stance that the HSWA requires all persons involved in the governance, management and practice of live line work to take a considered, balanced view of *all relevant risks*.

3.2.8 EEA considers that relevant risks go beyond worker and public safety and include:

a) the risks involved in undertaking the work de-energised, which, in turn, brings in consideration of operating risks (eg incorrect switching and isolation) and

b) risks associated with planned losses of supply to customers.

3.2.9 EEA considers that the criticality of the assets being worked on is the primary criterion that should be assessed when deciding between live or de-energised/isolated modes of work. EEA considers that the broader safety implications of undertaking de-energisation of part of a network, such as the impact on medically dependent people, the loss of traffic control etc., must be considered when considering criticality.

3.2.10 While the Guide covers live HV line work only, EEA's next related task is to develop a similar guide for LV work (ie work on the 400/230 volt mostly radial networks to which most of New Zealand's 2+ million customers directly connect). This will raise new and wider considerations, for example, of the emerging and growing incidence of distributed electricity sources, such as LV network-connected solar PV and consumer-installed batteries. The vast majority of LV network work is currently undertaken using live work techniques.

3.3 ENA approached the Commerce Commission and are collecting more data

3.3.1 The Electricity Networks Association (ENA) has a project underway to quantify the SAIDI and SAIFI impacts directly attributable to distributors' responses to the new HSWA.

3.3.2 In January 2017, ENA met and discussed their concerns with the Commerce Commission in the context of regulated distributors' price-quality path regulation. ENA considered that reductions in the amount of live line work undertaken by network businesses would inevitably reflect in the levels of planned SAIDI and SAIFI reported by distributors under the Information Disclosure Regulations and thereby increase the likelihood that a distributor might breach its quality threshold under the price-quality path regulation.

3.3.3 ENA considered there is a case to re-open default price-quality paths (DPPs) to take account of the change. The Commerce Commission may re-open (re-assess) a DPP for a 'change event' (that includes a change in legislative or regulatory requirements) occurring within the current regulatory period if it has not been explicitly provided for in the DPP. To qualify for reconsideration the change event must have a negative impact on revenue that exceeds 1% or causes an input methodology to become incapable of being applied.

3.3.4 The Commerce Commission has not seen evidence of financial impact in excess of the threshold. The onus is on distributors to compile quantified evidence of the potential issue in terms of price-quality path regulation.

3.3.5 ENA is using a robust independent survey approach to collect information about whether and how individual distributors intend to change their approaches to HV live line work and to obtain distributors' assessments of the impact on their SAIDI and SAIFI quality metrics. This project is currently in progress.

4 Understanding industry responses and their impacts, and what this means for an efficient level of reliability and the SRC's next steps

4.1 Timeline of key actions so far

4.1.1 Table 1 below sets out a timeline of key actions relevant to the likelihood of HV live line practices being used, categorised by whether each action has been a catalyst for responses or a response.

Table 1: Timeline of key actions relevant to HV live line practices being used

Date	Catalyst or response?	Action
September 2015	Catalyst	HSWA passed, Subpart 4 of Part 5 comes into force
2H 2015	Catalyst	Worksafe personnel meet with various network businesses and leave them with the impression that any incident involving live line work would have a high likelihood of leading to attempted prosecution under HSWA.
2H 2015	Response	Various network businesses start reviewing and changing their practices with respect to HV live line work. In general, HV live line work has been used less ever since.
April 2016	Catalyst	HSWA comes fully into force
September 2016	Response and catalyst	Publication of EEA's *Guide for the Assessment of Work Methods to Undertake High Voltage Overhead Line Work*
October 2016	Response	Various network businesses re-review their use of HV live line work in light of published EEA Guide.
January 2017	Response	ENA approached the Commerce Commission to discuss reduced HV live line work leading to decreased security and reliability for consumers
1Q 2017	Response	ENA starts formally gathering quantitative information from its members to assist future decision-making
June 2017	Catalyst	Worksafe address to EEA conference makes explicit the absence of a ban on live line work and the support for the EEA Guide.

4.1.2 Given ENA's information gathering remains as work in progress and reflecting that Worksafe's explicit support of the EEA Guide is a very recent development, network businesses are likely still taking stock of the situation and further responses should be expected.

