

**NEW ZEALAND ELECTRICAL
CODE OF PRACTICE
for
HIGH VOLTAGE LIVE LINE WORK**

Part 1

Glove and Barrier

Issued by:

Manager, Standards and Safety
Ministry of Consumer Affairs
Wellington, New Zealand

THE ELECTRICITY ACT 1992

Approval of the New Zealand Electrical Code of Practice for High Voltage Live Line Work 2003 (NZECP 46:2003)

Pursuant to section 38 of the Electricity Act 1992, I hereby approve the New Zealand Electrical Code of Practice for Live line Work 2003 (NZECP 46:2003) which comprises three parts:

ECP46.1: Glove and Barrier

ECP46.2: Barehand

ECP46.3: Stick

The New Zealand Electrical Code of Practice for Live Line Work 2003 (NZECP 46:2003) was issued by the Manager, Standards and Safety, Ministry of Consumer Affairs, acting under delegated authority (*pursuant to section 41 of the State Sector Act 1998*) from the Chief Executive, Ministry of Economic Development on the 12th day of October 2001.

Dated this 19th day of March, 2003

Hon Harry Duynhoven
Associate Minister of Energy

COMMITTEE REPRESENTATION

This Code of Practice was prepared by the Ministry of Consumer Affairs, in consultation with the following:

Members of the ECP46 Working Party

Electricity Engineers' Association of NZ (Inc) (EEA)

Engineering Printing and Manufacturing Union (EPMU)

Electrical Workers Licensing Group

Rail and Maritime Transport Union

The support of the Electricity Supply Association of Australia (ESAA) is also acknowledged.

REVIEW

This Code of practice will be revised as occasions arise. Suggestions for improvements of this Code are welcome. They should be sent to the Manager, Standards and Safety, Ministry of Consumer Affairs, PO Box 1473, Wellington.

OVERVIEW

This part of the Electrical Code of Practice for High Voltage Live Line work is in two Sections. Section 1 covers the general requirements for all live line techniques whilst Section 2 relates to the specific requirements for **Glove and Barrier work**.

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SECTION 1: SCOPE, INTERPRETATION AND GENERAL REQUIREMENTS

1.1 SCOPE

- 1.1.1** This Code sets out the minimum industry standards for high voltage live line work. The principles may be enhanced or supplemented, provided this does not result in reduced safety standards.
- 1.1.2** This Code applies to all work undertaken on live high voltage overhead lines using approved procedures, tools and equipment, and by persons holding the minimum competencies detailed under this Code. Other work on live high voltage overhead lines including, but not limited to, operating, is not covered by the Code.
- 1.1.3** This Code does not constitute a live line training manual, nor does it set down **live line work procedures**. These **procedures** should be developed in accordance with the principles in this Code.
- 1.1.4** The objectives of this Code are:
- (a) To ensure the safety of electrical workers and the general public.
 - (b) To specify the minimum standards for equipment required for live line work.
- 1.1.5** Equipment not specifically designed for a live line method shall not be used.
- 1.1.6** Throughout this Code:
- (c) The word "shall" is to be interpreted as mandatory.
 - (d) "Should" is to be interpreted as advisory or discretionary.
 - (e) Reference to lineworker unless specifically notified shall refer to a certificated live line mechanic.
- 1.1.7** While the principles of live line work contained in this Code have been written around work on overhead lines, the concepts may be equally applicable to work in other areas such as substation equipment, when combined with other appropriate training and work controls.
- 1.1.8** This Code does not substitute or override any regulation or legislation.
- 1.1.9** This Code does not apply to the following kinds of work:
- (a) The operation of fuses and the changing of the fuse elements;
 - (b) The operation of isolators and switches;
 - (c) The taking of electrical measurements;
 - (d) The measurement of distances;
 - (e) The phasing of conductors and fittings;
 - (f) The checking and testing of insulator strings;
 - (g) The removal of impediments on lines;
 - (h) The greasing of fittings.
 - (i) Traction live line work under 2,000 volts d.c.

The kinds of work listed above must be carried out using safe procedures and associated equipment designed specifically for the purpose.

1.2 INTERPRETATION

- 1.2.1 Approved** – means certified by the **Service Provider** as complying with the requirements of this code.
- 1.2.2 Asset Manager** - means an organisation responsible and accountable for the equipment to be worked on. An **Asset Manager** may also be a **Service Provider**.
- 1.2.3 Bonded** - means conductors and or fittings are connected together in such a manner as to ensure that they are at the same electrical potential.
- 1.2.4 De-Energised** – means disconnected from all sources of supply but not necessarily isolated, tested and earthed.
- 1.2.5 Earthed** – means effectively connected to the general mass of earth.
- 1.2.6 High-Voltage** – means any voltage exceeding 1000 V a.c. or 1500 V d.c.
- 1.2.7 Insulating Elevating Work Platform (Insulating EWP)** – means an approved and tested insulated aerial device.
- 1.2.8 Insulating Rope** – means standard commercial grade synthetic rope that is tested and manufactured to ensure good insulating properties but should not be intentionally placed across phase to phase or phase to earth air gaps.
- 1.2.9 Live (or Alive or Energised)** – means connected to a source of electrical supply.
- 1.2.10 Live Line Rope** – means rope that is specially designed, manufactured, tested and maintained so as to have very high insulating qualities and may be intentionally placed across phase to phase or phase to earth air gaps.
- 1.2.11 Live Line Equipment** – means all live line tools, rope, gloves and insulating equipment used for live line work.
- 1.2.12 Live Line Minimum Approach Distance (Live Line MAD)** – means the minimum air gap that shall be maintained between a lineworker and any other component at different potential during live line work, in order to prevent flashover and provide for worker safety.
- 1.2.13 Live Line Permit** – means a permit issued by the system controller or equivalent to verify to a **live line work** party that the control measures are in place on the circuit being worked on and to authorise work.
- 1.2.14 Live Line Stick (also called Hot Stick)** – means a solid or filled stick of insulating material specially designed, approved and tested for use in physically bridging the distance between;
- (a) the lineworker and energised components; or
 - (b) the energised components and earth; or
 - (c) adjacent phases; or
 - (d) to enable physical loads to be taken or tools to be applied.
- 1.2.15 Live Line Work** – means any high voltage work performed under approved procedures inside the minimum approach distance (MAD), on or near components of a line capable of being energised to high voltage without implementing the full protective practice of isolating, proving **de-energised** and earthing.

1.2.16 Method – means a fundamental technology for undertaking live line work. The three methods are **glove and barrier**, **barehand** and **stick**.

- (a) **Live Line Glove and Barrier Method** – means a method of performing **live line work** where the lineworker 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) **Live Line Barehand Method** – means a method of performing **live line work** in which the lineworker is in contact with energised components while insulated from other objects at different 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) **Live Line Stick Method** – means a method of performing **live line work** using tools and equipment mounted on **live line sticks**, with the lineworker maintaining the **minimum approach distance** from energised components.

1.2.17 Minimum Approach Distances – means the minimum distances when approaching live conductors that shall apply to any person who is not a competent live line lineworker, and include conductive material carried by them, vehicles, and mobile plant.

These distances apply to any part of the line mechanic's body or clothing and to anything in contact with the line mechanic, e.g. tools, ladders and scaffold poles (except live line tools and voltage detectors).

1.2.18 Minimum Tool Insulation Distance (also called **Effective Length**) – means the minimum effective length of exposed insulating material that is subjected to the voltage being contacted. This distance shall be measured between the metal end fitting at the conductor end of the insulating material and the metal end fitting or hand mark, where provided, at the opposite end of the insulating material.

When **live line sticks** consist of sections joined with metal couplings, the insulation distance shall be the total of each of the lengths of insulating material that have not been bridged out by the metal couplings.

1.2.19 Procedure – means a collection of **techniques** that, **when** used together, enables a total task outcome to be completed.

1.2.20 Service Provider – means an employer responsible for undertaking the **live line work**.

1.2.21 Technique – means a documented basic live line skill or competency that enables a specific task to be completed, for example:

- (a) Carry out a live line job risk assessment.
- (b) Access a transmission conductor barehand using live line rope.
- (c) Apply insulating barriers to a distribution pole structure.
- (d) Take conductor loads on a suspension structure.

1.2.22 Tested – means tested in accordance with the relevant standard.

1.2.23 Training Provider – means a provider of training who has the knowledge, skills, experience and resources required to deliver training that meets industry standards; and is also one of the following:

- (a) A NZQA registered and accredited training provider or an overseas equivalent (recognised by NZQA); or

- (b) a person or organisation approved by the Secretary to undertake live line training prior to the date of the commencement of this code. This approval is only valid up to the date specified on the approval.

1.3 GENERAL REQUIREMENTS RELATING TO ALL TECHNIQUES

1.3.1 Minimum Standards and Responsibilities

1.3.1.1 Responsibilities of the Asset Manager

Any **Asset Manager** using live work processes on their network shall ensure that the Service Provider complies with the requirements of clause 1.3.1.2.

1.3.1.2 Responsibilities of the Service Provider

Any **Service Provider** undertaking live line work shall:

- (a) meet as a minimum standard all the requirements of this Code;
- (b) have in place an effective process to regularly monitor and review all aspects of **live line work**;
- (c) have in place an effective process to inspect the field performance of **live line work**. This inspection shall address safe work practices and conformance with documented **techniques** at intervals not exceeding 12 months;
- (d) have in place an effective process to regularly review the health of live line lineworkers; and
- (e) have in place an effective risk management process.

1.3.2 Electric and Magnetic Fields

Each **Asset Manager/Service Provider** shall keep up to date on information arising out of scientific research on electric and magnetic fields, and shall keep its employees informed on the issue.

1.3.3 Work Techniques and Procedures

1.3.3.1 Development and Proving

Work techniques shall be developed and documented for each live line work outcome. These techniques shall be proven in a trial on disconnected and/or earthed equipment to verify that they can be carried out reliably and safely.

1.3.3.2 Documentation

Documentation shall contain information relating to the **Asset Manager's** requirements for accessing the network.

Documentation clearly setting out the basic steps shall be provided for each approved procedure or technique and shall:

- (a) Clearly identify the work objectives or desired task outcome.
- (b) Be part of a controlled document management system.
- (c) State the minimum number of lineworkers required.

A copy of the relevant work documentation shall be readily available at the worksite.

1.3.3.3 Live Line Manual

A live line manual, which may include this Code, shall be made available to each lineworker. This manual shall contain at least the following:

- (a) A description of live line principles and requirements.
- (b) A description of each live line tool, its functions, its uses and the determination of its safe working load.
- (c) Instructions on caring for the tools and equipment including:
 - (i) Checks before use.
 - (ii) Inspections.
 - (iii) Maintenance instructions.
 - (iv) Testing requirements for plant and equipment.
- (d) Guides for the calculation or assessment of conductor loads applied to tools and the consequent safety factors.
- (e) A set of approved live line work **procedures** or **techniques**.
- (f) Information for use in an emergency situation.

1.3.3.4 Compliance with Approved Work Documentation

Approved work documentation shall not be changed or disregarded on site except as otherwise provided for in clause 1.3.3.5.

1.3.3.5 Minor Changes to Work Techniques

Minor changes to work **procedures** or **techniques** may be required from time to time, such as changes to tooling to fit dimensional variations on structure components. Such changes must not compromise tool insulation, loading, air gap distances, or safety outcomes in any way and shall be recorded.

Such changes shall be agreed by the entire team at the outset of the job and not implemented in an *ad hoc* manner during the work.

1.3.4 Personnel Selection, Training, Certification, Records and Maintenance of Competency

1.3.4.1 Selection of Personnel

The Service Provider shall establish a policy on the minimum acceptable standards required prior to acceptance of a lineworker as a trainee in the **live work method**. This policy shall include:

1.3.4.2 Minimum Requirements

- (a) Registration as a Line Mechanic; or
 - (i) equivalent Line Mechanic National Certificate in the appropriate lines discipline; or
 - (ii) equivalent documented proof of qualifications or training as a line worker (as determined by NZQA); and
 - (iii) documented evidence of 2 years' post certification/registration experience in general line work, including current competence in the equivalent earthed line processes to be undertaken live; or

- (b) Registration as an Electrician or Electrical Inspector; or be a Qualified Engineer; and
 - (i) documented evidence of 4 years post registration or qualification experience in general line work, including current competence in the equivalent earthed line processes to be undertaken live.
- (c) Demonstrated personal attributes such as responsibility, concentration, communication, a high level of workmanship, and the ability to work in a team.
- (d) A medical examination shall be carried out by a qualified occupational health practitioner to check that the lineworker can physically meet the requirements to carry out the intended work and has no medical condition that could affect the safety of the lineworker or the work team.

1.3.4.3 Training and Certification

1.3.4.3.1 Supervision of Live Line Training

All training (including refresher training) shall be carried out under the direct and immediate supervision of a trainer certificated by the **Training Provider** as competent to undertake **procedures** or **techniques** being taught.

1.3.4.3.2 Live Work Methods Trainers

Prior to being certificated by the Training Provider as competent to undertake the **procedures** or **techniques** being taught, trainers of live working **methods** shall satisfy the following minimum requirements:

- (a) Minimum requirements as required by clause 1.3.4.2.
- (b) Current competency in the **method** being taught.
- (c) A minimum of 12 months documented work experience in the **method** being taught.
- (d) Have gained competency in instructing techniques.
- (e) Have conducted, to a certified trainer's satisfaction, a full live line work training course in the **method** being taught under the guidance of that certified trainer, and passed that trainer's assessment of the delivery of the instruction in **live line work** theory and practical techniques.

1.3.4.3.3 Training in Live Work Methods

- (a) The live work **method** training shall provide a thorough understanding of both the principles of the live work **method** as well as a comprehensive practical programme. This training shall include live work theory and application, correct use and maintenance of personal protection equipment, proper care of tools and equipment, and practising the required **procedures** or **techniques** on earthed lines before their application on energised lines.
- (b) Lineworkers undergoing live work training shall receive ongoing monitoring during the training programme to ensure their continued suitability for **live line work**.
- (c) Trainees who do not hold necessary allied or underpinning live work **methods** competencies, shall be taught the appropriate **techniques**, and those competencies shall be gained prior to the commencement of the training in the live work **method**.

- (d) Competency certification in the live work **method** shall only be issued when the trainee can demonstrate the required knowledge, skills and experience to carry out the work safely and to the required standards.

1.3.4.4 Certification and Records

1.3.4.4.1 Issue of Certificates

Competency Certificates shall be issued by the **Service Provider**:

- (a) Following satisfactory completion of the training as endorsed by the **Training Provider**.
- (b) Following satisfactory completion of annual refresher training and field inspection (refer section 1.3.4.5 Maintenance of Competency).
- (c) Immediately before a live line worker moves to a new **Service Provider**.
- (d) When a live line worker moves to a new **Service Provider**, and after satisfactory completion of appropriate refresher training.

1.3.4.4.2 Content of Certificate

A live line worker shall at all times hold a Competency Certificate issued by the Service Provider, indicating the live line work the lineworker is approved to undertake. Competency Certificates shall contain the following information:

- (a) Name of Holder.
- (b) Date of Issue.
- (c) Expiry Date.
- (d) Name of Training Provider.
- (e) Unique Certificate Number.
- (f) Categories of Work, allied live work methods techniques, voltage level and, if appropriate, competency groups in which the holder has demonstrated competency.
- (g) Relevant qualification attained.
- (h) Signature of issuing **Service Provider**.

1.3.4.4.3 Withdrawal of Certificate

A Certificate issued under 1.3.4.4.1 or (a) or (c) may be withdrawn by the Service Provider where a person is deemed not to be competent in relation to the categories of work, allied live work method techniques, voltage level or competency groups (as appropriate).

1.3.4.4.4 Categories of Work and Certificates

(a) Live Line Glove and Barrier

The holder of a **Live Line Glove and Barrier** Certificate can use glove and barrier procedures, including the use of live line sticks, to replace and install fittings, hardware and structures.

The requirements for this certificate are detailed in ECP46 Part 1.

(b) **Live Line Barehand**

The holder of a **Live Line Barehand** Certificate can use barehand methods and live line stick methods on lines from 66kV to 330 kV a.c. and 375 kV d.c. to:

- Displace lines, fittings and hardware.
- Install or replace poles, tower crossarms, insulators and fittings.

The requirements for this certificate are detailed in ECP46 Part 2.

(c) **Live Line Stick (non load bearing)**

(i) Up to and including 33 kV

The holder of a **Live Line Stick** Certificate (non load bearing) up to and including 33 kV can use **live line stick methods** on lines up to and including 33 kV to connect and disconnect spur lines, fittings and hardware.

The requirements for this certificate are detailed in ECP46 Part 3.

(ii) Above 33 kV

The holder of a **Live Line Stick** Certificate (non load bearing) up to 110 kV can use **live line stick methods** on lines up to 110 kV to test insulators and install dampers, corona balls and measuring devices.

The requirements for this certificate are detailed in ECP46 Part 3.

(d) **Live Line Stick (load bearing)**

(i) Up to 110 kV (with or without underbuilt)

The holder of a **Live Line Stick** Certificate (load bearing) up to 110 kV (with or without underbuilt) can use **live line stick methods** on lines up to 110 kV with and without underbuilt circuits.

The requirements for this certificate are detailed in ECP46 Part 3.

(ii) Above 33 kV (without underbuilt)

The holder of a **Live Line Stick** Certificate (load bearing) above 33 kV (without underbuilt) can use **live line stick methods** on lines without underbuilt circuits up to and including 375 kV d.c.

The requirements for this certificate are detailed in ECP46 Part 3.

- (e) No person shall carry out work to which this Code applies unless that person is the holder of a current competency certificate for that class of work or a trainee working under supervision.

1.3.4.4.5 Records

Service Providers shall keep for each live line lineworker adequate records of the training undertaken and live work history of each live line lineworker, including **techniques** and **procedures**.

1.3.4.5 Maintenance of Competency

1.3.4.5.1 Ensuring Ongoing Competency

To ensure ongoing competency, **Service Providers** shall monitor and document the performance of the **live line** lineworker by conducting field inspections at least annually.

1.3.4.5.2 Field Inspection of Competency

Field inspections shall assess demonstrated competencies against documented **live line methods, procedures** and **techniques** at least annually.

1.3.4.5.3 Requirements of a Person Conducting Field Inspections of Competency

Field inspections shall be conducted by a person:

- (a) who is authorised by the **Service Provider**;
- (b) who has been trained and is currently competent in the methods being inspected; and
- (c) who is independent of the work party.

1.3.4.5.4 Refresher Training

Refresher training shall be conducted on live work safety rules, concepts and **techniques** of the **method**:

- (a) At intervals no greater than twelve months, and
- (b) Whenever **techniques** are found to be deficient during the field inspections, and/or
- (c) When a lineworker has performed no live work in a specific competency for in excess of twelve months.

1.3.4.5.5 Trainer Competency

Training Providers shall regularly audit the competencies of their trainers to ensure they meet industry competency requirements. This process should include knowledge of live work accident causes, audited non-compliance trends, new technologies, and equipment mechanical and electrical limitations.

1.3.5 Equipment

1.3.5.1 General

Care and maintenance of equipment is essential for safe live line work.

1.3.5.1.1 Suitability of Live Line Equipment

All **live line** equipment shall be designed, tested and approved specifically for work on energised high-voltage lines.

1.3.5.1.2 Rating of Live Line Equipment

All **live line** equipment shall be rated and certified for use by the manufacturer and shall meet the standards listed in Appendix A or equivalent.

1.3.5.1.3 Tool Management

A **tool** management system shall be in place to ensure equipment is maintained to set standards (refer to Appendix A). This system shall, as a minimum, ensure that equipment is inspected, maintained and tested at appropriate intervals. Records of these events shall be kept for the working life of the equipment.

1.3.5.2 Care and Use of Live Line Equipment

1.3.5.2.1 Condition of Live Line Equipment

All **live line** equipment shall be maintained in a clean and dry condition.

1.3.5.2.2 Placement of Live Line Equipment

Live line equipment shall not be laid directly on the ground.

1.3.5.2.3 Storage and Transport of Live Line Equipment

Live line equipment shall be stored and transported in a way that shall ensure the equipment is not exposed to excess moisture, dust, chemicals, abrasion and other deteriorating effects.

1.3.5.2.4 Before Use Inspection and Cleaning of Live Line Equipment

Live line equipment shall be visually inspected, mechanically test-operated and cleaned before use. Any tool that appears to be defective shall be tagged and withdrawn from service for further inspection, testing, repair or replacement.