4.2 There are several impacts that can reasonably be expected from a reduction in HV live line work

4.2.1 The secretariat considers it is reasonable to conclude that there has been a reduction in HV live line work and this will result in:

a) reduced security and reliability, though consumers won't notice reduced security unless it manifests into an outage

b) a smaller pool of personnel qualified to undertake HV live line work, especially on transmission assets

c) increased costs of maintaining networks, as network businesses perform more analysis to choose a work method (live or de-energised) and have higher costs of more de-energised work (which generally takes more time and involves more personnel).

Reduced security and reliability

4.2.2 Reduced security will occur where consumers that were supplied by equipment with redundancy (n-1 or greater) have more hours every year where that security is temporarily reduced while de-energised maintenance is undertaken. Where this puts consumers on 'n' security and it coincides with a failure of the remaining circuit, consumers will then experience an outage.

4.2.3 The basis for expecting reduced reliability has been explained earlier in paragraphs 2.3.2-2.3.4. More frequent planned outages and longer unplanned outages can be expected to occur.

A smaller pool of personnel qualified to undertake HV live line work

4.2.4 HV live line work requires line mechanics to undertake specialised training and use special work techniques and equipment. Electrical maintenance contractors require a minimum level of work from network businesses to maintain line mechanic competencies and justify the investment and re-investment in specialised equipment.

4.2.5 Transpower is concerned that since it significantly reduced demand for HV live line work, its specialised transmission contractors will not be able to justify retaining the requisite competencies and capabilities for such a small amount of work.

4.2.6 In respect of distributors and their contractors, it appears unlikely that live work capabilities will be completely lost. The total amount of HV live line work on distribution networks has reduced, so it is reasonable to expect the total pool of qualified personnel should also reduce. The pool of personnel qualified for live work on HV distribution lines is, in effect, shared amongst all distributors.

4.2.7 EEA personnel expressed a concern to the secretariat that there are too many "qualified" live line workers who are not practising their live work techniques regularly enough to maintain proficiency. If this concern is valid, a reduction in the number of personnel qualified to undertake HV live line work could be beneficial if it raised the proficiency of the remaining personnel.

Increased costs of maintaining networks

4.2.8 The secretariat understands that reduced levels of HV live line work will lead to network businesses having higher costs due to:

a) more time and effort to perform analysis to choose a work method (live or de-energised)

b) more de-energised work taking more time and involving more personnel.

4.3 The impacts are unquantified and may not be deleterious overall

4.3.1 The impacts discussed in section 4.2 are not necessarily deleterious. The Authority seeks to promote an *efficient level of reliability* for the long-term benefit of consumers. It is possible for a reduction in reliability to be in the long-term benefit of consumers, though typically one would expect some associated cost reduction for such a situation to be true. Typical regulatory policy questions of this type concern the trade-offs involved in the different levels of reliability that arise from having more or less power system asset capability (and the attendant cost).

4.3.2 In the case of reduced HV live line work, the secretariat expects both a reduction in reliability and an increase in charges to consumers. However, if there are other benefits that accrue to consumers through their roles in society, then the change could still be of net benefit. In principle, improved worker and public safety could lead to lower healthcare costs, lower insurance costs and of course fewer injuries and fatalities.

4.3.3 Understanding that trade-off is a values-laden question that is better addressed by a policy-maker with a broader ambit than the Authority's electricity-specific objective.

4.3.4 In any case, the current lack of quantification of the impacts would make any policy decision-making less evidence-based. Accordingly, any reasonable policy-maker should be less willing to intervene while quantifiable evidence is unavailable.

4.4 The SRC should consider whether network businesses are facing any perverse incentives and request an update when quantifiable evidence is available

4.4.1 Network businesses have taken serious stock of their approaches to using HV live line work as a routine maintenance practice. However, this process is far from over and more time is needed to reach a new equilibrium and have data about the differences before and after.

4.4.2 Furthermore, the question of whether the changes to use of HV live line work are of net benefit to consumers (all things considered, including the benefits of improved safety) is too broad a question for the SRC or the Authority to consider.

4.4.3 Accordingly, the secretariat recommends the SRC:

a) consider a narrower question of whether network businesses, when making choices about whether to work live or de-energised on HV lines, are facing any incentives that are likely to lead to either perverse:

   i) outcomes

   ii) decision-making process (such as the value of lost load from consumer outages never entering into a business's decision about whether to choose between live and de-energised work methods)

b) direct the secretariat to discuss with the SRC Chair in December 2017 what evidence is available at that time and the merits of bringing another paper on this topic to the SRC.

4.4.4 The secretariat has not seen evidence to suggest that, as of July 2017, network businesses will be incentivised to make perverse decisions.

5 Questions for the SRC to consider

5.1.1 The SRC is asked to consider and provide advice on the following questions:

Q1.	Is the SRC aware of any evidence to suggest network businesses are encountering incentives that will lead to perverse outcomes or decision-making?
Q2.	Does the SRC wish to direct the secretariat to discuss the topic with the SRC Chair in December 2017?
Q3.	What further information, if any, does the SRC wish to have provided to it by the secretariat?
Q4.	What advice, if any, does the SRC wish to provide to the Authority?

Appendix A Health and safety regulation does not prohibit HV live line work

A.1 The HSWA, Electrical Safety Regulations and Codes of Practice provide a framework for safety

A.1.1 This appendix is a more detailed version of the material presented in section 2.1 of this paper.

A.2 The HSWA reformed health and safety legislation

A.2.1 The HSWA is part of a reform package aimed at reducing the number of serious work-related injuries and deaths by at least 25% by 2020. It has broad coverage and applies to all work undertaken in New Zealand, with few exceptions.

A.2.2 The HSWA shifts the focus from monitoring and recording health and safety incidents to proactively identifying and managing health and safety risks.

A.2.3 Under HSWA, most responsibilities relate to the conduct of work and how it can affect workers and others, however there are duties that relate to the physical workplace (where a worker goes or is likely to be while at work), as well as any place where work is normally carried out, for example, a vehicle, vessel, aircraft, ship, or other mobile structure.

A.2.4 The HSWA provides clear responsibilities for all that can influence health and safety risks.

a) **Businesses** have the primary responsibility for the health and safety of their workers and any other workers they influence or direct (such as contractors). They are also responsible for the health and safety of people at risk from the work of their business.

b) **Officers** (company directors, partners, board members, chief executives) must undertake due diligence to make sure the business understands—and is meeting—its health and safety responsibilities.

c) **Workers** must take reasonable care of their own health and safety and ensure their actions don't adversely affect the health and safety of others. They must also follow any reasonable health and safety instruction given to them by the business and cooperate with any reasonable business policy or procedure relating to health and safety in the workplace.

d) **Other people** who come into the workplace, such as visitors or customers, also have some health and safety duties to ensure that their actions don't adversely affect the health and safety of others.

A.3 How the HSWA applies to electricity networks

A.3.1 The main purpose of the HSWA is to provide a balanced framework to secure the health and safety of workers and workplaces by protecting workers and other persons against harm to their health, safety, and welfare by *eliminating or minimising* risks arising from work.

A.3.2 In furthering this purpose, electrical workers and other persons (i.e. members of the public) should be given the highest level of protection against harm to their health, safety, and welfare from hazards and risks that arise from electrical work or from specified types of electrical plant *so far as is reasonably practicable*.

A.3.3 The duty imposed on a person by or under the HSWA requires the person to eliminate risks to health and safety, so far as is reasonably practicable. If it is not reasonably practicable to eliminate risks to health and safety, then the duty is to *minimise those risks* so far as is reasonably practicable.

A.3.4 The italicised phrases highlight two critical factors:

a) elimination or minimisation of risk

b) how to interpret "reasonably practicability".

A.4 Where the Electricity (Safety) Regulations fit in

A.4.1 The Electricity (Safety) Regulations 2010 (ESRs) came into force on the 1st of April 2010, revoking the Electricity Regulations 1997. The ESRs promote the health and safety of members of the public in connection with the supply and use of electricity in New Zealand, and promote the prevention of damage to property in connection with the supply and use of electricity in New Zealand.