1.3.5.2.5 Regular Inspection and Maintenance of Live Line Equipment

Live line equipment and insulating tools shall be inspected and maintained in accordance with the manufacturer's recommendations and with relevant standards in Appendix A.

1.3.5.2.6 Avoidance of Deteriorating Contaminants

All **insulating equipment** should be kept clear of deteriorating contaminants such as handcreams, sunscreens, paint solvents, hydraulic oil, etc. that may affect or deteriorate insulating qualities of equipment.

1.3.5.3 Live Line Sticks

Live line sticks provide a rigid physical connection of known insulating quality between live line lineworkers and energised components.

1.3.5.3.1 Hollow Sticks

Hollow sticks are not acceptable due to the difficulties in maintaining their electrical integrity.

1.3.5.3.2 Stick Surfaces

Stick surfaces shall be maintained to the standards specified by the manufacturer.

1.3.5.3.3 Design of Metal End Fittings

Metal end fittings shall be designed so as to prevent the development of excessive electric field stresses and corona within the stick termination.

1.3.5.3.4 Termination of Metal End Fittings

Metal end fittings shall be terminated onto the sticks in such a way as to prevent the creation of airgaps or voids that could be detrimental to the electrical performance of the stick.

1.3.5.4 Conductor Support Equipment

This equipment is used to provide temporary support for energised conductors when carrying out live line work, eg. wire tongs.

1.3.5.4.1 Assessment of Conductor Load

When using conductor support equipment, the conductor load shall be assessed to ensure that the safe working load of the equipment is not exceeded.

1.3.5.4.2 Rating of Insulation of the Equipment

Ensure that the insulation of the equipment is of adequate rating for the line voltage involved, and that supplementary insulating devices are added where necessary.

1.3.5.5 Rope

1.3.5.5.1 Types of Rope in Use

There are two types of rope used in live line work. **Live line rope** is designed, manufactured and managed as an insulating tool for full phase voltage. **Insulating rope** is normal synthetic rope that is kept clean and dry but has no guaranteed insulating properties. Insulating rope may be used in series with an insulating stick or composite insulator to provide known insulating properties. All other rope for which no special management has been applied shall not be used on live line work sites.

1.3.5.5.2 Insulation Properties of Live Line Rope

Live line rope shall be of synthetic material that has high insulation properties and is moisture resistant, and that maintains these properties for a sustained period of service.

1.3.5.5.3 Use and Marking of Live Line Rope

Live line rope shall not be used for any other purpose, and shall be clearly marked and managed so that it cannot be inadvertently mistaken for **insulating rope**.

1.3.5.5.4 Electrical Testing of Live Line Rope

Live line rope shall be electrically tested before being placed in service, in accordance with ANSI/IEEE Standard 516 or equivalent.

1.3.5.5.5 Management of Live Line Rope Usage

Live line rope usage shall be managed in accordance with a specially developed maintenance system. This system shall address the following factors:

- (a) Visual inspection before each use.
- (b) Electrical testing at regular intervals.
- (c) Atmospheric humidity constraints for rope usage.
- (d) Removal from time to time of the most used (end) sections of rope coils to limit contamination and other deterioration of the rope.

- (e) Suitable clean and sealed storage with consideration given to the use of desiccant to ensure the rope is completely dried between each use.

1.3.5.5.6 Insulating Rope

Insulating rope shall be kept away from **live** components by a **distance** at least equal to the applicable **live line minimum approach distance**.

1.3.6 Safety Observer

During all live line work, one member of the work team shall be designated as the **Safety Observer**. The **Safety Observer's role** is to alert the work team to any potentially unsafe actions or lack of compliance with an approved work **procedure** or **technique**. The **Safety Observer** shall:

- (a) be certificated and competent to carry out the particular work being observed;
- (b) be positioned at a suitable location to observe the work being performed;
- (c) have the authority to temporarily suspend the work at any time;
- (d) maintain effective and immediate communication with the work team at all times;
- (e) not perform any other task whilst **live line work** is in progress; and
- (f) suspend all work in the event of having to leave the site or significantly change position until he/she has returned/reached a new location or has been replaced.

The **Safety Observer's role** may be rotated among members of the work team, for example to reduce fatigue. When this occurs it shall be formally handled such that all members of the work party are aware at all times who is performing the role of the **Safety Observer**.

1.3.7 Work Considerations

1.3.7.1 Line Hazard Identification

The **Asset Manager** shall advise the **Service Provider** of any known hazards that have the potential to impact on the safe outcome of the work, eg. conductor corrosion, defective insulator types, corroded or defective fittings or structures, and known over-crossings of other lines.

In addition to any hazards identified by the **Asset Manager**, the working party shall inspect the work site to identify electrical and non-electrical hazards that could impact upon the safety of the working party or the public.

1.3.7.2 Weather Conditions at Worksite

Work shall not proceed and the work team shall keep clear of the circuit in the event of the following:

- (a) An electrical storm is observed in the vicinity of the worksite.
- (b) Any significant rain (beyond intermittent spotting), mist, fog, snow or sleet unless using **techniques** and equipment specifically designed and tested as being able to operate whilst wet.
- (c) When using live line rope, any threat of rain, mist, fog, snow or sleet.
- (d) Excessive wind velocities, such that work cannot be continued in safety.

1.3.7.3 Fault Current Protection

Protective devices shall be operational in the circuit being worked on. These devices shall be capable of detecting and clearing faults at the worksite.

1.3.7.4 Disabling of Auto-Reclose

All **auto-reclose** equipment controlling the section of the circuit on which live line work is to be performed shall be blocked for the duration of the work.

This reclosing equipment shall be tagged with an appropriate safety tag.

1.3.7.5 Live Line Permit

1.3.7.5.1 Issue of Live Line Permits

Prior to the commencement of work, the work party shall receive a live line permit. The method of transfer may be verbal exchange, hard copy or by electronic means.

1.3.7.5.2 Identification and Disabling of Reclose Features and/or Processes

The procedure for the issue of the live line permit shall ensure all of the appropriate reclose features and/or processes (or restart for HV d.c.) are identified and disabled before the permit is issued. No manual reclose in the event of a tripping shall occur without first establishing the safety of the work party.

1.3.7.5.3 Cancellation of the Live Line Permit

The live line permit shall be cancelled on completion of the work.

1.3.7.5.4 Documentation for the Issue and Cancellation of Live Line Permits

The procedure for the issue and cancellation of **live line permits** shall be documented. Where required by the **Asset Manager**, the procedure shall include a description of the work and location where the work will be carried out.

1.3.7.5.5 Multiple Live Line Permits on the Same Circuit

Where more than one work team is working on the same circuit but at different locations, the procedure shall ensure that all teams have cancelled their live line permits before the reclose features and/or processes (or restart for HV d.c.) are returned to normal.

1.3.7.6 Work Team Communications

1.3.7.6.1 General

Each work team shall establish a reliable on-site two-way communications link with the issuer, system controller, or equivalent. Where practicable, and/or required by the **Asset Manager**, appropriate calls at specified times should be agreed upon between the work party and the Control Room, or equivalent.

1.3.7.6.2 Integrity of the Communications Link

The integrity of the communications link should be checked at regular intervals during the course of the work to ensure it is functioning correctly.

1.3.7.6.3 Communication Among Work Team Members

The work team shall establish and maintain effective communication among the work team members to ensure the safety of the team.

1.3.7.7 Public Safety

Public access to the work site shall be controlled at all times when work is in progress.

1.3.7.8 Work on De-Energised or Earthed Circuits

Live line work methods may be used to work on a circuit that is de-energised or earthed provided that all work is undertaken as though the circuit is energised.

1.3.7.9 Suspension of Work

If it becomes necessary to suspend work, the circuit shall be left in a safe condition and the **Asset Manager** informed.

1.3.7.10 Crane Operation

1.3.7.10.1 Instruction of Crane Operators

Prior to the commencement of work, crane operators shall be instructed on the procedure and safe working distances to be used.

1.3.7.10.2 Supervision of Crane Operators

The crane operator shall be under the direct and immediate supervision of a competent nominated member of the **live line** team.

1.3.8 Procedures in the Event of an Accident

1.3.8.1 Procedures for Responding to Accidents

Each Asset Manager and Service Provider shall have in place documented procedures for responding to accidents. These procedures shall as a minimum address, as appropriate, the following items:

- (a) The rescue of injured persons or those at risk.
- (b) Communication with Emergency Services.
- (c) The immediate first aid and medical needs of any injured person and the safety of other persons at the worksite.
- (d) Any emergency switching requirements.
- (e) Restoration of any circuit as a result of the incident.
- (f) Investigation and reporting requirements to determine the cause of the accident and the implementation of appropriate remedial measures.
- (g) Notification of all parties required under relevant regulations and industry agreements.

1.3.9 General Work Practices

1.3.9.1 Safety Monitoring

During all live work, all team members shall:

- (a) monitor the actions of other team members;

- (b) maintain effective communication with the work team; and
- (c) have the authority to temporarily suspend the work at any time due to unsafe actions or lack of compliance with approved work **procedures**.

1.3.9.2 On-Site Team Review

Before commencing work an on-site team review shall be carried out to address hazard management and work practices and shall:

- (a) identify hazards;
- (b) assess risks that may result because of the hazards;
- (c) have emergency personnel contact numbers;
- (d) have procedures to contact and interact with Emergency Services;
- (e) decide on control measures to prevent or minimise the level of the risks; and
- (f) implement control measures.

Particular attention should be given but not limited to:

- (a) **WHY** the work is to be done.
- (b) **WHAT** is to be accomplished.
- (c) A discussion of **HOW** the work is to be carried out and **WHO** will do it.
- (d) The integrity of the structure on which work is to be carried out including mechanical loads and condition of conductors and joints.
- (e) The integrity of the adjacent structures and spans.
- (f) The integrity of insulation in the immediate work area.
- (g) Clearances to potential midspan hazards, particularly where conductors are to be moved during the work.
- (h) Site terrain conditions (stability of equipment and footing).
- (i) Live stock management (interference with the work).
- (j) Traffic management.
- (k) Public safety.
- (l) Potential weather conditions during the work.

1.3.9.3 Weather Conditions

Live line work shall only be carried out in suitable weather conditions (refer to clause 1.3.7.2).

1.3.9.4 Light Conditions

Live line work shall only be performed when there is adequate light.

1.3.9.5 Personal and Protective Apparel Worn By Lineworkers

Personal and protective apparel worn by lineworkers shall include as a minimum:

- (a) Full body coverage, fire resistant clothing. Workers should consider wearing underclothing of fire resistant material, such as cotton, to reduce the severity of injuries in the event of fire.
- (b) Hard hats.
- (c) Protective footwear with non-slip soles, including conductive boots when appropriate.

1.3.9.6 Conductive Clothing

Conductive clothing shall be worn where necessary to limit discomfort from induced static discharges.

1.3.9.7 Eye Protection

Suitable eye protection shall be provided and used at all times. Anti-glare eye protection should be used as appropriate.

1.3.9.8 Wearing of Metallic Objects

Metallic objects such as neck chains, earrings and other body adornments, rings, watches and bracelets should not be worn while carrying out **live line work**.

1.3.9.9 Long Hair

Long hair shall be securely fixed and confined close to the head.

1.3.9.10 Electrical Rating of Insulating Equipment

All **insulating equipment** shall have an electrical rating suitable for the voltage being worked on.

1.3.9.11 Restraint of PPE and Tooling

The free end of body belts, pole straps and ropes shall be restrained from infringing the **live line minimum approach distance**.

1.3.9.12 Other Activity

When **live line work** is being performed, no other activity that could compromise the safety of the work team shall be carried out.

1.3.9.13 Leaving of Live Line Insulating Equipment on Energised Lines

Live line insulating equipment should not be left on energised lines for extended periods such as overnight. Where this is necessary, they shall not subsequently be depended upon to protect the lineworker. Before re-use they shall be removed, cleaned and visually inspected, and, if suspect, submitted for electrical test.

1.3.9.14 Responsibilities of the Supervisor of the Work Team

At all **live line work** sites, one person in the work party should:

- (a) have sole charge of all on-site activities;
- (b) ensure individual members of the work party have been designated to all the various tasks required by the work procedure including the role of the safety observer;
- (c) at the start of the work, run a work site briefing; and

- (d) at the completion of the work, run a work site de-briefing to ensure that all difficulties encountered during the work are identified.

NOTE: This person may undertake any of the roles required by the procedure. However, if undertaking the role of the safety observer, they must be free to assume the duties as detailed in clause 1.3.6.

1.3.9.15 Manual Reclose or Other Planned Switching of a Circuit

In the event that a manual reclose or other planned switching of a circuit is required, the work teams shall move clear of the circuit prior to the switching being attempted.

1.4 MINIMUM REQUIREMENTS FOR ALL CATEGORIES OF LIVE LINE WORK

All live line workers shall meet the following requirements:

1.4.1 Theory/Standards

- (a) Understand and apply **live line work** theory and the principles of the **live line work method** concerned.
- (b) Understand and apply the parts of ECP 46 as applicable to:
 - (i) Live Line Glove and Barrier Work.
 - (ii) Live Line Barehand Work.
 - (iii) Live Line Stick Work.
- (c) Understand and apply the relevant Statutes, Regulations, Codes and Rules.
- (d) Understand and mitigate the hazards of step and touch potentials.

1.4.2 Work Site Management and Participation

- (a) Conduct a work site risk assessment including hazard evaluation, work limitations and mitigation of hazards.
- (b) Work in the different roles within a team including:
 - (i) Conducting a tailgate session
 - (ii) Directing a work team through the use of a procedure
 - (iii) Acting as a team member
 - (iv) Acting as a safety observer.
- (c) Constructively participate in the development of safe work procedures for a specific work task.

1.4.3 Practical Skills

- (a) Safely climb and observe minimum approach distances on line structures.
- (b) Safely use and maintain safety belts and harnesses.
- (c) Take access permits.
- (d) Perform rescue procedures.
- (e) Implement customer service and land owner protocols.

- (f) Safely rig and establish applied conductor loads.
- (g) In-field inspect, test, care for and maintain, as applicable, live line sticks, tools, barriers, guards, gloves, sleeves and other equipment relevant to the **live line work procedure** concerned.
- (h) Safely apply work site earthing.
- (i) Take **live line permit** and reclose blocks.
- (j) Evaluate line condition prior to undertaking work.

SECTION 2: LIVE LINE GLOVE AND BARRIER WORK

2.1 GENERAL

For Live Line **Glove and Barrier** work, there shall be compliance with the requirements of Section 1, this Section and, where live line sticks are used, with ECP 46 Part 3.

2.2 DEFINITIONS SPECIFIC TO THIS SECTION

- 2.2.1 Brush Contact** - means momentary accidental contact.
- 2.2.2 Contact Area** - means the area within one metre of the nearest **energised high-voltage** line or component whilst carrying out glove and barrier work.
- 2.2.3 Insulating Barrier** (also called Cover-Up Equipment) - means a barrier of insulating material specifically designed, approved and **tested** for use as a line cover, insulator cover, cutout cover, crossarm cover, deadend cover or as a cover for similar equipment. **Insulating barriers** may be rigid or flexible and are intended to prevent lineworkers from making accidental **brush contact** with **live** components or equipment at a different potential.
- 2.2.4 Insulating Gloves and Sleeves** - means **insulating gloves and sleeves** specifically designed, approved and **tested** to a rated voltage and worn with approved protective gloves.
- 2.2.5 Insulating Platform** - means a platform of insulating material specifically designed, approved and **tested** for use with the **live line glove and barrier method**.

2.3 CONCEPTS

The live line glove and barrier method is based on the principle that the lineworker shall always maintain a minimum of two levels of insulation to prevent phase-to-earth and/or phase-to phase contact.

This is achieved by:

- (a) Wearing appropriately rated and tested insulating gloves and sleeves, and
- (b) Always working from an insulated **elevating work platform (EWP)** or insulating platform and never directly from a ladder, pole or structure.

Additional protection for the lineworker is provided by using **insulating barriers** and fitting an insulating basket liner in the EWP.

The **live line glove and barrier method** is carried out on **energised high-voltage** lines with the lineworkers wearing approved **insulating gloves and sleeves**. The **insulating gloves** are protected from mechanical damage by outer protective gloves. All sources of potential difference in the immediate work area are covered with **insulating barriers**.

The **live line glove and barrier** method may be combined with the live line stick method subject to meeting the requirements of the respective parts of ECP 46.

2.4 APPROACH DISTANCES

There is no **live line minimum approach distance** that applies to glove and barrier work. It is important, however, that lineworkers shall maintain an air gap between the uninsulated part of their body and any **energised** equipment.

2.5 WORK TECHNIQUES AND PROCEDURES

2.5.1 Combination Glove and Barrier and Stick Methods

When **live line work** is to be accomplished through a combination of glove and barrier and stick **methods**, the work shall be limited to situations where the safety margins are not decreased by introducing the **live line stick method** into the **contact area**.

Lineworkers shall be certificated in the live line **procedure** they are using.

All lineworkers carrying out **live line glove and barrier method** within the **contact area** shall wear **insulating gloves and sleeves** and these shall not be removed until they have moved outside the **contact area**.

Any lineworker changing from glove and barrier method to the stick method shall move outside the **contact area**, remove their **insulating gloves and sleeves**, and re-enter the work area observing the **live line minimum approach distance** appropriate for the **live line stick method** for the voltage concerned.

The following combinations of live line glove and barrier and stick **methods** are not permitted:

- (a) One lineworker carrying out stick work and one lineworker **carrying** out glove and barrier work from the same **insulating EWP**.
- (b) One lineworker on a pole or structure carrying out stick work and one lineworker on an **insulating platform** carrying out glove and barrier work.

2.6 EQUIPMENT

2.6.1 Cranes and Crane Insulation

2.6.1.1 Use of Cranes

Cranes, insulated and set up in accordance with the requirements of this section, may be used to support conductors and equipment for the live line procedure.

2.6.1.2 Insulation of Crane Hook

When supporting energised components, appropriate insulation, rated to meet the electrical and mechanical loads, shall be fitted between the crane hook and the energised components.

2.6.1.3 Uninsulated Parts of the Crane

Parts of the crane that are not insulated shall be carefully monitored to ensure they do not encroach within a predetermined approach distance. In addition, consideration should be given to movement of the conductor with wind and changes of temperature.

2.6.1.4 Earthing and Bonding of the Chassis of the Crane

The chassis of the crane shall, where practicable, be **earthed** and **bonded** to the structure to create an equipotential work zone.

2.6.2 Insulating Elevating Work Platforms (Insulating EWPs)

2.6.2.1 Currency of the High-Voltage Electrical Test Certificate for the Insulating EWP

Insulating EWPs shall have current electrical, mechanical and acoustic test certificates.

2.6.2.2 Insulation of the Basket of the Insulating EWP

The basket of the **insulating EWP** shall be fitted with an approved insulating liner.

2.6.2.3 Tooling or Other Accessories

Where tooling or other accessories are fitted to an **insulating EWP** that bridge the primary insulation, the hoses, hydraulic fluids and other insulating components shall be designed, **tested** and managed such that they do not degrade the electrical integrity of the **insulating EWP**.

2.6.2.4 Work Performed on an Insulating EWP

Whenever any work is performed on an **insulating EWP** that could affect its insulating qualities, the **insulating EWP** shall be electrically **tested** before being returned to service.

2.6.2.5 Earthing and Bonding of the Chassis of the Insulating EWP

The chassis of the **insulating EWP** shall, where practicable, be **earthed** and **bonded** to the structure to create an equipotential work zone.

2.6.3 Insulating Gloves and Sleeves

2.6.3.1 Cleaning of Insulating Gloves and Sleeves

Insulating gloves and sleeves shall be cleaned at least once a week or more often if required. They should be washed with an approved cleaning fluid, rinsed with clean water, then appropriately positioned to allow drying.

2.6.3.2 Application of Pure Talcum Powder

Pure talcum powder should be applied to the inside surface of the **insulating gloves and sleeves** when dry, after cleaning or prior to use.

2.6.3.3 Storage for a Lengthy Period

If storage is required for a lengthy period, the inside and outside surfaces of **insulating gloves and sleeves** should be powdered.

2.6.3.4 Colour of Insulating Gloves and Sleeves

The **insulating gloves and sleeves** shall have a contrasting inside and outside colour for easier damage detection. **Insulating gloves** are manufactured with the hands curved to assist in reducing user fatigue.

2.6.3.5 Before Use Testing and Inspection of Insulating Gloves

Insulating gloves shall be field air-tested and visually inspected both inside and out before use. **Insulating gloves and sleeves** shall be inspected for pin holes, cuts, scratches, abrasions, ageing, corona cutting or other mechanical damage.