A.4.2 The ESRs address safety with respect to safe electrical equipment and appliances and design and installation standards. In particular, the ESRs:

a) gather together and state the generic rules and requirements about electrical safety, and what is deemed to be electrically safe and electrically unsafe

b) deal with the design, construction and use of works, installations, fittings, and appliances

c) deal with the importation and sale of fittings and appliances

d) provide for installations to be designed and installed under the standard AS/NZS 3000

e) define requirements relating to safety management systems

f) set out in schedules all the standards applicable to the regulations, with a focus on the adoption of international standards

g) provide for offences including infringement offences.

Regulation 101 specifies employer responsibilities

A.4.3 ESR Regulation 101 deals with the responsibility of employers for the safety of employees undertaking prescribed electrical work, in particular requiring employers to, so far as is reasonably practicable:

a) provide safe working procedures for employees to follow when carrying out the work

b) ensure that any associated equipment and personal protective equipment used by an employee is arranged, designed, made, tested, inspected, and maintained so that it is safe for the employee to use.

A.4.4 Further, the employer must ensure, so far as is reasonably practicable, that the employee who carries out the work:

a) has adequate knowledge and experience of the type of work being carried out

b) has been adequately trained in the safe use of the associated equipment, the personal protective equipment, and the procedures for carrying out the work

c) immediately before the start of the work, checks that the associated equipment and personal protective equipment is in good order and condition

d) uses the equipment and the procedures that the employer has approved for the work.

A.4.5 The responsibilities of the employer set out in Regulation 101 are in addition to, and do not limit, the responsibilities of the employer under HSWA.

Regulation 102 deals with live work on HV overhead lines

A.4.6 Regulation 102 deals with work on live HV overhead electric lines and provides that such work must be carried out in accordance with (Electrical Code of Practice) ECP 46.

A.5 ECP 46 is the code of practice specific to HV overhead live line work

A.5.1 ECP 46, approved on 19 March 2003, sets out the minimum industry standards for HV live line work. Users may enhance or supplement the principles set out in ECP 46 provided this does not result in reduced safety standards.

A.5.2 ECP 46 applies to all work undertaken on live HV overhead lines using approved procedures, tools and equipment, and by persons holding the minimum competencies detailed within the Code.

A.5.3 ECP 46 deals with three specific HV live line work techniques:

a) **ECP 46.1 - Glove and Barrier:** a method of performing live line work where the worker is fully insulated from earth and other phases, using approved insulating gloves and sleeves, insulating platform and/or insulating elevating work platform and insulating barriers.

b) **ECP 46.2 - Barehand:** a method of performing live line work in which the worker is in contact with energised components while insulated from other objects at different voltage potential and maintaining minimum approach distances. Access to the components may be by insulating ladders, live line ropes, insulating elevating work platforms, cranes or helicopters.

c) **ECP 46.3 - Stick:** a method of performing live line work using tools and equipment mounted on live line sticks, with the worker maintaining the minimum approach distance from energised components.

A.5.4 ECP 46 is not a live line training manual and does not set down live line work procedures. ECP 46 requires that these procedures should be developed in accordance with the principles stated within ECP 46.

A.6 EEA published a practice note about ECP 46

A.6.1 In 2014/15, in consultation with industry, EEA's National Committee on Live Work undertook a review that identified a number of areas of possible change to improve the ECP 46 work practices and align with updated standards. This work culminated in publication of the EEA practice note *ECP 46 High Voltage Live Line Work Industry Practice Note, May 2017.*

A.6.2 The practice note provides updated information that enhances and supplements safety standards relating to practices in ECP 46 used by live line workers when undertaking HV live line work. This includes specific information on each of the three techniques included in ECP 46, i.e. glove and barrier, barehand and stick.

A.7 The legal framework does not prohibit HV live line work

A.7.1 In combination, the HSWA, the ESRs and ECP 46 provide the legal framework governing live HV overhead line work. There is no prohibition on HV live line work within any of this health and safety related regulation. In addition, EEA's 2017 practice note on ECP 46 enhances and supplements ECP 46.

A.7.2 The effect of the HSWA in 2015 was to clarify and sharpen the responsibilities for safety outcomes at all business levels, from directors at governance level, through management levels to planners, supervisors and the line mechanics themselves. This has given risk management real focus, dealing with both static and dynamic risk.