2.6.3.6 Use of Cotton Gloves Covering the Wrist

Cotton gloves covering the wrist should be worn beneath the **insulating gloves** to assist in the absorption of perspiration and improve comfort.

2.6.3.7 Use of Protective Gloves

Protective gloves shall be worn over **insulating gloves** at all times.

2.6.3.8 Contamination of Protective Gloves

Protective gloves that have been heavily contaminated by any oil-based substances, to the extent that the rubber **insulating gloves and sleeves** may be damaged, shall be discarded.

2.6.4 Insulating Covers

2.6.4.1 General

Insulating covers are used to provide protection against **brush contact** with **energised** equipment or equipment at different potential.

Insulating covers are not intended to provide long term insulation and should not be allowed to touch both an **energised** surface and an **earthed** surface for an extended time unless two levels of insulation is provided.

Lineworkers shall not purposely make contact with an insulating cover except with rated **insulating gloves** or an insulating stick.

2.6.4.2 Styles of Insulating Covers

The two main styles of covers available are:

- (a) rigid covers that are made from polyethylene or ABS plastic; and
- (b) flexible covers that are made from natural or synthetic rubber.

2.6.4.3 Use of Insulating Covers

Insulating covers rated for the line voltage shall be used. On structures that support the multiphase system from which the SWER system derives, the insulating covers rated for the multiphase system shall be used.

2.6.4.4 Protective Barriers

Insulating barriers may be used in a number of ways:

- (a) To provide a barrier to physically limit the size of a work area for safety reasons.
- (b) To reinforce air gaps so that smaller live line minimum approach distances can be applied.

2.6.5 Insulating Platforms

2.6.5.1 General

Insulating platforms are designed to be attached to a pole to provide an insulated working position for a lineworker.

2.6.5.2 Requirements for Insulating Platforms

Insulating platforms designed for the live line glove and barrier method shall have:

- (a) an insulated section that can be subjected to a **high-voltage** insulation test;
- (b) a safety belt attachment point;

- (c) a non-slip surface.

2.6.6 Temporary Dropout Tools

2.6.6.1 General

Temporary dropout tools may be used to provide fuse protection during live line maintenance. They are installed onto the line using a **live line stick**. The fuse size shall grade with the existing protection.

2.6.6.2 Temporary Dropout Tools

Temporary dropout tools shall be inspected prior to use to ensure that:

- (a) The fuse carrier is free to open and close on the hinge.
- (b) The electrical cable and clamp are electrically adequate for the load they are required to carry.
- (c) All electrical connections are secure.

2.6.6.3 Before Use Cleaning of the Insulating Portion of Temporary Dropout Tools

The insulating portion of temporary dropout tools shall be cleaned prior to use.

2.6.7 Temporary Insulated Jumpers

2.6.7.1 General

Temporary insulated jumpers are used to electrically bypass the work area where equipment is under repair. They shall have a current and insulation rating adequate for the task.

2.6.7.2 Inspection of Temporary Insulated Jumpers

Temporary insulated jumpers shall be visually inspected prior to use to ensure that all electrical connections and clamps are secure and that the cable is not damaged.

2.6.8 Proof Test/Use Voltage Relationship

2.6.8.1 Rated Voltage (AC Proof-Test Voltage)

The rated voltage (a.c. Proof-Test voltage) is the maximum nominal design voltage (Phase-to-Phase) of the multiphase circuit on which work is to be carried out.

2.6.8.2 Maximum Use Voltage

The maximum use voltage is the maximum voltage at which **insulating gloves**, insulating sleeves and flexible barriers shall be used and that provides a safety margin below the Rated Voltage in accordance with the formula:

Maximum use voltage (Phase-to-Phase) = 0.95 (a.c. Proof-Test voltage) - 2000 volts

[This formula is taken directly from ASTM Standards, which also include reference to D.C. testing Standards if required].

2.6.9 Rating/Use Voltage Relationship

2.6.9.1 Classes of Insulating Gloves, Sleeves and Flexible Barriers

Insulating gloves, sleeves and flexible barriers designed for **high-voltage live line work** are available in four classes, which are listed below.

Class	Rated Voltage (AC Proof Test)	Maximum Use Voltage
1	10 kV	7.5 kV
2	20 kV	17 kV
3	30 kV	26.5 kV
4	40 kV	36 kV

2.6.9.2 Where No Multiphase Exposure is Involved (such as when working on SWER)

Where there is no multiphase exposure, such as when working on SWER, the phase to earth voltage can be used for the selection of the appropriate class of **insulating gloves and sleeves**, as shown above. However, it should be noted that some SWER systems use 11 kV as the phase to earth voltage in order to use a standard line – line connected transformer at the receiving end of the system.

2.6.10 Testing

The recommended maximum testing intervals are defined in the appropriate standards listed in Appendix A. A summary of the testing frequencies is set out in the table below. **The testing intervals below should be reduced for equipment with high usage.**

Equipment	Test Intervals
Insulating gloves and sleeves	not exceeding 6 months
Insulating blankets	not exceeding 12 months
Insulating line hoses, connectors covers	not exceeding 12 months
Conductor support equipment, insulating platforms and temporary dropout tools	not exceeding 12 months
Insulated jumpers	not exceeding 12 months
Insulated hoses	not exceeding 6 months
Insulating EWPs	not exceeding 6 months
Insulated EWP basket liner	not exceeding 12 months

EWPs can be electrically tested at six month intervals only where the EWP is used solely for Live Line Glove and Barrier work. In all other cases, the one month interval applies.

2.7 WORK CONSIDERATIONS

2.7.1 Integrity of Insulation

2.7.1.1 Visual Inspection of Insulators in the Immediate Work Zone Prior to Work

All insulators in the immediate work zone should be visually inspected prior to work to ascertain the existence and extent of any damage. This damage should be carefully assessed to ensure that the insulation is safe to approach and work on.

2.7.1.2 Treatment of Insulators or Insulator Strings Exhibiting Physical Damage or Signs of Electrical Distress

Any insulator or insulator string exhibiting physical damage or signs of electrical distress, such as elevated noise levels or surface discharging, shall be approached with care and appropriate safe working techniques adopted to minimise the risk of flashover and consequent injury to workers.

2.7.1.3 Where Reduced Insulating Properties are Known or Suspected

Where reduced insulating properties are known or suspected, electrical hazards such as step and touch potentials may exist at the structure. Appropriate safe work practices should be adopted such as:

- (a) Performing an earth leakage test before climbing.
- (b) Undertaking the work from an EWP.
- (c) Covering the insulation with one or more mats.
- (d) Undertaking the work at distance using **live line sticks** instead of the **glove and barrier method**.

2.7.1.4 Performance of Live Line Work in Close Proximity to Insulator Strings Containing Porcelain Disc Insulators

Where live line work is to be performed in close proximity to strings containing porcelain disc insulators on conductive structures and cross arms, each disc should be electrically tested. This testing should preferably be performed immediately prior to starting work.

Note: This is because porcelain disc insulators may puncture in service resulting in reduced insulating properties. Punctures in porcelain discs are not readily identified by visual inspection and may not create audible noise.

2.8 GENERAL WORK PRACTICES

2.8.1 Insulating Barriers

All components within the immediate work area that are, or could be, at a different potential shall be covered with **insulating barriers**.

2.8.1.1 Working from the Basket of an Insulating EWP or an Insulating Platform

Work shall be performed either from the basket of an **insulating EWP** or from an **insulating platform**, never directly from a ladder, pole or structure.

2.8.1.2 Live Line Glove and Barrier Method Using One Insulating EWP

When the **live line glove and barrier method** is being performed utilising one **insulating EWP**, work shall be restricted to one phase at a time. When work is being performed using additional **insulating EWPs**, care must be observed to ensure that sufficient clearance is maintained between the work parties unless working at the same potential.

2.8.1.3 Use of an Insulating EWP or Insulating Platform Between Circuits

When using an **insulating EWP** or **insulating platform** between circuits:

- (a) a minimum of 150 mm clearance shall be maintained between the basket of the EWP and the lower circuit; or
- (b) adequate **insulating barriers** rated for the higher voltage shall be fitted to the lower circuit.

2.8.1.4 Use of an Insulating EWP with a Telescoping Boom

- (a) Where an **insulating EWP** with a telescoping boom is used, the boom shall be extended to ensure that the insulating requirement as specified on the **high-voltage** certification of the equipment, relevant for the voltage being worked on, is obtained.
- (b) Care should be taken to ensure that uninsulated parts are not introduced into the work area that could create a hazard for the lineworker.

2.8.1.5 All Persons at Ground Level

All persons at ground level shall be kept clear to avoid contact with the **insulating EWP** while **live line glove and barrier method** is being performed.

2.8.1.6 Before Use Inspection of Insulating EWPs

Prior to using **insulating EWPs** for **high-voltage live line glove and barrier method**, all insulating components shall be visually inspected and wiped clean with a silicone impregnated cloth.

2.8.1.7 Contact Between the Insulated Boom or Basket of an Insulating EWP and Uninsulated Conductive or Earthed Objects

At no time shall the insulated boom or basket of an **insulating EWP** contact uninsulated conductive or **earthed** objects as this may reduce the insulating qualities.

2.8.1.8 Leaving of Live Line Insulating Equipment on Energised Lines

Live line insulating equipment should not be left on **energised** lines for extended periods such as overnight. Where this is necessary they shall not subsequently be depended upon to protect the line worker. Before re-use they shall be removed, cleaned and visually inspected and, if suspect, submitted for electrical test.

2.8.1.9 Testing and Inspection of Insulating Gloves and Sleeves Prior to Commencement of Work

Insulating gloves and sleeves shall be field air-tested and visually inspected prior to commencement of work, or at any other time their condition is in doubt.

2.8.1.10 Wearing of Insulating Gloves and Sleeves within the Contact Area

Insulating gloves and sleeves shall be worn at all times within the contact area.

2.8.1.11 Wearing of Insulating Gloves and Sleeves Inside Out

Insulating gloves and sleeves shall never be worn inside out.

2.8.1.12 Wearing of Insulating Gloves and Sleeves with Approved Outer Protective Covers

Insulating gloves and sleeves shall only be worn with approved outer protective covers.

2.8.1.12.1 Outer protective covers

Outer protective covers shall not be used for any other purpose than with **insulating gloves** to prevent contamination and damage of the insulating glove.

2.9 MINIMUM REQUIREMENTS FOR LIVE LINE GLOVE AND BARRIER WORK

The holder of a certificate in live line glove and barrier shall have the following competencies additional to those listed in Section 1.4:

- (a) Be able to safely deal with lost conductors and restore electricity supply.
- (b) Verify EWP/platforms certification (e.g. acoustic, mechanical and electrical).
- (c) Operate, care for and maintain EWPs/platforms.
- (d) Evaluate the condition of conductors to ensure that they are able to be displaced using live line work techniques.
- (e) Determine safe conductor loads.
- (f) Use both live line stick and glove and barrier **techniques** to:
 - (i) Apply, remove and move line guards, barriers and cover-up gear to ensure there is no unintended contact between phase and earth or phase to phase.
 - (ii) Connect and disconnect spur lines, line equipment, fittings and hardware.
 - (iii) Test connections.
 - (iv) Displace conductors to:
 - Install, change or replace pin and disc insulators.
 - Install, change or replace crossarms.
 - Install, change or replace poles, including strain poles.
 - Install, change or replace line equipment.
 - (v) Displace conductors with and without the use of a crane or a Hiab and on systems with underbuilt conductors present.
- (g) Use live line glove and barrier **procedures** to:
 - (i) Carry out mid-span repair of conductors.
 - (ii) Install and remove mid-span breaks.

APPENDIX A: REFERENCE DOCUMENTS

A1.1 New Zealand Live Line Training Unit Standards

National Qualifications Framework administered by the New Zealand Qualifications Authority.

A1.2 Joint Australian/New Zealand Standards (AS/NZS)

Until joint Australian/New Zealand Standards (AS/NZS) are developed, equipment used for **live line work** shall comply with appropriate internationally recognised standards.

A1.3 Live Line Standards Organisations

As a guideline, the following is a list of Standards Bodies that have produced standards that have some relevance for live line work. This is not an exhaustive list:

- 1 ASTM (The American Society for Testing and Materials)
- 2 ANSI (American National Standards Institute)
- 3 IEEE (The Institute of Electrical and Electronics Engineers Inc USA)
- 4 CAN/CSA (Canadian Standards Association)
- 5 IEC (International Electrotechnical Commission)
- 6 SIA (Scaffold Industry Association incorporated in America)

A1.4 Live Line Standards

As a guideline, set down in Table 1 below is a list of standards as at the preparation date of this Code. There are also several new standards currently in preparation or circulated in draft form, which will be issued subsequent to the printing of this Code. Readers should check with Standards New Zealand from time to time for any new or updated standards. Contact details are as follows:

Standards New Zealand, Radio New Zealand House, The Terrace, Private Bag 2439, Wellington.
Phone (04) 498 5991

TABLE A1
LIST OF LIVE LINE RELATED STANDARDS

Types of Live Work	Standard Number	Latest Issue Date*	Title
All	ANSI/IEEE:978	1984	Guideline for In-Service Maintenance and Electrical Testing of Live Line Tools
All	ANSI/IEEE:935	1989	Guide on Terminology for Tools and Equipment to be used in Live Line Working
All	ANSI/IEEE:516	1995	Guideline for Maintenance Methods on Energised Power-Lines
All	ANSI/IEEE:957	1995	Guideline for Cleaning Insulators
BH, S	IEEE 1067	1996	Guideline for In-Service Use, Care, Maintenance and Testing of Conductive Clothing for Use on Voltages up to 765kV AC
BH,S	ANSI Z41.3	1991	Men's Conductive Footwear
G&B, S	ANSI/SIA A92.2	1990	Vehicle Mounted Elevating and Rotating Aerial Devices

Types of Live Work	Standard Number	Latest Issue Date*	Title
G&B, S	AS 1418 Part 10	1996	SAA Crane Code - Elevating Work Platforms
G&B, S	AS 1418		Crane Code
G&B	ASTM:D120	1995	Standard Specification for Rubber Insulating Gloves
G&B,S	ASTM:D1048	1999	Standard Specification for Rubber Insulating Blankets
G&B, S	ASTM:D1049	1998	Standard Specification for Rubber Insulating Covers
G&B, S	ASTM:D1050	1999	Standard Specification for Rubber Insulating Line Hose
G&B, S	ASTM:D1051	1995	Standard Specification for Rubber Insulating Sleeves
G&B, S	ASTM:F478	1999	Standard Specification for In-Service Care of Insulating Line Hose and Covers
G&B, S	ASTM:F479	1995	Standard Specification for In-Service Care of Insulating Blankets
G&B	ASTM: F496	1999	Standard Specification for In-Service Care of Insulating Gloves and Sleeves
G&B	ASTM: F696	1997	Standard Specification for Leather Protectors for Rubber Insulating Gloves and Mittens
All	ASTM:F711	2000	Standard Specification for Fibreglass – Reinforced Plastic (FRP) Rod and Tube used in Live Line Tools
G&B, S	ASTM:F712	1995	Standard Test Methods for Electrically Insulating Plastic Guard Equipment for Protection of Workers
G&B, S	ASTM:F1564	2000	Standard Specification for Structure Mounted Insulating Work Platforms for Electrical Workers
S, BH	IEC 60895 (Prev 895)	1987	Specification for Conductive Clothing for Live Working at Nominal Voltages up to 800 kV a.c.

* As at date of preparation of this Code.

The following is a list of all issued IEC standards relating to live working at the date of preparation of this Code:

IEC 60050-651 Ed. 1.0 (1999-07)	Chapter 651 of the International Electrotechnical Vocabulary: Live working
IEC 60417-1 Ed. 1.0 (1998-08)	Graphical Symbols for use on Equipment - Part 1: Overview and Application
IEC 60743 Ed. 1.0 (1983-01) Amendment 1 (1995-01)	Terminology for Tools and Equipment to be used in Live Working
IEC 60832 Ed. 1.0 (1988-04)	Insulating Poles (Insulating Sticks) and Universal Tool Attachments (Fittings) for Live Working
IEC 60855 Ed. 1.0 (1985-01)	Insulating Foam-Filled Tubes and Solid Rods for Live Working
IEC 60895 Ed. 1.0 (1987-12)	Conductive Clothing for Live Working at Nominal Voltage up to 800 kV a.c.
IEC 60900 Ed. 1.0 (1987-12) Amendment 1 (1995-08)	Hand Tools for Live Working up to 1000 V a.c. and 1500 V d.c.
IEC 60903 Ed. 1.0 (1988-03)	Specification for Gloves and Mitts of Insulating Material for Live Working
IEC 60984 Ed. 1.0 (1990-02)	Sleeves of Insulating Material for Live Working

IEC 61057 Ed. 1.0 (1991-06)	Aerial Devices with Insulating Boom used for Live Working
IEC 61111 Ed. 1.0 (1992-12)	Matting of Insulating Material for Electrical Purposes
IEC 61112 Ed. 1.0 (1992-12)	Blankets of Insulating Material for Electrical Purposes
IEC 61219 Ed. 1.0 (1993-10)	Live Working — Earthing or Earthing and Short-Circuiting Equipment using Lances as a Short-Circuiting Device — Lance Earthing
IEC 61229 Ed. 1.0 (1993-07) Amendment 1 (1998-02)	Rigid Protective Covers for Live Working on a.c. Installations
IEC 61230 Ed. 1.0 (1993-09)	Live Working — Portable Equipment for Earthing or Earthing and Short-Circuiting
IEC 61235 Ed. 1.0 (1993-09)	Live Working — Insulating Hollow Tubes for Electrical Purposes
IEC 61236 Ed. 1.0 (1993-08)	Saddles, Pole Clamps (Stick Clamps) and Accessories for Live Working
IEC 61243-1 Ed. 1.0 (1993-11) Amendment 1 (1997-10)	Live Working – Voltage detectors — Part 1: Capacitive Type to be used for Voltages Exceeding 1 kV a.c.
IEC 61243-2 Ed. 1.0 (1995-10) Amendment 1 (1999-10)	Live Working - Voltage Detectors - Part 2: Resistive Type to be used for Voltages of 1 kV to 36 kV a.c.
IEC 61243-3 Ed. 1.0 (1998-10)	Live Working - Voltage Detectors – Part 3: Two-Pole Low-Voltage Type
IEC 61243-5 Ed. 1.0 (1997-06)	Live Working – Voltage Detectors - Part 5: Voltage Detecting Systems (VDS)
IEC 61278 Ed. 1.0 (1997-01)	Live Working – Guidelines for Dielectric Testing of Tools and Equipment
IEC 61318 Ed. 1.0 (1994-08)	Live Working — Guidelines for Quality Assurance Plans
IEC 61328 Ed. 1.0 (1995-08)	Live Working – Installation of Transmission Line Conductors and Earthwires - Stringing Equipment and Accessory Items
IEC 61472 Ed. 1.0 (1998-11)	Live Working – Minimum Approach Distances. Method of Calculation
IEC 61813 Ed. 1.0 (2000-09)	Live Working – Care, Maintenance and Inservice Testing of Aerial Devices with Insulating Booms
IEC 61911 Ed. 1.0 (1998-12)	Live Working – Installation of Distribution Line Conductors - Stringing Equipment and Accessory Items
IEC 61942 Ed. 1.0 (1997-09)	Live Working - Gloves and Mitts with Mechanical Protection

The following is a list of all Draft IEC draft standards relating to live working at the date of preparation of this Code:

IEC 60417-1 Ed 2.0 Amendment 1	Graphical Symbols: 5216 Pr 'Suitable for Live Working'
IEC 60743 Ed. 2.0	Terminology for Tools and Equipment and Devices to be used in Live Working (Revision of IEC 60743 Ed. 1.0)
IEC 60895 Ed. 2.0	Conductive Clothing for Live Working at a Nominal up to 800 kV a.c. or \pm 600 kV d.c. (Revision of IEC 60895 Ed. 1.0)
IEC 60903 Ed. 2.0	Specification for Gloves and Mitts of Insulating Material for Live Working. (Revision of IEC 60903 Ed. 1.0)
IEC 61057 Ed. 2.0	Aerial Devices with Insulating Boom used for Live Working. (Revision of IEC 61057 Ed. 1.0)
IEC 61243-1 Ed. 2.0	Live Working - Voltage Detectors — Part 1: Capacitive Type to be Used for Voltages Exceeding 1 kV a.c. (Revision of IEC 61243-1 Ed. 1.0)

IEC 61477 Ed. 1.0	Guidelines for Use of Tools and Equipment for Live Working
IEC 61478 Ed. 1.0	Live Working - Ladders of Insulating Material
IEC 61479 Ed. 1.0	Live Working - Conductor Covers (Line Hoses) of Insulating Material for Electrical Purposes
IEC 61481 Ed. 1.0	Portable Phase Comparators for Voltages of 1 kV to 36 kV
IEC 61482-1 Ed. 1.0	Live Working - Clothing for Thermal Protection Of Workers; Thermal Hazards of an Electric Arc - Part 1: Test Methods
IEC 61482-2 Ed. 1.0	Live Working - Clothing for Thermal Protection Of Workers. Thermal Hazards of an Electric Arc - Part 2: Performance Requirements
IEC 62192 Ed. 1.0	Live Working – Ropes of Insulating Material
IEC 62193 Ed. 1.0	Live Working – Telescopic Sticks
IEC 62237 Ed 1.0	Live Working - Mobile Insulating Hoses used with Hydraulic Tools for Live Working
IEC PNW 78-324 Ed. 1.0	Live Working – Guidelines for the Installation and Maintenance of Optical Cabling – Part 1 : Overhead High-Voltage Power Supply Lines

**NEW ZEALAND ELECTRICAL
CODE OF PRACTICE
for
HIGH VOLTAGE LIVE LINE WORK**

Part 2

Barehand

Issued by:

Manager, Standards and Safety
Ministry of Consumer Affairs
Wellington, New Zealand

THE ELECTRICITY ACT 1992

Approval of the New Zealand Electrical Code of Practice for High Voltage Live Line Work 2003 (*NZEC 46:2003*)

Pursuant to section 38 of the Electricity Act 1992, I hereby approve the New Zealand Electrical Code of Practice for Live line Work 2003 (*NZEC 46:2003*) which comprises three parts:

ECP46.1: Glove and Barrier

ECP46.2: Barehand

ECP46.3: Stick

The New Zealand Electrical Code of Practice for High Voltage Live Line Work 2003 (*NZEC 46:2003*) was issued by the Manager, Standards and Safety, Ministry of Consumer Affairs, acting under delegated authority (*pursuant to section 41 of the State Sector Act 1998*) from the Chief Executive, Ministry of Economic Development on the 12th day of October 2001.

Dated this 19th day of March, 2003

Hon Harry Duynhoven
Associate Minister of Energy

COMMITTEE REPRESENTATION

This Code of Practice was prepared by the Ministry of Consumer Affairs, in consultation with the following:

Members of the ECP46 Working Party

Electricity Engineers' Association of NZ (Inc) (EEA)

Engineering Printing and Manufacturing Union (EPMU)

Electrical Workers Licensing Group

Rail and Maritime Transport Union

The support of the Electricity Supply Association of Australia (ESAA) is also acknowledged.

REVIEW

This Code of practice will be revised as occasions arise. Suggestions for improvements of this Code are welcome. They should be sent to the Manager, Standards and Safety, Ministry of Consumer Affairs, PO Box 1473, Wellington.

OVERVIEW

This part of the Electrical Code of Practice for High Voltage Live Line work is in two Sections. Section 1 covers the general requirements for all live line techniques whilst Section 2 relates to the specific requirements for **Glove and Barrier work**.

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SECTION 1: SCOPE, INTERPRETATION AND GENERAL REQUIREMENTS

1.1 SCOPE

- 1.1.1** This Code sets out the minimum industry standards for high voltage live line work. The principles may be enhanced or supplemented, provided this does not result in reduced safety standards.
- 1.1.2** This Code applies to all work undertaken on live high voltage overhead lines using approved procedures, tools and equipment, and by persons holding the minimum competencies detailed under this Code. Other work on live high voltage overhead lines including, but not limited to, operating, is not covered by the Code.
- 1.1.3** This Code does not constitute a live line training manual, nor does it set down **live line work procedures**. These **procedures** should be developed in accordance with the principles in this Code.
- 1.1.4** The objectives of this Code are:
- (a) To ensure the safety of electrical workers and the general public.
 - (b) To specify the minimum standards for equipment required for live line work.
- 1.1.5** Equipment not specifically designed for a live line method shall not be used.
- 1.1.6** Throughout this Code:
- (a) The word "shall" is to be interpreted as mandatory.
 - (b) "Should" is to be interpreted as advisory or discretionary.
 - (c) Reference to lineworker unless specifically notified shall refer to a certificated live line mechanic.
- 1.1.7** While the principles of live line work contained in this Code have been written around work on overhead lines, the concepts may be equally applicable to work in other areas such as substation equipment, when combined with other appropriate training and work controls.
- 1.1.8** This Code does not substitute or override any regulation or legislation.
- 1.1.9** This Code does not apply to the following kinds of work:
- (a) The operation of fuses and the changing of the fuse elements;
 - (b) The operation of isolators and switches;
 - (c) The taking of electrical measurements;
 - (d) The measurement of distances;
 - (e) The phasing of conductors and fittings;
 - (f) The checking and testing of insulator strings;
 - (g) The removal of impediments on lines;
 - (h) The greasing of fittings.
 - (i) Traction live line work under 2,000 volts d.c.

The kinds of work listed above must be carried out using safe procedures and associated equipment designed specifically for the purpose.

1.2 INTERPRETATION

- 1.2.1 Approved** – means certified by the **Service Provider** as complying with the requirements of this code.
- 1.2.2 Asset Manager** - means an organisation responsible and accountable for the equipment to be worked on. An **Asset Manager** may also be a **Service Provider**.
- 1.2.3 Bonded** - means conductors and or fittings are connected together in such a manner as to ensure that they are at the same electrical potential.
- 1.2.4 De-Energised** – means disconnected from all sources of supply but not necessarily isolated, tested and earthed.
- 1.2.5 Earthed** – means effectively connected to the general mass of earth.
- 1.2.6 High-Voltage** – means any voltage exceeding 1000 V a.c. or 1500 V d.c.
- 1.2.7 Insulating Elevating Work Platform (Insulating EWP)** – means an approved and tested insulated aerial device.
- 1.2.8 Insulating Rope** – means standard commercial grade synthetic rope that is tested and manufactured to ensure good insulating properties but should not be intentionally placed across phase to phase or phase to earth air gaps.
- 1.2.9 Live (or Alive or Energised)** – means connected to a source of electrical supply.
- 1.2.10 Live Line Rope** – means rope that is specially designed, manufactured, tested and maintained so as to have very high insulating qualities and may be intentionally placed across phase to phase or phase to earth air gaps.
- 1.2.11 Live Line Equipment** – means all live line tools, rope, gloves and insulating equipment used for live line work.
- 1.2.12 Live Line Minimum Approach Distance (Live Line MAD)** – means the minimum air gap that shall be maintained between a lineworker and any other component at different potential during live line work, in order to prevent flashover and provide for worker safety.
- 1.2.13 Live Line Permit** – means a permit issued by the system controller or equivalent to verify to a **live line work** party that the control measures are in place on the circuit being worked on and to authorise work.
- 1.2.14 Live Line Stick (also called Hot Stick)** – means a solid or filled stick of insulating material specially designed, approved and tested for use in physically bridging the distance between;
- (a) the lineworker and energised components; or
 - (b) the energised components and earth; or
 - (c) adjacent phases; or
 - (d) to enable physical loads to be taken or tools to be applied.
- 1.2.15 Live Line Work** – means any high voltage work performed under approved procedures inside the minimum approach distance (MAD), on or near components of a line capable of being energised to high voltage without implementing the full protective practice of isolating, proving **de-energised** and earthing.

1.2.16 Method – means a fundamental technology for undertaking live line work. The three methods are **glove and barrier**, **barehand** and **stick**.

- (a) **Live Line Glove and Barrier Method** – means a method of performing **live line work** where the lineworker 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) **Live Line Barehand Method** – means a method of performing **live line work** in which the lineworker is in contact with energised components while insulated from other objects at different 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) **Live Line Stick Method** – means a method of performing **live line work** using tools and equipment mounted on **live line sticks**, with the lineworker maintaining the **minimum approach distance** from energised components.

1.2.17 Minimum Approach Distances – means the minimum distances when approaching live conductors that shall apply to any person who is not a competent live line lineworker, and include conductive material carried by them, vehicles, and mobile plant.

These distances apply to any part of the line mechanic's body or clothing and to anything in contact with the line mechanic, e.g. tools, ladders and scaffold poles (except live line tools and voltage detectors).

1.2.18 Minimum Tool Insulation Distance (also called **Effective Length**) – means the minimum effective length of exposed insulating material that is subjected to the voltage being contacted. This distance shall be measured between the metal end fitting at the conductor end of the insulating material and the metal end fitting or hand mark, where provided, at the opposite end of the insulating material.

When **live line sticks** consist of sections joined with metal couplings, the insulation distance shall be the total of each of the lengths of insulating material that have not been bridged out by the metal couplings.

1.2.19 Procedure – means a collection of **techniques** that, **when** used together, enables a total task outcome to be completed.

1.2.20 Service Provider – means an employer responsible for undertaking the **live line work**.

1.2.21 Technique – means a documented basic live line skill or competency that enables a specific task to be completed, for example:

- (a) Carry out a live line job risk assessment.
- (b) Access a transmission conductor barehand using live line rope.
- (c) Apply insulating barriers to a distribution pole structure.
- (d) Take conductor loads on a suspension structure.

1.2.22 Tested – means tested in accordance with the relevant standard.

1.2.23 Training Provider – means a provider of training who has the knowledge, skills, experience and resources required to deliver training that meets industry standards; and is also one of the following:

- (a) A NZQA registered and accredited training provider or an overseas equivalent (recognised by NZQA); or

- (b) a person or organisation approved by the Secretary to undertake live line training prior to the date of the commencement of this code. This approval is only valid up to the date specified on the approval.

1.3 GENERAL REQUIREMENTS RELATING TO ALL TECHNIQUES

1.3.1 Minimum Standards and Responsibilities

1.3.1.1 Responsibilities of the Asset Manager

Any **Asset Manager** using live work processes on their network shall ensure that the Service Provider complies with the requirements of clause 1.3.1.2.

1.3.1.2 Responsibilities of the Service Provider

Any **Service Provider** undertaking live line work shall:

- (a) meet as a minimum standard all the requirements of this Code;
- (b) have in place an effective process to regularly monitor and review all aspects of **live line work**;
- (c) have in place an effective process to inspect the field performance of **live line work**. This inspection shall address safe work practices and conformance with documented **techniques** at intervals not exceeding 12 months;
- (d) have in place an effective process to regularly review the health of live line lineworkers; and
- (e) have in place an effective risk management process.

1.3.2 Electric and Magnetic Fields

Each **Asset Manager/Service Provider** shall keep up to date on information arising out of scientific research on electric and magnetic fields, and shall keep its employees informed on the issue.

1.3.3 Work Techniques and Procedures

1.3.3.1 Development and Proving

Work techniques shall be developed and documented for each live line work outcome. These techniques shall be proven in a trial on disconnected and/or earthed equipment to verify that they can be carried out reliably and safely.

1.3.3.2 Documentation

Documentation shall contain information relating to the **Asset Manager's** requirements for accessing the network.

Documentation clearly setting out the basic steps shall be provided for each approved procedure or technique and shall:

- (a) Clearly identify the work objectives or desired task outcome.
- (b) Be part of a controlled document management system.
- (c) State the minimum number of lineworkers required.

A copy of the relevant work documentation shall be readily available at the worksite.

1.3.3.3 Live Line Manual

A live line manual, which may include this Code, shall be made available to each lineworker. This manual shall contain at least the following:

- (a) A description of live line principles and requirements.
- (b) A description of each live line tool, its functions, its uses and the determination of its safe working load.
- (c) Instructions on caring for the tools and equipment including:
 - (i) Checks before use.
 - (ii) Inspections.
 - (iii) Maintenance instructions.
 - (iv) Testing requirements for plant and equipment.
- (d) Guides for the calculation or assessment of conductor loads applied to tools and the consequent safety factors.
- (e) A set of approved live line work **procedures** or **techniques**.
- (f) Information for use in an emergency situation.

1.3.3.4 Compliance with Approved Work Documentation

Approved work documentation shall not be changed or disregarded on site except as otherwise provided for in clause 1.3.3.5.

1.3.3.5 Minor Changes to Work Techniques

Minor changes to work **procedures** or **techniques** may be required from time to time, such as changes to tooling to fit dimensional variations on structure components. Such changes must not compromise tool insulation, loading, air gap distances, or safety outcomes in any way and shall be recorded.

Such changes shall be agreed by the entire team at the outset of the job and not implemented in an *ad hoc* manner during the work.

1.3.4 Personnel Selection, Training, Certification, Records and Maintenance of Competency

1.3.4.1 Selection of Personnel

The Service Provider shall establish a policy on the minimum acceptable standards required prior to acceptance of a lineworker as a trainee in the **live work method**. This policy shall include:

1.3.4.2 Minimum Requirements

- (a) Registration as a Line Mechanic; or
 - (i) equivalent Line Mechanic National Certificate in the appropriate lines discipline; or
 - (ii) equivalent documented proof of qualifications or training as a line worker (as determined by NZQA); and
 - (iii) documented evidence of 2 years' post certification/registration experience in general line work, including current competence in the equivalent earthed line processes to be undertaken live; or

- (b) Registration as an Electrician or Electrical Inspector; or be a Qualified Engineer; and
 - (i) documented evidence of 4 years post registration or qualification experience in general line work, including current competence in the equivalent earthed line processes to be undertaken live.
- (c) Demonstrated personal attributes such as responsibility, concentration, communication, a high level of workmanship, and the ability to work in a team.
- (d) A medical examination shall be carried out by a qualified occupational health practitioner to check that the lineworker can physically meet the requirements to carry out the intended work and has no medical condition that could affect the safety of the lineworker or the work team.

1.3.4.3 Training and Certification

1.3.4.3.1 Supervision of Live Line Training

All training (including refresher training) shall be carried out under the direct and immediate supervision of a trainer certificated by the **Training Provider** as competent to undertake **procedures** or **techniques** being taught.

1.3.4.3.2 Live Work Methods Trainers

Prior to being certificated by the Training Provider as competent to undertake the **procedures** or **techniques** being taught, trainers of live working **methods** shall satisfy the following minimum requirements:

- (a) Minimum requirements as required by clause 1.3.4.2.
- (b) Current competency in the **method** being taught.
- (c) A minimum of 12 months documented work experience in the **method** being taught.
- (d) Have gained competency in instructing techniques.
- (e) Have conducted, to a certified trainer's satisfaction, a full live line work training course in the **method** being taught under the guidance of that certified trainer, and passed that trainer's assessment of the delivery of the instruction in **live line work** theory and practical techniques.

1.3.4.3.3 Training in Live Work Methods

- (a) The live work **method** training shall provide a thorough understanding of both the principles of the live work **method** as well as a comprehensive practical programme. This training shall include live work theory and application, correct use and maintenance of personal protection equipment, proper care of tools and equipment, and practising the required **procedures** or **techniques** on earthed lines before their application on energised lines.
- (b) Lineworkers undergoing live work training shall receive ongoing monitoring during the training programme to ensure their continued suitability for **live line work**.
- (c) Trainees who do not hold necessary allied or underpinning live work **methods** competencies, shall be taught the appropriate **techniques**, and those competencies shall be gained prior to the commencement of the training in the live work **method**.

- (d) Competency certification in the live work **method** shall only be issued when the trainee can demonstrate the required knowledge, skills and experience to carry out the work safely and to the required standards.

1.3.4.4 Certification and Records

1.3.4.4.1 Issue of Certificates

Competency Certificates shall be issued by the **Service Provider**:

- (a) Following satisfactory completion of the training as endorsed by the **Training Provider**.
- (b) Following satisfactory completion of annual refresher training and field inspection (refer section 1.3.4.5 Maintenance of Competency).
- (c) Immediately before a live line worker moves to a new **Service Provider**.
- (d) When a live line worker moves to a new **Service Provider**, and after satisfactory completion of appropriate refresher training.

1.3.4.4.2 Content of Certificate

A live line worker shall at all times hold a Competency Certificate issued by the Service Provider, indicating the live line work the lineworker is approved to undertake. Competency Certificates shall contain the following information:

- (a) Name of Holder.
- (b) Date of Issue.
- (c) Expiry Date.
- (d) Name of Training Provider.
- (e) Unique Certificate Number.
- (f) Categories of Work, allied live work methods techniques, voltage level and, if appropriate, competency groups in which the holder has demonstrated competency.
- (g) Relevant qualification attained.
- (h) Signature of issuing **Service Provider**.

1.3.4.4.3 Withdrawal of Certificate

A Certificate issued under 1.3.4.4.1 may be withdrawn by the Service Provider where a person is deemed not to be competent in relation to the categories of work, allied live work method techniques, voltage level or competency groups (as appropriate).

1.3.4.4.4 Categories of Work and Certificates

(a) Live Line Glove and Barrier

The holder of a **Live Line Glove and Barrier** Certificate can use glove and barrier procedures, including the use of live line sticks, to replace and install fittings, hardware and structures.

The requirements for this certificate are detailed in ECP46 Part 1.

(b) **Live Line Barehand**

The holder of a **Live Line Barehand** Certificate can use barehand methods and live line stick methods on lines from 66kV to 330 kV a.c. and 375 kV d.c. to:

- Displace lines, fittings and hardware.
- Install or replace poles, tower crossarms, insulators and fittings.

The requirements for this certificate are detailed in ECP46 Part 2.

(c) **Live Line Stick (non load bearing)**

(i) Up to and including 33 kV

The holder of a **Live Line Stick** Certificate (non load bearing) up to and including 33 kV can use **live line stick methods** on lines up to and including 33 kV to connect and disconnect spur lines, fittings and hardware.

The requirements for this certificate are detailed in ECP46 Part 3.

(ii) Above 33 kV

The holder of a **Live Line Stick** Certificate (non load bearing) up to 110 kV can use **live line stick methods** on lines up to 110 kV to test insulators and install dampers, corona balls and measuring devices.

The requirements for this certificate are detailed in ECP46 Part 3.

(d) **Live Line Stick (load bearing)**

(i) Up to 110 kV (with or without underbuilt)

The holder of a **Live Line Stick** Certificate (load bearing) up to 110 kV (with or without underbuilt) can use **live line stick methods** on lines up to 110 kV with and without underbuilt circuits.

The requirements for this certificate are detailed in ECP46 Part 3.

(ii) Above 33 kV (without underbuilt)

The holder of a **Live Line Stick** Certificate (load bearing) above 33 kV (without underbuilt) can use **live line stick methods** on lines without underbuilt circuits up to and including 375 kV d.c.

The requirements for this certificate are detailed in ECP46 Part 3.

- (e) No person shall carry out work to which this Code applies unless that person is the holder of a current competency certificate for that class of work or a trainee working under supervision.

1.3.4.4.5 Records

Service Providers shall keep for each live line lineworker adequate records of the training undertaken and live work history of each live line lineworker, including **techniques** and **procedures**.

1.3.4.5 Maintenance of Competency

1.3.4.5.1 Ensuring Ongoing Competency

To ensure ongoing competency, **Service Providers** shall monitor and document the performance of the **live line** lineworker by conducting field inspections at least annually.

1.3.4.5.2 Field Inspection of Competency

Field inspections shall assess demonstrated competencies against documented **live line methods, procedures** and **techniques** at least annually.

1.3.4.5.3 Requirements of a Person Conducting Field Inspections of Competency

Field inspections shall be conducted by a person:

- (a) who is authorised by the **Service Provider**;
- (b) who has been trained and is currently competent in the methods being inspected; and
- (c) who is independent of the work party.

1.3.4.5.4 Refresher Training

Refresher training shall be conducted on live work safety rules, concepts and **techniques** of the **method**:

- (a) At intervals no greater than twelve months, and
- (b) Whenever **techniques** are found to be deficient during the field inspections, and/or
- (c) When a lineworker has performed no live work in a specific competency for in excess of twelve months.

1.3.4.5.5 Trainer Competency

Training Providers shall regularly audit the competencies of their trainers to ensure they meet industry competency requirements. This process should include knowledge of live work accident causes, audited non-compliance trends, new technologies, and equipment mechanical and electrical limitations.

1.3.5 Equipment

1.3.5.1 General

Care and maintenance of equipment is essential for safe live line work.

1.3.5.1.1 Suitability of Live Line Equipment

All **live line** equipment shall be designed, tested and approved specifically for work on energised high-voltage lines.

1.3.5.1.2 Rating of Live Line Equipment

All **live line** equipment shall be rated and certified for use by the manufacturer and shall meet the standards listed in Appendix A or equivalent.

1.3.5.1.3 Tool Management

A **tool** management system shall be in place to ensure equipment is maintained to set standards (refer to Appendix A). This system shall, as a minimum, ensure that equipment is inspected, maintained and tested at appropriate intervals. Records of these events shall be kept for the working life of the equipment.

1.3.5.2 Care and Use of Live Line Equipment

1.3.5.2.1 Condition of Live Line Equipment

All **live line** equipment shall be maintained in a clean and dry condition.

1.3.5.2.2 Placement of Live Line Equipment

Live line equipment shall not be laid directly on the ground.

1.3.5.2.3 Storage and Transport of Live Line Equipment

Live line equipment shall be stored and transported in a way that shall ensure the equipment is not exposed to excess moisture, dust, chemicals, abrasion and other deteriorating effects.

1.3.5.2.4 Before Use Inspection and Cleaning of Live Line Equipment

Live line equipment shall be visually inspected, mechanically test-operated and cleaned before use. Any tool that appears to be defective shall be tagged and withdrawn from service for further inspection, testing, repair or replacement.

1.3.5.2.5 Regular Inspection and Maintenance of Live Line Equipment

Live line equipment and insulating tools shall be inspected and maintained in accordance with the manufacturer's recommendations and with relevant standards in Appendix A.

1.3.5.2.6 Avoidance of Deteriorating Contaminants

All **insulating equipment** should be kept clear of deteriorating contaminants such as handcreams, sunscreens, paint solvents, hydraulic oil, etc. that may affect or deteriorate insulating qualities of equipment.

1.3.5.3 Live Line Sticks

Live line sticks provide a rigid physical connection of known insulating quality between live line lineworkers and energised components.

1.3.5.3.1 Hollow Sticks

Hollow sticks are not acceptable due to the difficulties in maintaining their electrical integrity.

1.3.5.3.2 Stick Surfaces

Stick surfaces shall be maintained to the standards specified by the manufacturer.

1.3.5.3.3 Design of Metal End Fittings

Metal end fittings shall be designed so as to prevent the development of excessive electric field stresses and corona within the stick termination.

1.3.5.3.4 Termination of Metal End Fittings

Metal end fittings shall be terminated onto the sticks in such a way as to prevent the creation of airgaps or voids that could be detrimental to the electrical performance of the stick.

1.3.5.4 Conductor Support Equipment

This equipment is used to provide temporary support for energised conductors when carrying out live line work, eg. wire tongs.

1.3.5.4.1 Assessment of Conductor Load

When using conductor support equipment, the conductor load shall be assessed to ensure that the safe working load of the equipment is not exceeded.

1.3.5.4.2 Rating of Insulation of the Equipment

Ensure that the insulation of the equipment is of adequate rating for the line voltage involved, and that supplementary insulating devices are added where necessary.

1.3.5.5 Rope

1.3.5.5.1 Types of Rope in Use

There are two types of rope used in live line work. **Live line rope** is designed, manufactured and managed as an insulating tool for full phase voltage. **Insulating rope** is normal synthetic rope that is kept clean and dry but has no guaranteed insulating properties. Insulating rope may be used in series with an insulating stick or composite insulator to provide known insulating properties. All other rope for which no special management has been applied shall not be used on live line work sites.

1.3.5.5.2 Insulation Properties of Live Line Rope

Live line rope shall be of synthetic material that has high insulation properties and is moisture resistant, and that maintains these properties for a sustained period of service.

1.3.5.5.3 Use and Marking of Live Line Rope

Live line rope shall not be used for any other purpose, and shall be clearly marked and managed so that it cannot be inadvertently mistaken for **insulating rope**.

1.3.5.5.4 Electrical Testing of Live Line Rope

Live line rope shall be electrically tested before being placed in service, in accordance with ANSI/IEEE Standard 516 or equivalent.

1.3.5.5.5 Management of Live Line Rope Usage

Live line rope usage shall be managed in accordance with a specially developed maintenance system. This system shall address the following factors:

- (a) Visual inspection before each use.
- (b) Electrical testing at regular intervals.
- (c) Atmospheric humidity constraints for rope usage.
- (d) Removal from time to time of the most used (end) sections of rope coils to limit contamination and other deterioration of the rope.

- (e) Suitable clean and sealed storage with consideration given to the use of desiccant to ensure the rope is completely dried between each use.

1.3.5.5.6 Insulating Rope

Insulating rope shall be kept away from **live** components by a **distance** at least equal to the applicable **live line minimum approach distance**.

1.3.6 Safety Observer

During all live line work, one member of the work team shall be designated as the **Safety Observer**. The **Safety Observer's role** is to alert the work team to any potentially unsafe actions or lack of compliance with an approved work **procedure** or **technique**. The **Safety Observer** shall:

- (a) be certificated and competent to carry out the particular work being observed;
- (b) be positioned at a suitable location to observe the work being performed;
- (c) have the authority to temporarily suspend the work at any time;
- (d) maintain effective and immediate communication with the work team at all times;
- (e) not perform any other task whilst **live line work** is in progress; and
- (f) suspend all work in the event of having to leave the site or significantly change position until he/she has returned/reached a new location or has been replaced.

The **Safety Observer's role** may be rotated among members of the work team, for example to reduce fatigue. When this occurs it shall be formally handled such that all members of the work party are aware at all times who is performing the role of the **Safety Observer**.

1.3.7 Work Considerations

1.3.7.1 Line Hazard Identification

The **Asset Manager** shall advise the **Service Provider** of any known hazards that have the potential to impact on the safe outcome of the work, eg. conductor corrosion, defective insulator types, corroded or defective fittings or structures, and known over-crossings of other lines.

In addition to any hazards identified by the **Asset Manager**, the working party shall inspect the work site to identify electrical and non-electrical hazards that could impact upon the safety of the working party or the public.

1.3.7.2 Weather Conditions at Worksite

Work shall not proceed and the work team shall keep clear of the circuit in the event of the following:

- (a) An electrical storm is observed in the vicinity of the worksite.
- (b) Any significant rain (beyond intermittent spotting), mist, fog, snow or sleet unless using **techniques** and equipment specifically designed and tested as being able to operate whilst wet.
- (c) When using live line rope, any threat of rain, mist, fog, snow or sleet.
- (d) Excessive wind velocities, such that work cannot be continued in safety.

1.3.7.3 Fault Current Protection

Protective devices shall be operational in the circuit being worked on. These devices shall be capable of detecting and clearing faults at the worksite.

1.3.7.4 Disabling of Auto-Reclose

All **auto-reclose** equipment controlling the section of the circuit on which live line work is to be performed shall be blocked for the duration of the work.

This reclosing equipment shall be tagged with an appropriate safety tag.

1.3.7.5 Live Line Permit

1.3.7.5.1 Issue of Live Line Permits

Prior to the commencement of work, the work party shall receive a live line permit. The method of transfer may be verbal exchange, hard copy or by electronic means.

1.3.7.5.2 Identification and Disabling of Reclose Features and/or Processes

The procedure for the issue of the live line permit shall ensure all of the appropriate reclose features and/or processes (or restart for HV d.c.) are identified and disabled before the permit is issued. No manual reclose in the event of a tripping shall occur without first establishing the safety of the work party.

1.3.7.5.3 Cancellation of the Live Line Permit

The live line permit shall be cancelled on completion of the work.

1.3.7.5.4 Documentation for the Issue and Cancellation of Live Line Permits

The procedure for the issue and cancellation of **live line permits** shall be documented. Where required by the **Asset Manager**, the procedure shall include a description of the work and location where the work will be carried out.

1.3.7.5.5 Multiple Live Line Permits on the Same Circuit

Where more than one work team is working on the same circuit but at different locations, the procedure shall ensure that all teams have cancelled their live line permits before the reclose features and/or processes (or restart for HV d.c.) are returned to normal.

1.3.7.6 Work Team Communications

1.3.7.6.1 General

Each work team shall establish a reliable on-site two-way communications link with the issuer, system controller, or equivalent. Where practicable, and/or required by the **Asset Manager**, appropriate calls at specified times should be agreed upon between the work party and the Control Room, or equivalent.

1.3.7.6.2 Integrity of the Communications Link

The integrity of the communications link should be checked at regular intervals during the course of the work to ensure it is functioning correctly.

1.3.7.6.3 Communication Among Work Team Members

The work team shall establish and maintain effective communication among the work team members to ensure the safety of the team.

1.3.7.7 Public Safety

Public access to the work site shall be controlled at all times when work is in progress.

1.3.7.8 Work on De-Energised or Earthed Circuits

Live line work methods may be used to work on a circuit that is de-energised or earthed provided that all work is undertaken as though the circuit is energised.

1.3.7.9 Suspension of Work

If it becomes necessary to suspend work, the circuit shall be left in a safe condition and the **Asset Manager** informed.

1.3.7.10 Crane Operation

1.3.7.10.1 Instruction of Crane Operators

Prior to the commencement of work, crane operators shall be instructed on the procedure and safe working distances to be used.

1.3.7.10.2 Supervision of Crane Operators

The crane operator shall be under the direct and immediate supervision of a competent nominated member of the **live line** team.

1.3.8 Procedures in the Event of an Accident

1.3.8.1 Procedures for Responding to Accidents

Each Asset Manager and Service Provider shall have in place documented procedures for responding to accidents. These procedures shall as a minimum address, as appropriate, the following items:

- (a) The rescue of injured persons or those at risk.
- (b) Communication with Emergency Services.
- (c) The immediate first aid and medical needs of any injured person and the safety of other persons at the worksite.
- (d) Any emergency switching requirements.
- (e) Restoration of any circuit as a result of the incident.
- (f) Investigation and reporting requirements to determine the cause of the accident and the implementation of appropriate remedial measures.
- (g) Notification of all parties required under relevant regulations and industry agreements.

1.3.9 General Work Practices

1.3.9.1 Safety Monitoring

During all live work, all team members shall:

- (a) monitor the actions of other team members;

- (b) maintain effective communication with the work team; and
- (c) have the authority to temporarily suspend the work at any time due to unsafe actions or lack of compliance with approved work **procedures**.

1.3.9.2 On-Site Team Review

Before commencing work an on-site team review shall be carried out to address hazard management and work practices and shall:

- (a) identify hazards;
- (b) assess risks that may result because of the hazards;
- (c) have emergency personnel contact numbers;
- (d) have procedures to contact and interact with Emergency Services;
- (e) decide on control measures to prevent or minimise the level of the risks; and
- (f) implement control measures.

Particular attention should be given but not limited to:

- (a) **WHY** the work is to be done.
- (b) **WHAT** is to be accomplished.
- (c) A discussion of **HOW** the work is to be carried out and **WHO** will do it.
- (d) The integrity of the structure on which work is to be carried out including mechanical loads and condition of conductors and joints.
- (e) The integrity of the adjacent structures and spans.
- (f) The integrity of insulation in the immediate work area.
- (g) Clearances to potential midspan hazards, particularly where conductors are to be moved during the work.
- (h) Site terrain conditions (stability of equipment and footing).
- (i) Live stock management (interference with the work).
- (j) Traffic management.
- (k) Public safety.
- (l) Potential weather conditions during the work.

1.3.9.3 Weather Conditions

Live line work shall only be carried out in suitable weather conditions (refer to clause 1.3.7.2).

1.3.9.4 Light Conditions

Live line work shall only be performed when there is adequate light.

1.3.9.5 Personal and Protective Apparel Worn By Lineworkers

Personal and protective apparel worn by lineworkers shall include as a minimum:

- (a) Full body coverage, fire resistant clothing. Workers should consider wearing underclothing of fire resistant material, such as cotton, to reduce the severity of injuries in the event of fire.
- (b) Hard hats.
- (c) Protective footwear with non-slip soles, including conductive boots when appropriate.

1.3.9.6 Conductive Clothing

Conductive clothing shall be worn where necessary to limit discomfort from induced static discharges.

1.3.9.7 Eye Protection

Suitable eye protection shall be provided and used at all times. Anti-glare eye protection should be used as appropriate.

1.3.9.8 Wearing of Metallic Objects

Metallic objects such as neck chains, earrings and other body adornments, rings, watches and bracelets should not be worn while carrying out **live line work**.

1.3.9.9 Long Hair

Long hair shall be securely fixed and confined close to the head.

1.3.9.10 Electrical Rating of Insulating Equipment

All **insulating equipment** shall have an electrical rating suitable for the voltage being worked on.

1.3.9.11 Restraint of PPE and Tooling

The free end of body belts, pole straps and ropes shall be restrained from infringing the **live line minimum approach distance**.

1.3.9.12 Other Activity

When **live line work** is being performed, no other activity that could compromise the safety of the work team shall be carried out.

1.3.9.13 Leaving of Live Line Insulating Equipment on Energised Lines

Live line insulating equipment should not be left on energised lines for extended periods such as overnight. Where this is necessary, they shall not subsequently be depended upon to protect the lineworker. Before re-use they shall be removed, cleaned and visually inspected, and, if suspect, submitted for electrical test.

1.3.9.14 Responsibilities of the Supervisor of the Work Team

At all **live line work** sites, one person in the work party should:

- (a) have sole charge of all on-site activities;
- (b) ensure individual members of the work party have been designated to all the various tasks required by the work procedure including the role of the safety observer;
- (c) at the start of the work, run a work site briefing; and

- (d) at the completion of the work, run a work site de-briefing to ensure that all difficulties encountered during the work are identified.

NOTE: This person may undertake any of the roles required by the procedure. However, if undertaking the role of the safety observer, they must be free to assume the duties as detailed in clause 1.3.6.

1.3.9.15 Manual Reclose or Other Planned Switching of a Circuit

In the event that a manual reclose or other planned switching of a circuit is required, the work teams shall move clear of the circuit prior to the switching being attempted.

1.4 MINIMUM REQUIREMENTS FOR ALL CATEGORIES OF LIVE LINE WORK

All live line workers shall meet the following requirements:

1.4.1 Theory/Standards

- (a) Understand and apply **live line work** theory and the principles of the **live line work method** concerned.
- (b) Understand and apply the parts of ECP 46 as applicable to:
 - (i) **Live Line Glove and Barrier** Work.
 - (ii) **Live Line Barehand** Work.
 - (iii) **Live Line Stick** Work.
- (c) Understand and apply the relevant Statutes, Regulations, Codes and Rules.
- (d) Understand and mitigate the hazards of step and touch potentials.

1.4.2 Work Site Management and Participation

- (a) Conduct a work site risk assessment including hazard evaluation, work limitations and mitigation of hazards.
- (b) Work in the different roles within a team including:
 - (i) Conducting a tailgate session
 - (ii) Directing a work team through the use of a procedure
 - (iii) Acting as a team member
 - (iv) Acting as a safety observer.
- (c) Constructively participate in the development of safe work procedures for a specific work task.

1.4.3 Practical Skills

- (a) Safely climb and observe minimum approach distances on line structures.
- (b) Safely use and maintain safety belts and harnesses.
- (c) Take access permits.
- (d) Perform rescue procedures.
- (e) Implement customer service and land owner protocols.

- (f) Safely rig and establish applied conductor loads.
- (g) In-field inspect, test, care for and maintain, as applicable, live line sticks, tools, barriers, guards, gloves, sleeves and other equipment relevant to the **live line work procedure** concerned.
- (h) Safely apply work site earthing.
- (i) Take **live line permit** and reclose blocks.
- (j) Evaluate line condition prior to undertaking work.

SECTION 2: LIVE LINE BAREHAND WORK

2.1 GENERAL

For **Live Line Barehand Work**, there shall be compliance with the requirements of Section 1 and this Section.

2.2 CONCEPTS

Live line barehand work is carried out on energised high and extra high-voltage lines, with the lineworkers normally wearing conductive clothing. The lineworker is in contact with the **energised** line whilst insulated from earth and other electrical potentials.

The **live line barehand method** is based on the principle that a lineworker can safely be in contact with an **energised** line, provided that the lineworker is insulated from any other object at a different potential.

The application of this principle requires the use of:

- (a) Electrically insulating equipment for a lineworker to gain access to the energised conductor or fitting while maintaining adequate air clearance as insulation from other objects at different electrical potential.
- (b) Conductive clothing to provide the benefits to the lineworker of Faraday's discovery in the 19th century that no electrostatic field exists inside an energised metal cage.

Access to the work can be by way of **insulating** ladder or **rope, insulating elevating work platform**, crane or helicopter.

The work can include inspections and repairs to conductors and/or fittings and the replacement of insulators.

2.3 APPROACH DISTANCES

2.3.1 Live Line Minimum Approach Distances

The following Table for **live line minimum approach distances** shall normally be adopted:

Nominal Line Voltage	Live Line Minimum Approach Distance (mm)

	Phase to Earth	Phase to Phase
6.6/11 kV	350	350
22 kV	400	450
33 kV	500	550
50/66 kV	700	900
110 kV	950	1300
220 kV	1600	2300
270 kV d.c.	1600	2700
330 kV	2050	3150
350 kV d.c.	1800	3300

Note: Phase to Earth LLMAD and Phase to Phase LLMAD in relation to the above table:

- (a) In the absence of specific information on transient levels likely to be experienced on a given network of lines, the application of the **Live Line Minimum Approach Distances** above is considered conservative.
- (b) The column titled LLMAD / Phase to Earth should be interpreted as the minimum required airgap between any unearthed phase conductor, and any adjacent conductive or semi conductive earthed reference (such as an earthwire, pole, crossarm, neutral wire, etc) including any conductive tooling or workers body in contact with the phase or earthed reference.
- (c) The column titled LLMAD / Phase to Phase should be considered as the minimum required airgap between any two unearthed phases including any conductive tooling or workers in contact with those phases.
- (d) The Phase to Earth or Phase to Phase LLMAD may consist of two airgaps (with a worker or tooling "electrically floating" between), always provided that the two airgaps together provide the total required LLMAD airgap. For example, a worker may be positioned between two phases provided the airgap on each side at least equals the total required LLMAD Phase to Phase.
- (e) The columns titled "Phase to Earth" and "Phase to Phase" should be read as "Pole to Earth" and "Pole to Pole" respectively for d.c. systems.

2.3.2 Live Line Minimum Approach Distances Greater Than Normal

The live line minimum approach distances adopted by individual **Asset Managers** for use on their system may be more conservative than those set down in clause 2.3.1. These greater distances shall be strictly observed at all times during **live line work**.

2.3.3 Live Line Minimum Approach Distances Less Than Normal

Where **live line minimum approach distances** less than those in clause 2.3.1 are proposed to be adopted, these distances shall be calculated in accordance with the following guidelines:

- (a) It is normal international practice to determine the live line minimum approach distance as that required to prevent flashover from worst-case voltage transients on the system with an additional allowance for inadvertent movement of the lineworker.
- (b) The air gap required to prevent flashover (“Air Insulation Distance”) is derived on the basis of switching impulse withstand strengths. Detailed information on the selection of Air Insulation Distances for various system nominal voltages and system transient voltage levels is given in ANSI/IEEE Standard 516.
- (c) The allowance for inadvertent movement adopted by the **Asset Manager** in establishing **live line minimum approach distances** shall be based on ergonomic considerations of the lineworker, the equipment used and the work environment.
- (d) The minimum inadvertent movement distance shall be 300 mm unless the lineworker is physically constrained by barriers or other means, in which case a lesser distance may be used.
- (e) Live line minimum approach distances in clause 2.3.1 have been derived in accordance with the principles set out in ANSI/IEEE Standard 516 and using an allowance for inadvertent movement of 300 mm. The maximum switching overvoltages considered were:
 - (i) 3.0 per unit up to and including 275 kV;
 - (ii) 2.5 per unit for 330 kV;
 - (iii) 2.0 per unit for 500kV, 270 kV d.c. and 350 kV d.c.

These maximum transient overvoltages assume that the auto-reclose (or restart on HV d.c.) facility on the line being worked on is disabled in accordance with normal practice.

*Significantly higher switching surge levels are possible if line auto-reclose facilities are not disabled. This is of particular significance at transmission voltages where the **live line minimum approach distance** is strongly dependent on the maximum switching transient assumed.*

- (f) Where properly co-ordinated temporary air-gaps or surge arresters are fitted in the vicinity of the worksite, live line minimum approach distances may be reduced. For these transient control devices to be effective, they should be fitted as close as practicable to the work site, but not at the structure being worked on.
- (g) Altitude correction factors should be applied in accordance with ANSI/IEEE Standard 516 when work is to be performed at altitudes higher than 900 m.

2.3.4 Live Line Minimum Approach Distance for Barehand Work

For barehand work, the **live line minimum approach distance** is the sum of air gaps providing air insulation for the lineworker. During the process of moving to or from the conductors and bonding on, the **Live Line Minimum Approach Distance** shall be interpreted as the sum of airgaps from conductor to lineworker and from lineworker to earth.

2.3.5 Tool Insulation Distance

2.3.5.1 Tool Insulation Distances

The tool insulation distances adopted by the **Asset Manager** for use on their system shall be equal to the live line minimum approach distance for line voltages up to and including 33 kV, and never less than the Air Insulation Distance shown in the table in clause 2.3.1.

2.3.5.2 Reductions in Tool Insulation Distance

Reductions in tool insulation distance below the **live line minimum approach distance** may be necessary where, for example, tooling such as strain poles are used to support insulator assemblies that are themselves shorter than the **live line minimum approach distance**. Because such tools do not require an inadvertent movement allowance, a reduction of 300 mm is possible to enable the tool to fit across the available air gap without compromising electrical safety.

NOTE: This does not imply any reduction of worker **live line minimum approach distance**.

2.4 EQUIPMENT

2.4.1 Cranes and Elevating Work Platforms (EWPs)

Cranes and **EWPs**, insulated and set up in accordance with the requirements of this section, may be used to support conductors and equipment for the **live line** procedure.

2.4.1.1 Supporting Energised Components

When supporting energised components, appropriate insulation, rated to meet the electrical and mechanical loads, shall be fitted between the crane or **EWP** and the **energised** components.

2.4.1.2 Uninsulated Parts of the Crane or EWP

Parts of the crane or **EWP** that are not insulated shall be carefully monitored to ensure they do not encroach within a predetermined approach distance. In addition, consideration should be given to movement of the conductor with wind and changes of temperature.

2.4.1.3 Earthing and Bonding of the Chassis of the Crane or EWP

The chassis of the crane or **EWP** shall, where practicable, be **earthed** and **bonded** to the structure to create an equipotential work zone.

2.4.1.4 Maintenance Management System for EWPs Used for Barehand Work

EWPs used for barehand work shall have a maintenance management system in place. This system shall address at least the following:

- (a) Testing and maintenance practices to ensure electrical and mechanical integrity of the insulating boom.
- (b) Site electrical testing prior to work, including placing the **EWP** bucket in contact with a live phase and monitoring the leakage current on the insulating boom for at least 1 minute.

2.4.2 Insulating Ladders

Insulating ladders are used to provide access for lineworkers to their work position on or near energised components.

2.4.2.1 Before Use Inspection and Cleaning of Insulating Ladders

Insulating ladders shall be visually inspected prior to use with particular reference to the condition of the stiles, and wiped clean before use.

2.4.2.2 Testing of Insulating Ladders Used for Barehand Work

Insulating ladders used by barehand workers shall be electrically tested prior to use, by placing the ladder onto the **live** conductors for a minimum of 1 minute and monitoring the leakage current. The steady state leakage current shall not exceed 1 μ A per kV (phase to earth).

2.4.3 Protective Barriers

Insulating barriers may be used in a number of ways:

- (a) To provide a barrier to physically limit the size of a work area for safety reasons.
- (b) To reinforce air gaps so that smaller **live line minimum approach distances** can be applied.

2.4.4 Conductive Clothing

- (a) Conductive clothing (live line suits) shall be maintained in accordance with manufacturer's instructions.
- (b) Conductive clothing (live line suits) shall be tested regularly.

NOTE: Electrical testing of conductive suits can be carried out in accordance with IEC Standard 895. Additional information on care and maintenance is in IEEE Standard 1067.

- (c) Conductive suits shall include conductive socks, gloves and head covering hoods and shall be worn by live lineworkers as follows:
 - (i) For all barehand work irrespective of circuit voltage.

- (ii) By any live line mechanic experiencing an unacceptable level of discomfort from the electric field.
- (d) Conductive clothing should be washed using a mild detergent and a delicate washing cycle, thoroughly rinsed in clean water and hung to dry (not tumbled).
- (e) Conductive clothing should be stored in ventilated bags.
- (f) Repairs to torn conductive clothing shall be made using conductive patches made from the same material as the suit. Sewn on conductive patches shall overlap over damaged areas to ensure a positive electrical continuity between the patch and suit. The repaired suit shall be tested before reuse.
- (g) Conductive clothing shall be worn where necessary to limit discomfort from induced static discharges.

2.4.5 Conducting Footwear

Conducting boots shall only be worn in conjunction with live line suits. The boots shall be provided, and should be worn, when it is considered that the uncontrolled discharge of electrostatic charges could affect the lineworker's comfort and safety.

Conducting boots shall meet the requirements of the relevant safety standards.

Conducting boots shall be marked to clearly indicate they are not normal safety footwear and shall comply with an appropriate International Standard for live line footwear (refer to Appendix A).

2.5 INTEGRITY OF INSULATION

2.5.1 Visual Inspection of Insulators in the Immediate Work Zone Prior to Work

All insulators in the immediate work zone should be visually inspected prior to work to ascertain the existence and extent of any damage. This damage should be carefully assessed to ensure that the insulation is safe to approach and work on.

2.5.2 Treatment of Insulator or Insulator String Exhibiting Signs of Electrical Distress

Any **insulator or insulator string exhibiting significant signs of electrical distress**, such as louder than normal audible noise levels and/or intermittent visually apparent surface discharging, shall not be tested or changed using **live line techniques** irrespective of the number of apparently sound discs in the string.

2.5.3 Performance of Live Line Work in Close Proximity to Insulator Strings Containing Porcelain Disc Insulators

Where **live line work** is to be performed in close proximity to strings containing porcelain disc insulators, each disc should be electrically tested. This testing should preferably be performed immediately prior to starting work.

NOTE: This is because porcelain disc insulators may puncture in service, resulting in reduced insulating properties. Punctures in porcelain discs are not readily identified by visual inspection and may not create audible noise.

2.5.4 Instruments for Testing Insulators

Instruments for testing insulators shall be capable of reliably detecting electrically defective insulators. Where testers that measure the actual voltage are used, the voltage across each disc in the string shall be recorded so that discrepancies in the normal voltage gradient pattern can be readily observed. Buzz type testers shall not be used on a.c. lines.

2.5.5 Minimum Number of Electrically Sound Discs in Circuit

During live line work the minimum number of electrically sound and functioning disc insulators, in addition to any shunted discs, should be:

Nominal Line Voltage	Minimum Number of Electrically Sound Standard Profile Insulators
50/66 kV	3
110 kV	4
132 kV	4
220 kV	7
270 kV d.c.	7
275 kV	8
330 kV	11
350 kV d.c.	10
500 kV	16

2.5.6 Disc Insulators with Significant Damage

Disc insulators with significant damage to their sheds, or glass discs missing their sheds, shall also be considered as electrically unsound for the purpose of determining minimum insulation present.

2.5.7 Live Line Work Where the Minimum Number of Electrically Sound Discs is not Available in Circuit

Live line work may be performed with fewer sound disc insulators than shown above, provided that specific approved work practices are utilised for that situation, or an appropriate engineering check is undertaken to determine the adequacy of the available insulation. These may include properly co-ordinated temporary air gaps or surge arresters fitted in the vicinity of the worksite.

2.6 MINIMUM REQUIREMENTS FOR LIVE LINE BAREHAND WORK

The holder of a certificate in **live line barehand work** must be able to demonstrate correct live line access **techniques** to the safe working zone for undertaking barehand tasks, including rope and ladder.

The holder of a live line barehand certificate must have one or more of the following groups of competencies additional to those listed under Section 1.4. Certificates of Competency shall indicate the group(s) of competencies for which the certificate is issued.

(a) **Non Load Bearing**

- (i) Change dampers, corona balls, etc. using barehand and live line stick techniques.

(b) **Suspension Insulators on Towers and Poles**

- (i) Change dampers, corona balls, etc. using barehand and live line stick techniques.
- (ii) Change suspension insulators and fittings on poles and towers using live line stick techniques.
- (iii) Change suspension insulators and fittings on towers using barehand techniques.

(c) **Suspension and Tension Insulators on Towers and Poles**

- (i) Change dampers, corona balls, etc. using barehand and live line stick techniques.
- (ii) Change suspension insulators and fittings on poles and towers using live line stick techniques.
- (iii) Change suspension insulators and fittings on towers using barehand techniques.
- (iv) Change tension insulators and fittings on poles and towers using live line stick techniques.
- (v) Change tension insulators and fittings on towers using barehand techniques.

(d) **Pin and Post Insulators**

- (i) Change dampers, corona balls, etc. using barehand and live line stick techniques.
- (ii) Change vertical pin and post insulators on poles using live line stick techniques.

(e) **Poles Replacement**

- (i) Change dampers, corona balls etc. using barehand and live line stick techniques.
- (ii) Change poles and crossarms and associated fittings on pole structures using live line stick techniques.

(f) **Conductor Trolleys**

- (i) Change dampers, corona balls, etc. using barehand techniques.

(ii) Carry out work involving conductor trolleys on energised conductors.

(g) **'V' and 'Y' Suspension Insulators**

(i) Change dampers, corona balls, etc. using barehand and live line stick techniques.

(ii) Change 'V' and 'Y' suspension insulators and fittings on poles and towers.

(h) **Special Insulators**

(i) Change dampers, corona balls, etc. using barehand and live line stick techniques.

(ii) Change horizontal vee brace or strut insulators.

APPENDIX A: REFERENCE DOCUMENTS

A1.1 New Zealand Live Line Training Unit Standards

National Qualifications Framework administered by the New Zealand Qualifications Authority.

A1.2 Joint Australian/New Zealand Standards (AS/NZS)

Until joint Australian/New Zealand Standards (AS/NZS) are developed, equipment used for **live line work** shall comply with appropriate internationally recognised standards.

A1.3 Live Line Standards Organisations

As a guideline, the following is a list of Standards Bodies that have produced standards that have some relevance for live line work. This is not an exhaustive list:

- 1 ASTM (The American Society for Testing and Materials)
- 2 ANSI (American National Standards Institute)
- 3 IEEE (The Institute of Electrical and Electronics Engineers Inc USA)
- 4 CAN/CSA (Canadian Standards Association)
- 5 IEC (International Electrotechnical Commission)
- 6 SIA (Scaffold Industry Association incorporated in America)

A1.4 Live Line Standards

As a guideline, set down in Table 1 below is a list of standards as at the preparation date of this Code. There are also several new standards currently in preparation or circulated in draft form, which will be issued subsequent to the printing of this Code. Readers should check with Standards New Zealand from time to time for any new or updated standards. Contact details are as follows:

Standards New Zealand, Radio New Zealand House, The Terrace, Private Bag 2439, Wellington.
Phone (04) 498 5991

TABLE A1
LIST OF LIVE LINE RELATED STANDARDS

Types of Live Work	Standard Number	Latest Issue Date*	Title
All	ANSI/IEEE:978	1984	Guideline for In-Service Maintenance and Electrical Testing of Live Line Tools
All	ANSI/IEEE:935	1989	Guide on Terminology for Tools and Equipment to be used in Live Line Working
All	ANSI/IEEE:516	1995	Guideline for Maintenance Methods on Energised Power-Lines
All	ANSI/IEEE:957	1995	Guideline for Cleaning Insulators
BH, S	IEEE 1067	1996	Guideline for In-Service Use, Care, Maintenance and Testing of Conductive Clothing for Use on Voltages up to 765kV AC
BH,S	ANSI Z41.3	1991	Men's Conductive Footwear
G&B, S	ANSI/SIA A92.2	1990	Vehicle Mounted Elevating and Rotating Aerial Devices

Types of Live Work	Standard Number	Latest Issue Date*	Title
G&B, S	AS 1418 Part 10	1996	SAA Crane Code - Elevating Work Platforms
G&B, S	AS 1418		Crane Code
G&B	ASTM:D120	1995	Standard Specification for Rubber Insulating Gloves
G&B,S	ASTM:D1048	1999	Standard Specification for Rubber Insulating Blankets
G&B, S	ASTM:D1049	1998	Standard Specification for Rubber Insulating Covers
G&B, S	ASTM:D1050	1999	Standard Specification for Rubber Insulating Line Hose
G&B, S	ASTM:D1051	1995	Standard Specification for Rubber Insulating Sleeves
G&B, S	ASTM:F478	1999	Standard Specification for In-Service Care of Insulating Line Hose and Covers
G&B, S	ASTM:F479	1995	Standard Specification for In-Service Care of Insulating Blankets
G&B	ASTM: F496	1999	Standard Specification for In-Service Care of Insulating Gloves and Sleeves
G&B	ASTM: F696	1997	Standard Specification for Leather Protectors for Rubber Insulating Gloves and Mittens
All	ASTM:F711	2000	Standard Specification for Fibreglass – Reinforced Plastic (FRP) Rod and Tube used in Live Line Tools
G&B, S	ASTM:F712	1995	Standard Test Methods for Electrically Insulating Plastic Guard Equipment for Protection of Workers
G&B, S	ASTM:F1564	2000	Standard Specification for Structure Mounted Insulating Work Platforms for Electrical Workers
S, BH	IEC 60895 (Prev 895)	1987	Specification for Conductive Clothing for Live Working at Nominal Voltages up to 800 kV a.c.

* As at date of preparation of this Code.

The following is a list of all issued IEC standards relating to live working at the date of preparation of this Code:

IEC 60050-651 Ed. 1.0 (1999-07)	Chapter 651 of the International Electrotechnical Vocabulary: Live working
IEC 60417-1 Ed. 1.0 (1998-08)	Graphical Symbols for use on Equipment - Part 1: Overview and Application
IEC 60743 Ed. 1.0 (1983-01) Amendment 1 (1995-01)	Terminology for Tools and Equipment to be used in Live Working
IEC 60832 Ed. 1.0 (1988-04)	Insulating Poles (Insulating Sticks) and Universal Tool Attachments (Fittings) for Live Working
IEC 60855 Ed. 1.0 (1985-01)	Insulating Foam-Filled Tubes and Solid Rods for Live Working
IEC 60895 Ed. 1.0 (1987-12)	Conductive Clothing for Live Working at Nominal Voltage up to 800 kV a.c.
IEC 60900 Ed. 1.0 (1987-12) Amendment 1 (1995-08)	Hand Tools for Live Working up to 1000 V a.c. and 1500 V d.c.
IEC 60903 Ed. 1.0 (1988-03)	Specification for Gloves and Mitts of Insulating Material for Live Working
IEC 60984 Ed. 1.0 (1990-02)	Sleeves of Insulating Material for Live Working

IEC 61057 Ed. 1.0 (1991-06)	Aerial Devices with Insulating Boom used for Live Working
IEC 61111 Ed. 1.0 (1992-12)	Matting of Insulating Material for Electrical Purposes
IEC 61112 Ed. 1.0 (1992-12)	Blankets of Insulating Material for Electrical Purposes
IEC 61219 Ed. 1.0 (1993-10)	Live Working — Earthing or Earthing and Short-Circuiting Equipment using Lances as a Short-Circuiting Device — Lance Earthing
IEC 61229 Ed. 1.0 (1993-07) Amendment 1 (1998-02)	Rigid Protective Covers for Live Working on a.c. Installations
IEC 61230 Ed. 1.0 (1993-09)	Live Working — Portable Equipment for Earthing or Earthing and Short-Circuiting
IEC 61235 Ed. 1.0 (1993-09)	Live Working — Insulating Hollow Tubes for Electrical Purposes
IEC 61236 Ed. 1.0 (1993-08)	Saddles, Pole Clamps (Stick Clamps) and Accessories for Live Working
IEC 61243-1 Ed. 1.0 (1993-11) Amendment 1 (1997-10)	Live Working – Voltage detectors — Part 1: Capacitive Type to be used for Voltages Exceeding 1 kV a.c.
IEC 61243-2 Ed. 1.0 (1995-10) Amendment 1 (1999-10)	Live Working - Voltage Detectors - Part 2: Resistive Type to be used for Voltages of 1 kV to 36 kV a.c.
IEC 61243-3 Ed. 1.0 (1998-10)	Live Working - Voltage Detectors – Part 3: Two-Pole Low-Voltage Type
IEC 61243-5 Ed. 1.0 (1997-06)	Live Working – Voltage Detectors - Part 5: Voltage Detecting Systems (VDS)
IEC 61278 Ed. 1.0 (1997-01)	Live Working – Guidelines for Dielectric Testing of Tools and Equipment
IEC 61318 Ed. 1.0 (1994-08)	Live Working — Guidelines for Quality Assurance Plans
IEC 61328 Ed. 1.0 (1995-08)	Live Working – Installation of Transmission Line Conductors and Earthwires - Stringing Equipment and Accessory Items
IEC 61472 Ed. 1.0 (1998-11)	Live Working – Minimum Approach Distances. Method of Calculation
IEC 61813 Ed. 1.0 (2000-09)	Live Working – Care, Maintenance and Inservice Testing of Aerial Devices with Insulating Booms
IEC 61911 Ed. 1.0 (1998-12)	Live Working – Installation of Distribution Line Conductors - Stringing Equipment and Accessory Items
IEC 61942 Ed. 1.0 (1997-09)	Live Working - Gloves and Mitts with Mechanical Protection

The following is a list of all Draft IEC draft standards relating to live working at the date of preparation of this Code:

IEC 60417-1 Ed 2.0 Amendment 1	Graphical Symbols: 5216 Pr 'Suitable for Live Working'
IEC 60743 Ed. 2.0	Terminology for Tools and Equipment and Devices to be used in Live Working (Revision of IEC 60743 Ed. 1.0)
IEC 60895 Ed. 2.0	Conductive Clothing for Live Working at a Nominal up to 800 kV a.c. or \pm 600 kV d.c. (Revision of IEC 60895 Ed. 1.0)
IEC 60903 Ed. 2.0	Specification for Gloves and Mitts of Insulating Material for Live Working. (Revision of IEC 60903 Ed. 1.0)
IEC 61057 Ed. 2.0	Aerial Devices with Insulating Boom used for Live Working. (Revision of IEC 61057 Ed. 1.0)
IEC 61243-1 Ed. 2.0	Live Working - Voltage Detectors — Part 1: Capacitive Type to be Used for Voltages Exceeding 1 kV a.c. (Revision of IEC 61243-1 Ed. 1.0)

IEC 61477 Ed. 1.0	Guidelines for Use of Tools and Equipment for Live Working
IEC 61478 Ed. 1.0	Live Working - Ladders of Insulating Material
IEC 61479 Ed. 1.0	Live Working - Conductor Covers (Line Hoses) of Insulating Material for Electrical Purposes
IEC 61481 Ed. 1.0	Portable Phase Comparators for Voltages of 1 kV to 36 kV
IEC 61482-1 Ed. 1.0	Live Working - Clothing for Thermal Protection Of Workers; Thermal Hazards of an Electric Arc - Part 1: Test Methods
IEC 61482-2 Ed. 1.0	Live Working - Clothing for Thermal Protection Of Workers. Thermal Hazards of an Electric Arc - Part 2: Performance Requirements
IEC 62192 Ed. 1.0	Live Working – Ropes of Insulating Material
IEC 62193 Ed. 1.0	Live Working – Telescopic Sticks
IEC 62237 Ed 1.0	Live Working - Mobile Insulating Hoses used with Hydraulic Tools for Live Working
IEC PNW 78-324 Ed. 1.0	Live Working – Guidelines for the Installation and Maintenance of Optical Cabling – Part 1 : Overhead High-Voltage Power Supply Lines

**NEW ZEALAND ELECTRICAL
CODE OF PRACTICE
for
HIGH VOLTAGE LIVE LINE WORK**

Part 3

Stick

Issued by:

Manager, Standards and Safety
Ministry of Consumer Affairs
Wellington, New Zealand

THE ELECTRICITY ACT 1992

Approval of the New Zealand Electrical Code of Practice for High Voltage Live Line Work 2003 (*NZEC 46:2003*)

Pursuant to section 38 of the Electricity Act 1992, I hereby approve the New Zealand Electrical Code of Practice for Live line Work 2003 (*NZEC 46:2003*) which comprises three parts:

ECP46.1: Glove and Barrier

ECP46.2: Barehand

ECP46.3: Stick

The New Zealand Electrical Code of Practice for High Voltage Live Line Work 2003 (*NZEC 46:2003*) was issued by the Manager, Standards and Safety, Ministry of Consumer Affairs, acting under delegated authority (*pursuant to section 41 of the State Sector Act 1998*) from the Chief Executive, Ministry of Economic Development on the 12th day of October 2001.

Dated this 19th day of March, 2003

Hon Harry Duynhoven
Associate Minister of Energy

COMMITTEE REPRESENTATION

This Code of Practice was prepared by the Ministry of Consumer Affairs, in consultation with the following:

Members of the ECP46 Working Party

Electricity Engineers' Association of NZ (Inc) (EEA)

Engineering Printing and Manufacturing Union (EPMU)

Electrical Workers Licensing Group

Rail and Maritime Transport Union

The support of the Electricity Supply Association of Australia (ESAA) is also acknowledged.

REVIEW

This Code of practice will be revised as occasions arise. Suggestions for improvements of this Code are welcome. They should be sent to the Manager, Standards and Safety, Ministry of Consumer Affairs, PO Box 1473, Wellington.

OVERVIEW

This part of the Electrical Code of Practice for High Voltage Live Line work is in two Sections. Section 1 covers the general requirements for all live line techniques whilst Section 2 relates to the specific requirements for **Glove and Barrier work**.

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SECTION 1: SCOPE, INTERPRETATION AND GENERAL REQUIREMENTS

1.1 SCOPE

- 1.1.1** This Code sets out the minimum industry standards for high voltage live line work. The principles may be enhanced or supplemented, provided this does not result in reduced safety standards.
- 1.1.2** This Code applies to all work undertaken on live high voltage overhead lines using approved procedures, tools and equipment, and by persons holding the minimum competencies detailed under this Code. Other work on live high voltage overhead lines including, but not limited to, operating, is not covered by the Code.
- 1.1.3** This Code does not constitute a live line training manual, nor does it set down **live line work procedures**. These **procedures** should be developed in accordance with the principles in this Code.
- 1.1.4** The objectives of this Code are:
- (a) To ensure the safety of electrical workers and the general public.
 - (b) To specify the minimum standards for equipment required for live line work.
- 1.1.5** Equipment not specifically designed for a live line method shall not be used.
- 1.1.6** Throughout this Code:
- (a) The word "shall" is to be interpreted as mandatory.
 - (b) "Should" is to be interpreted as advisory or discretionary.
 - (c) Reference to lineworker unless specifically notified shall refer to a certificated live line mechanic.
- 1.1.7** While the principles of live line work contained in this Code have been written around work on overhead lines, the concepts may be equally applicable to work in other areas such as substation equipment, when combined with other appropriate training and work controls.
- 1.1.8** This Code does not substitute or override any regulation or legislation.
- 1.1.9** This Code does not apply to the following kinds of work:
- (a) The operation of fuses and the changing of the fuse elements;
 - (b) The operation of isolators and switches;
 - (c) The taking of electrical measurements;
 - (d) The measurement of distances;
 - (e) The phasing of conductors and fittings;
 - (f) The checking and testing of insulator strings;
 - (g) The removal of impediments on lines;
 - (h) The greasing of fittings.
 - (i) Traction live line work under 2,000 volts d.c.

The kinds of work listed above must be carried out using safe procedures and associated equipment designed specifically for the purpose.

1.2 INTERPRETATION

- 1.2.1 Approved** – means certified by the **Service Provider** as complying with the requirements of this code.
- 1.2.2 Asset Manager** - means an organisation responsible and accountable for the equipment to be worked on. An **Asset Manager** may also be a **Service Provider**.
- 1.2.3 Bonded** - means conductors and or fittings are connected together in such a manner as to ensure that they are at the same electrical potential.
- 1.2.4 De-Energised** – means disconnected from all sources of supply but not necessarily isolated, tested and earthed.
- 1.2.5 Earthed** – means effectively connected to the general mass of earth.
- 1.2.6 High-Voltage** – means any voltage exceeding 1000 V a.c. or 1500 V d.c.
- 1.2.7 Insulating Elevating Work Platform (Insulating EWP)** – means an approved and tested insulated aerial device.
- 1.2.8 Insulating Rope** – means standard commercial grade synthetic rope that is tested and manufactured to ensure good insulating properties but should not be intentionally placed across phase to phase or phase to earth air gaps.
- 1.2.9 Live (or Alive or Energised)** – means connected to a source of electrical supply.
- 1.2.10 Live Line Rope** – means rope that is specially designed, manufactured, tested and maintained so as to have very high insulating qualities and may be intentionally placed across phase to phase or phase to earth air gaps.
- 1.2.11 Live Line Equipment** – means all live line tools, rope, gloves and insulating equipment used for live line work.
- 1.2.12 Live Line Minimum Approach Distance (Live Line MAD)** – means the minimum air gap that shall be maintained between a lineworker and any other component at different potential during live line work, in order to prevent flashover and provide for worker safety.
- 1.2.13 Live Line Permit** – means a permit issued by the system controller or equivalent to verify to a **live line work** party that the control measures are in place on the circuit being worked on and to authorise work.
- 1.2.14 Live Line Stick (also called Hot Stick)** – means a solid or filled stick of insulating material specially designed, approved and tested for use in physically bridging the distance between;
- (a) the lineworker and energised components; or
 - (b) the energised components and earth; or
 - (c) adjacent phases; or
 - (d) to enable physical loads to be taken or tools to be applied.
- 1.2.15 Live Line Work** – means any high voltage work performed under approved procedures inside the minimum approach distance (MAD), on or near components of a line capable of being energised to high voltage without implementing the full protective practice of isolating, proving **de-energised** and earthing.

1.2.16 Method – means a fundamental technology for undertaking live line work. The three methods are **glove and barrier**, **barehand** and **stick**.

(a) **Live Line Glove and Barrier Method** – means a method of performing **live line work** where the lineworker 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) **Live Line Barehand Method** – means a method of performing **live line work** in which the lineworker is in contact with energised components while insulated from other objects at different 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) **Live Line Stick Method** – means a method of performing **live line work** using tools and equipment mounted on **live line sticks**, with the lineworker maintaining the **minimum approach distance** from energised components.

1.2.17 Minimum Approach Distances – means the minimum distances when approaching live conductors that shall apply to any person who is not a competent live line lineworker, and include conductive material carried by them, vehicles, and mobile plant.

These distances apply to any part of the line mechanic's body or clothing and to anything in contact with the line mechanic, e.g. tools, ladders and scaffold poles (except live line tools and voltage detectors).

1.2.18 Minimum Tool Insulation Distance (also called **Effective Length**) – means the minimum effective length of exposed insulating material that is subjected to the voltage being contacted. This distance shall be measured between the metal end fitting at the conductor end of the insulating material and the metal end fitting or hand mark, where provided, at the opposite end of the insulating material.

When **live line sticks** consist of sections joined with metal couplings, the insulation distance shall be the total of each of the lengths of insulating material that have not been bridged out by the metal couplings.

1.2.19 Procedure – means a collection of **techniques** that, **when** used together, enables a total task outcome to be completed.

1.2.20 Service Provider – means an employer responsible for undertaking the **live line work**.

1.2.21 Technique – means a documented basic live line skill or competency that enables a specific task to be completed, for example:

- (a) Carry out a live line job risk assessment.
- (b) Access a transmission conductor barehand using live line rope.
- (c) Apply insulating barriers to a distribution pole structure.
- (d) Take conductor loads on a suspension structure.

1.2.22 Tested – means tested in accordance with the relevant standard.

1.2.23 Training Provider – means a provider of training who has the knowledge, skills, experience and resources required to deliver training that meets industry standards; and is also one of the following:

- (a) A NZQA registered and accredited training provider or an overseas equivalent (recognised by NZQA); or

- (b) a person or organisation approved by the Secretary to undertake live line training prior to the date of the commencement of this code. This approval is only valid up to the date specified on the approval.

1.3 GENERAL REQUIREMENTS RELATING TO ALL TECHNIQUES

1.3.1 Minimum Standards and Responsibilities

1.3.1.1 Responsibilities of the Asset Manager

Any **Asset Manager** using live work processes on their network shall ensure that the Service Provider complies with the requirements of clause 1.3.1.2.

1.3.1.2 Responsibilities of the Service Provider

Any **Service Provider** undertaking live line work shall:

- (a) meet as a minimum standard all the requirements of this Code;
- (b) have in place an effective process to regularly monitor and review all aspects of **live line work**;
- (c) have in place an effective process to inspect the field performance of **live line work**. This inspection shall address safe work practices and conformance with documented **techniques** at intervals not exceeding 12 months;
- (d) have in place an effective process to regularly review the health of live line lineworkers; and
- (e) have in place an effective risk management process.

1.3.2 Electric and Magnetic Fields

Each **Asset Manager/Service Provider** shall keep up to date on information arising out of scientific research on electric and magnetic fields, and shall keep its employees informed on the issue.

1.3.3 Work Techniques and Procedures

1.3.3.1 Development and Proving

Work techniques shall be developed and documented for each live line work outcome. These techniques shall be proven in a trial on disconnected and/or earthed equipment to verify that they can be carried out reliably and safely.

1.3.3.2 Documentation

Documentation shall contain information relating to the **Asset Manager's** requirements for accessing the network.

Documentation clearly setting out the basic steps shall be provided for each approved procedure or technique and shall:

- (a) Clearly identify the work objectives or desired task outcome.
- (b) Be part of a controlled document management system.
- (c) State the minimum number of lineworkers required.

A copy of the relevant work documentation shall be readily available at the worksite.

1.3.3.3 Live Line Manual

A live line manual, which may include this Code, shall be made available to each lineworker. This manual shall contain at least the following:

- (a) A description of live line principles and requirements.
- (b) A description of each live line tool, its functions, its uses and the determination of its safe working load.
- (c) Instructions on caring for the tools and equipment including:
 - (i) Checks before use.
 - (ii) Inspections.
 - (iii) Maintenance instructions.
 - (iv) Testing requirements for plant and equipment.
- (d) Guides for the calculation or assessment of conductor loads applied to tools and the consequent safety factors.
- (e) A set of approved live line work **procedures** or **techniques**.
- (f) Information for use in an emergency situation.

1.3.3.4 Compliance with Approved Work Documentation

Approved work documentation shall not be changed or disregarded on site except as otherwise provided for in clause 1.3.3.5.

1.3.3.5 Minor Changes to Work Techniques

Minor changes to work **procedures** or **techniques** may be required from time to time, such as changes to tooling to fit dimensional variations on structure components. Such changes must not compromise tool insulation, loading, air gap distances, or safety outcomes in any way and shall be recorded.

Such changes shall be agreed by the entire team at the outset of the job and not implemented in an *ad hoc* manner during the work.

1.3.4 Personnel Selection, Training, Certification, Records and Maintenance of Competency

1.3.4.1 Selection of Personnel

The Service Provider shall establish a policy on the minimum acceptable standards required prior to acceptance of a lineworker as a trainee in the **live work method**. This policy shall include:

1.3.4.2 Minimum Requirements

- (a) Registration as a Line Mechanic; or
 - (i) equivalent Line Mechanic National Certificate in the appropriate lines discipline; or
 - (ii) equivalent documented proof of qualifications or training as a line worker (as determined by NZQA); and
 - (iii) documented evidence of 2 years' post certification/registration experience in general line work, including current competence in the equivalent earthed line processes to be undertaken live; or

- (b) Registration as an Electrician or Electrical Inspector; or be a Qualified Engineer; and
 - (i) documented evidence of 4 years post registration or qualification experience in general line work, including current competence in the equivalent earthed line processes to be undertaken live.
- (c) Demonstrated personal attributes such as responsibility, concentration, communication, a high level of workmanship, and the ability to work in a team.
- (d) A medical examination shall be carried out by a qualified occupational health practitioner to check that the lineworker can physically meet the requirements to carry out the intended work and has no medical condition that could affect the safety of the lineworker or the work team.

1.3.4.3 Training and Certification

1.3.4.3.1 Supervision of Live Line Training

All training (including refresher training) shall be carried out under the direct and immediate supervision of a trainer certificated by the **Training Provider** as competent to undertake **procedures** or **techniques** being taught.

1.3.4.3.2 Live Work Methods Trainers

Prior to being certificated by the Training Provider as competent to undertake the **procedures** or **techniques** being taught, trainers of live working **methods** shall satisfy the following minimum requirements:

- (a) Minimum requirements as required by clause 1.3.4.2.
- (b) Current competency in the **method** being taught.
- (c) A minimum of 12 months documented work experience in the **method** being taught.
- (d) Have gained competency in instructing techniques.
- (e) Have conducted, to a certified trainer's satisfaction, a full live line work training course in the **method** being taught under the guidance of that certified trainer, and passed that trainer's assessment of the delivery of the instruction in **live line work** theory and practical techniques.

1.3.4.3.3 Training in Live Work Methods

- (a) The live work **method** training shall provide a thorough understanding of both the principles of the live work **method** as well as a comprehensive practical programme. This training shall include live work theory and application, correct use and maintenance of personal protection equipment, proper care of tools and equipment, and practising the required **procedures** or **techniques** on earthed lines before their application on energised lines.
- (b) Lineworkers undergoing live work training shall receive ongoing monitoring during the training programme to ensure their continued suitability for **live line work**.
- (c) Trainees who do not hold necessary allied or underpinning live work **methods** competencies, shall be taught the appropriate **techniques**, and those competencies shall be gained prior to the commencement of the training in the live work **method**.

- (d) Competency certification in the live work **method** shall only be issued when the trainee can demonstrate the required knowledge, skills and experience to carry out the work safely and to the required standards.

1.3.4.4 Certification and Records

1.3.4.4.1 Issue of Certificates

Competency Certificates shall be issued by the **Service Provider**:

- (a) Following satisfactory completion of the training as endorsed by the **Training Provider**.
- (b) Following satisfactory completion of annual refresher training and field inspection (refer section 1.3.4.5 Maintenance of Competency).
- (c) Immediately before a live line worker moves to a new **Service Provider**.
- (d) When a live line worker moves to a new **Service Provider**, and after satisfactory completion of appropriate refresher training.

1.3.4.4.2 Content of Certificate

A live line worker shall at all times hold a Competency Certificate issued by the Service Provider, indicating the live line work the lineworker is approved to undertake. Competency Certificates shall contain the following information:

- (a) Name of Holder.
- (b) Date of Issue.
- (c) Expiry Date.
- (d) Name of Training Provider.
- (e) Unique Certificate Number.
- (f) Categories of Work, allied live work methods techniques, voltage level and, if appropriate, competency groups in which the holder has demonstrated competency.
- (g) Relevant qualification attained.
- (h) Signature of issuing **Service Provider**.

1.3.4.4.3 Withdrawal of Certificate

A Certificate issued under 1.3.4.4.1 may be withdrawn by the Service Provider where a person is deemed not to be competent in relation to the categories of work, allied live work method techniques, voltage level or competency groups (as appropriate).

1.3.4.4.4 Categories of Work and Certificates

(a) Live Line Glove and Barrier

The holder of a **Live Line Glove and Barrier** Certificate can use glove and barrier procedures, including the use of live line sticks, to replace and install fittings, hardware and structures.

The requirements for this certificate are detailed in ECP46 Part 1.

(b) **Live Line Barehand**

The holder of a **Live Line Barehand** Certificate can use barehand methods and live line stick methods on lines from 66kV to 330 kV a.c. and 375 kV d.c. to:

- Displace lines, fittings and hardware.
- Install or replace poles, tower crossarms, insulators and fittings.

The requirements for this certificate are detailed in ECP46 Part 2.

(c) **Live Line Stick (non load bearing)**

(i) Up to and including 33 kV

The holder of a **Live Line Stick** Certificate (non load bearing) up to and including 33 kV can use **live line stick methods** on lines up to and including 33 kV to connect and disconnect spur lines, fittings and hardware.

The requirements for this certificate are detailed in ECP46 Part 3.

(ii) Above 33 kV

The holder of a **Live Line Stick** Certificate (non load bearing) up to 110 kV can use **live line stick methods** on lines up to 110 kV to test insulators and install dampers, corona balls and measuring devices.

The requirements for this certificate are detailed in ECP46 Part 3.

(d) **Live Line Stick (load bearing)**

(i) Up to 110 kV (with or without underbuilt)

The holder of a **Live Line Stick** Certificate (load bearing) up to 110 kV (with or without underbuilt) can use **live line stick methods** on lines up to 110 kV with and without underbuilt circuits.

The requirements for this certificate are detailed in ECP46 Part 3.

(ii) Above 33 kV (without underbuilt)

The holder of a **Live Line Stick** Certificate (load bearing) above 33 kV (without underbuilt) can use **live line stick methods** on lines without underbuilt circuits up to and including 375 kV d.c.

The requirements for this certificate are detailed in ECP46 Part 3.

- (e) No person shall carry out work to which this Code applies unless that person is the holder of a current competency certificate for that class of work or a trainee working under supervision.

1.3.4.4.5 Records

Service Providers shall keep for each live line lineworker adequate records of the training undertaken and live work history of each live line lineworker, including **techniques** and **procedures**.

1.3.4.5 Maintenance of Competency

1.3.4.5.1 Ensuring Ongoing Competency

To ensure ongoing competency, **Service Providers** shall monitor and document the performance of the **live line** lineworker by conducting field inspections at least annually.

1.3.4.5.2 Field Inspection of Competency

Field inspections shall assess demonstrated competencies against documented **live line methods, procedures** and **techniques** at least annually.

1.3.4.5.3 Requirements of a Person Conducting Field Inspections of Competency

Field inspections shall be conducted by a person:

- (a) who is authorised by the **Service Provider**;
- (b) who has been trained and is currently competent in the methods being inspected; and
- (c) who is independent of the work party.

1.3.4.5.4 Refresher Training

Refresher training shall be conducted on live work safety rules, concepts and **techniques** of the **method**:

- (a) At intervals no greater than twelve months, and
- (b) Whenever **techniques** are found to be deficient during the field inspections, and/or
- (c) When a lineworker has performed no live work in a specific competency for in excess of twelve months.

1.3.4.5.5 Trainer Competency

Training Providers shall regularly audit the competencies of their trainers to ensure they meet industry competency requirements. This process should include knowledge of live work accident causes, audited non-compliance trends, new technologies, and equipment mechanical and electrical limitations.

1.3.5 Equipment

1.3.5.1 General

Care and maintenance of equipment is essential for safe live line work.

1.3.5.1.1 Suitability of Live Line Equipment

All **live line** equipment shall be designed, tested and approved specifically for work on energised high-voltage lines.

1.3.5.1.2 Rating of Live Line Equipment

All **live line** equipment shall be rated and certified for use by the manufacturer and shall meet the standards listed in Appendix A or equivalent.

1.3.5.1.3 Tool Management

A **tool** management system shall be in place to ensure equipment is maintained to set standards (refer to Appendix A). This system shall, as a minimum, ensure that equipment is inspected, maintained and tested at appropriate intervals. Records of these events shall be kept for the working life of the equipment.

1.3.5.2 Care and Use of Live Line Equipment

1.3.5.2.1 Condition of Live Line Equipment

All **live line** equipment shall be maintained in a clean and dry condition.

1.3.5.2.2 Placement of Live Line Equipment

Live line equipment shall not be laid directly on the ground.

1.3.5.2.3 Storage and Transport of Live Line Equipment

Live line equipment shall be stored and transported in a way that shall ensure the equipment is not exposed to excess moisture, dust, chemicals, abrasion and other deteriorating effects.

1.3.5.2.4 Before Use Inspection and Cleaning of Live Line Equipment

Live line equipment shall be visually inspected, mechanically test-operated and cleaned before use. Any tool that appears to be defective shall be tagged and withdrawn from service for further inspection, testing, repair or replacement.

1.3.5.2.5 Regular Inspection and Maintenance of Live Line Equipment

Live line equipment and insulating tools shall be inspected and maintained in accordance with the manufacturer's recommendations and with relevant standards in Appendix A.

1.3.5.2.6 Avoidance of Deteriorating Contaminants

All **insulating equipment** should be kept clear of deteriorating contaminants such as handcreams, sunscreens, paint solvents, hydraulic oil, etc. that may affect or deteriorate insulating qualities of equipment.

1.3.5.3 Live Line Sticks

Live line sticks provide a rigid physical connection of known insulating quality between live line lineworkers and energised components.

1.3.5.3.1 Hollow Sticks

Hollow sticks are not acceptable due to the difficulties in maintaining their electrical integrity.

1.3.5.3.2 Stick Surfaces

Stick surfaces shall be maintained to the standards specified by the manufacturer.

1.3.5.3.3 Design of Metal End Fittings

Metal end fittings shall be designed so as to prevent the development of excessive electric field stresses and corona within the stick termination.

1.3.5.3.4 Termination of Metal End Fittings

Metal end fittings shall be terminated onto the sticks in such a way as to prevent the creation of airgaps or voids that could be detrimental to the electrical performance of the stick.

1.3.5.4 Conductor Support Equipment

This equipment is used to provide temporary support for energised conductors when carrying out live line work, eg. wire tongs.

1.3.5.4.1 Assessment of Conductor Load

When using conductor support equipment, the conductor load shall be assessed to ensure that the safe working load of the equipment is not exceeded.

1.3.5.4.2 Rating of Insulation of the Equipment

Ensure that the insulation of the equipment is of adequate rating for the line voltage involved, and that supplementary insulating devices are added where necessary.

1.3.5.5 Rope

1.3.5.5.1 Types of Rope in Use

There are two types of rope used in live line work. **Live line rope** is designed, manufactured and managed as an insulating tool for full phase voltage. **Insulating rope** is normal synthetic rope that is kept clean and dry but has no guaranteed insulating properties. Insulating rope may be used in series with an insulating stick or composite insulator to provide known insulating properties. All other rope for which no special management has been applied shall not be used on live line work sites.

1.3.5.5.2 Insulation Properties of Live Line Rope

Live line rope shall be of synthetic material that has high insulation properties and is moisture resistant, and that maintains these properties for a sustained period of service.

1.3.5.5.3 Use and Marking of Live Line Rope

Live line rope shall not be used for any other purpose, and shall be clearly marked and managed so that it cannot be inadvertently mistaken for **insulating rope**.

1.3.5.5.4 Electrical Testing of Live Line Rope

Live line rope shall be electrically tested before being placed in service, in accordance with ANSI/IEEE Standard 516 or equivalent.

1.3.5.5.5 Management of Live Line Rope Usage

Live line rope usage shall be managed in accordance with a specially developed maintenance system. This system shall address the following factors:

- (a) Visual inspection before each use.
- (b) Electrical testing at regular intervals.
- (c) Atmospheric humidity constraints for rope usage.
- (d) Removal from time to time of the most used (end) sections of rope coils to limit contamination and other deterioration of the rope.

- (e) Suitable clean and sealed storage with consideration given to the use of desiccant to ensure the rope is completely dried between each use.

1.3.5.5.6 Insulating Rope

Insulating rope shall be kept away from **live** components by a **distance** at least equal to the applicable **live line minimum approach distance**.

1.3.6 Safety Observer

During all live line work, one member of the work team shall be designated as the **Safety Observer**. The **Safety Observer's role** is to alert the work team to any potentially unsafe actions or lack of compliance with an approved work **procedure** or **technique**. The **Safety Observer** shall:

- (a) be certificated and competent to carry out the particular work being observed;
- (b) be positioned at a suitable location to observe the work being performed;
- (c) have the authority to temporarily suspend the work at any time;
- (d) maintain effective and immediate communication with the work team at all times;
- (e) not perform any other task whilst **live line work** is in progress; and
- (f) suspend all work in the event of having to leave the site or significantly change position until he/she has returned/reached a new location or has been replaced.

The **Safety Observer's role** may be rotated among members of the work team, for example to reduce fatigue. When this occurs it shall be formally handled such that all members of the work party are aware at all times who is performing the role of the **Safety Observer**.

1.3.7 Work Considerations

1.3.7.1 Line Hazard Identification

The **Asset Manager** shall advise the **Service Provider** of any known hazards that have the potential to impact on the safe outcome of the work, eg. conductor corrosion, defective insulator types, corroded or defective fittings or structures, and known over-crossings of other lines.

In addition to any hazards identified by the **Asset Manager**, the working party shall inspect the work site to identify electrical and non-electrical hazards that could impact upon the safety of the working party or the public.

1.3.7.2 Weather Conditions at Worksite

Work shall not proceed and the work team shall keep clear of the circuit in the event of the following:

- (a) An electrical storm is observed in the vicinity of the worksite.
- (b) Any significant rain (beyond intermittent spotting), mist, fog, snow or sleet unless using **techniques** and equipment specifically designed and tested as being able to operate whilst wet.
- (c) When using live line rope, any threat of rain, mist, fog, snow or sleet.
- (d) Excessive wind velocities, such that work cannot be continued in safety.

1.3.7.3 Fault Current Protection

Protective devices shall be operational in the circuit being worked on. These devices shall be capable of detecting and clearing faults at the worksite.

1.3.7.4 Disabling of Auto-Reclose

All **auto-reclose** equipment controlling the section of the circuit on which live line work is to be performed shall be blocked for the duration of the work.

This reclosing equipment shall be tagged with an appropriate safety tag.

1.3.7.5 Live Line Permit

1.3.7.5.1 Issue of Live Line Permits

Prior to the commencement of work, the work party shall receive a live line permit. The method of transfer may be verbal exchange, hard copy or by electronic means.

1.3.7.5.2 Identification and Disabling of Reclose Features and/or Processes

The procedure for the issue of the live line permit shall ensure all of the appropriate reclose features and/or processes (or restart for HV d.c.) are identified and disabled before the permit is issued. No manual reclose in the event of a tripping shall occur without first establishing the safety of the work party.

1.3.7.5.3 Cancellation of the Live Line Permit

The live line permit shall be cancelled on completion of the work.

1.3.7.5.4 Documentation for the Issue and Cancellation of Live Line Permits

The procedure for the issue and cancellation of **live line permits** shall be documented. Where required by the **Asset Manager**, the procedure shall include a description of the work and location where the work will be carried out.

1.3.7.5.5 Multiple Live Line Permits on the Same Circuit

Where more than one work team is working on the same circuit but at different locations, the procedure shall ensure that all teams have cancelled their live line permits before the reclose features and/or processes (or restart for HV d.c.) are returned to normal.

1.3.7.6 Work Team Communications

1.3.7.6.1 General

Each work team shall establish a reliable on-site two-way communications link with the issuer, system controller, or equivalent. Where practicable, and/or required by the **Asset Manager**, appropriate calls at specified times should be agreed upon between the work party and the Control Room, or equivalent.

1.3.7.6.2 Integrity of the Communications Link

The integrity of the communications link should be checked at regular intervals during the course of the work to ensure it is functioning correctly.

1.3.7.6.3 Communication Among Work Team Members

The work team shall establish and maintain effective communication among the work team members to ensure the safety of the team.

1.3.7.7 Public Safety

Public access to the work site shall be controlled at all times when work is in progress.

1.3.7.8 Work on De-Energised or Earthed Circuits

Live line work methods may be used to work on a circuit that is de-energised or earthed provided that all work is undertaken as though the circuit is energised.

1.3.7.9 Suspension of Work

If it becomes necessary to suspend work, the circuit shall be left in a safe condition and the **Asset Manager** informed.

1.3.7.10 Crane Operation

1.3.7.10.1 Instruction of Crane Operators

Prior to the commencement of work, crane operators shall be instructed on the procedure and safe working distances to be used.

1.3.7.10.2 Supervision of Crane Operators

The crane operator shall be under the direct and immediate supervision of a competent nominated member of the **live line** team.

1.3.8 Procedures in the Event of an Accident

1.3.8.1 Procedures for Responding to Accidents

Each Asset Manager and Service Provider shall have in place documented procedures for responding to accidents. These procedures shall as a minimum address, as appropriate, the following items:

- (a) The rescue of injured persons or those at risk.
- (b) Communication with Emergency Services.
- (c) The immediate first aid and medical needs of any injured person and the safety of other persons at the worksite.
- (d) Any emergency switching requirements.
- (e) Restoration of any circuit as a result of the incident.
- (f) Investigation and reporting requirements to determine the cause of the accident and the implementation of appropriate remedial measures.
- (g) Notification of all parties required under relevant regulations and industry agreements.

1.3.9 General Work Practices

1.3.9.1 Safety Monitoring

During all live work, all team members shall:

- (a) monitor the actions of other team members;

- (b) maintain effective communication with the work team; and
- (c) have the authority to temporarily suspend the work at any time due to unsafe actions or lack of compliance with approved work **procedures**.

1.3.9.2 On-Site Team Review

Before commencing work an on-site team review shall be carried out to address hazard management and work practices and shall:

- (a) identify hazards;
- (b) assess risks that may result because of the hazards;
- (c) have emergency personnel contact numbers;
- (d) have procedures to contact and interact with Emergency Services;
- (e) decide on control measures to prevent or minimise the level of the risks; and
- (f) implement control measures.

Particular attention should be given but not limited to:

- (a) **WHY** the work is to be done.
- (b) **WHAT** is to be accomplished.
- (c) A discussion of **HOW** the work is to be carried out and **WHO** will do it.
- (d) The integrity of the structure on which work is to be carried out including mechanical loads and condition of conductors and joints.
- (e) The integrity of the adjacent structures and spans.
- (f) The integrity of insulation in the immediate work area.
- (g) Clearances to potential midspan hazards, particularly where conductors are to be moved during the work.
- (h) Site terrain conditions (stability of equipment and footing).
- (i) Live stock management (interference with the work).
- (j) Traffic management.
- (k) Public safety.
- (l) Potential weather conditions during the work.

1.3.9.3 Weather Conditions

Live line work shall only be carried out in suitable weather conditions (refer to clause 1.3.7.2).

1.3.9.4 Light Conditions

Live line work shall only be performed when there is adequate light.

1.3.9.5 Personal and Protective Apparel Worn By Lineworkers

Personal and protective apparel worn by lineworkers shall include as a minimum:

- (a) Full body coverage, fire resistant clothing. Workers should consider wearing underclothing of fire resistant material, such as cotton, to reduce the severity of injuries in the event of fire.
- (b) Hard hats.
- (c) Protective footwear with non-slip soles, including conductive boots when appropriate.

1.3.9.6 Conductive Clothing

Conductive clothing shall be worn where necessary to limit discomfort from induced static discharges.

1.3.9.7 Eye Protection

Suitable eye protection shall be provided and used at all times. Anti-glare eye protection should be used as appropriate.

1.3.9.8 Wearing of Metallic Objects

Metallic objects such as neck chains, earrings and other body adornments, rings, watches and bracelets should not be worn while carrying out **live line work**.

1.3.9.9 Long Hair

Long hair shall be securely fixed and confined close to the head.

1.3.9.10 Electrical Rating of Insulating Equipment

All **insulating equipment** shall have an electrical rating suitable for the voltage being worked on.

1.3.9.11 Restraint of PPE and Tooling

The free end of body belts, pole straps and ropes shall be restrained from infringing the **live line minimum approach distance**.

1.3.9.12 Other Activity

When **live line work** is being performed, no other activity that could compromise the safety of the work team shall be carried out.

1.3.9.13 Leaving of Live Line Insulating Equipment on Energised Lines

Live line insulating equipment should not be left on energised lines for extended periods such as overnight. Where this is necessary, they shall not subsequently be depended upon to protect the lineworker. Before re-use they shall be removed, cleaned and visually inspected, and, if suspect, submitted for electrical test.

1.3.9.14 Responsibilities of the Supervisor of the Work Team

At all **live line work** sites, one person in the work party should:

- (a) have sole charge of all on-site activities;
- (b) ensure individual members of the work party have been designated to all the various tasks required by the work procedure including the role of the safety observer;
- (c) at the start of the work, run a work site briefing; and

- (d) at the completion of the work, run a work site de-briefing to ensure that all difficulties encountered during the work are identified.

NOTE: This person may undertake any of the roles required by the procedure. However, if undertaking the role of the safety observer, they must be free to assume the duties as detailed in clause 1.3.6.

1.3.9.15 Manual Reclose or Other Planned Switching of a Circuit

In the event that a manual reclose or other planned switching of a circuit is required, the work teams shall move clear of the circuit prior to the switching being attempted.

1.4 MINIMUM REQUIREMENTS FOR ALL CATEGORIES OF LIVE LINE WORK

All live line workers shall meet the following requirements:

1.4.1 Theory/Standards

- (a) Understand and apply **live line work** theory and the principles of the **live line work method** concerned.
- (b) Understand and apply the parts of ECP 46 as applicable to:
 - (i) **Live Line Glove and Barrier Work.**
 - (ii) **Live Line Barehand Work.**
 - (iii) **Live Line Stick Work.**
- (c) Understand and apply the relevant Statutes, Regulations, Codes and Rules.
- (d) Understand and mitigate the hazards of step and touch potentials.

1.4.2 Work Site Management and Participation

- (a) Conduct a work site risk assessment including hazard evaluation, work limitations and mitigation of hazards.
- (b) Work in the different roles within a team including:
 - (i) Conducting a tailgate session
 - (ii) Directing a work team through the use of a procedure
 - (iii) Acting as a team member
 - (iv) Acting as a safety observer.
- (c) Constructively participate in the development of safe work procedures for a specific work task.

1.4.3 Practical Skills

- (a) Safely climb and observe minimum approach distances on line structures.
- (b) Safely use and maintain safety belts and harnesses.
- (c) Take access permits.
- (d) Perform rescue procedures.
- (e) Implement customer service and land owner protocols.

- (f) Safely rig and establish applied conductor loads.
- (g) In-field inspect, test, care for and maintain, as applicable, live line sticks, tools, barriers, guards, gloves, sleeves and other equipment relevant to the **live line work procedure** concerned.
- (h) Safely apply work site earthing.
- (i) Take **live line permit** and reclose blocks.
- (j) Evaluate line condition prior to undertaking work.

SECTION 2: LIVE LINE STICK WORK

2.1 GENERAL

For Live Line Stick Work there shall be compliance with the requirements of Section 1 and this Section.

2.2 DEFINITIONS SPECIFIC TO THIS SECTION

2.2.1 Brush Contact - means momentary accidental contact.

2.2.2 Insulating Barrier (also called Cover-Up Equipment) - means a barrier of insulating material specifically designed, approved and tested for use as a line cover, insulator cover, cutout cover, crossarm cover, deadened cover or as a cover for similar equipment. **Insulating barriers** may be rigid or flexible and are intended to prevent lineworkers from making accidental **brush contact** with live components or equipment at a different potential.

2.3 CONCEPTS

The **live line stick method** is based on the principle that the lineworker shall always maintain a **minimum approach distance** from any **energised** high-voltage line or apparatus while performing work using tools and equipment fitted to insulating **live line sticks**.

Access to the work can be from a pole or structure, a work platform or ladder attached to pole or structure, **elevating work platform**, or work platform attached to a helicopter.

2.4 APPROACH DISTANCES

2.4.1 Live Line Minimum Approach Distances

The following Table for **live line minimum approach distances** shall normally be adopted:

Nominal Line Voltage	Live Line Minimum Approach Distance (mm)	
	Phase to Earth	Phase to Phase
6.6/11 kV	350	350

22 kV	400	450
33 kV	500	550
50/66 kV	700	900
110 kV	950	1300
220 kV	1600	2300
270 kV d.c.	1600	2700
330 kV	2050	3150
350 kV d.c.	1800	3300

Note: Phase to Earth LLMAD and Phase to Phase LLMAD in relation to the above table:

- (a) In the absence of specific information on transient levels likely to be experienced on a given network of lines, the application of the Live Line Minimum Approach Distances above is considered conservative.
- (b) The column titled LLMAD / Phase to Earth should be interpreted as the minimum required airgap between any unearthed phase conductor, and any adjacent conductive or semi conductive earthed reference (such as an earthwire, pole, crossarm, neutral wire, etc) including any conductive tooling or worker's body in contact with the phase or earthed reference.
- (c) The column titled LLMAD / Phase to Phase should be considered as the minimum required airgap between any two unearthed phases including any conductive tooling or workers in contact with those phases.
- (d) The Phase to Earth or Phase to Phase LLMAD may consist of two airgaps (with a worker or tooling "electrically floating" between), always provided that the two airgaps together provide the total required LLMAD airgap. For example, a worker may be positioned between two phases provided the airgap on each side at least equals the total required LLMAD Phase to Phase.
- (e) The columns titled "Phase to Earth" and "Phase to Phase" should be read as "*Pole to Earth*" and "*Pole to Pole*" respectively for d.c. systems.

2.4.1.1 Live Line Minimum Approach Distances Greater Than Normal

The live line minimum approach distances adopted by individual **Asset Managers** for use on their system may be more conservative than those set down in clause 2.4.1. These greater distances shall be strictly observed at all times during **live line work**.

2.4.1.2 Live Line Minimum Approach Distances Less Than Normal

Where live line minimum approach distances less than those in clause 2.4.1 are proposed to be adopted, these distances shall be calculated in accordance with the following guidelines:

- (a) It is normal international practice to determine the live line minimum approach distance as that required to prevent flashover from worst-case voltage

transients on the system with an additional allowance for inadvertent movement of the lineworker.

- (b) The air gap required to prevent flashover (“Air Insulation Distance”) is derived on the basis of switching impulse withstand strengths. Detailed information on the selection of Air Insulation Distances for various system nominal voltages and system transient voltage levels is given in ANSI/IEEE Standard 516.
- (c) The allowance for inadvertent movement adopted by the **Asset Manager** in establishing **live line minimum approach distances** shall be based on ergonomic considerations of the lineworker, the equipment used and the work environment.
- (d) The minimum inadvertent movement distance shall be 300 mm unless the lineworker is physically constrained by barriers or other means, in which case a lesser distance may be used.
- (e) Live line minimum approach distances in clause 2.4.1 have been derived in accordance with the principles set out in ANSI/IEEE Standard 516 and using an allowance for inadvertent movement of 300 mm. The maximum switching overvoltages considered were:
 - 3.0 per unit up to and including 275 kV;
 - 2.5 per unit for 330 kV;
 - 2.0 per unit for 500 kV, 270 kV d.c. and 350 kV d.c.

These maximum transient overvoltages assume that the auto-reclose (or restart on HVDC) facility on the line being worked on is disabled in accordance with normal practice.

Significantly higher switching surge levels are possible if line auto-reclose facilities are not disabled. This is of particular significance at transmission voltages where the live line minimum approach distance is strongly dependent on the maximum switching transient assumed.

- (f) Where properly co-ordinated temporary air-gaps or surge arresters are fitted in the vicinity of the worksite, live line minimum approach distances may be reduced. For these transient control devices to be effective, they should be fitted as close as practicable to the work site, but not at the structure being worked on.
- (g) Altitude correction factors should be applied in accordance with ANSI/IEEE Standard 516 when work is to be performed at altitudes higher than 900 m.

2.4.2 Tool Insulation Distance

2.4.2.1 Tool Insulation Distances

The tool insulation distances adopted by the **Asset Manager** for use on their system shall be equal to the live line minimum approach distance for line voltages.

2.4.2.2 Reductions in Tool Insulation Distance

Reductions in tool insulation distance below the live line minimum approach distance may be necessary where, for example, tooling such as strain poles are used to support insulator assemblies, which are themselves shorter than the **live line minimum approach distance**. Because such tools do not require an inadvertent movement allowance, a reduction of 300 mm is possible to enable the tool to fit across the available air gap without compromising electrical safety at 33 kV and above.

NOTE: This does not imply any reduction of worker live line minimum approach distance.

2.5 EQUIPMENT

2.5.1 Cranes and Elevating Work Platforms (EWPs)

2.5.1.1 Use of Cranes and EWPs

Cranes and **EWPs**, insulated and set up in accordance with the requirements of this section, may be used to support conductors and equipment for the **live line** procedure.

2.5.1.2 Supporting Energised Components

When supporting energised components, appropriate insulation, rated to meet the electrical and mechanical loads, shall be fitted between the crane or **EWP** and the **energised** components.

2.5.1.3 Uninsulated Parts of the Crane or EWP

Parts of the crane or **EWP** that are not insulated shall be carefully monitored to ensure they do not encroach within a predetermined approach distance. In addition, consideration should be given to movement of the conductor with wind and changes of temperature.

2.5.1.4 Earthing and Bonding of the Chassis of the Crane or EWP

The chassis of the crane or **EWP** shall, where practicable, be **earthed** and **bonded** to the structure to create an equipotential work zone.

2.5.2 Insulating Ladders

Insulating ladders are used to provide access for lineworkers to their work position on or near energised components.

2.5.2.1 Before Use Inspection and Cleaning of Insulating Ladders

Insulating **ladders** shall be visually inspected prior to use with particular reference to the condition of the stiles, and wiped clean before use.

2.5.2.2 Conductive Clothing

Conductive clothing shall be worn where necessary to limit discomfort from induced static discharges.

2.5.3 Insulating Covers

2.5.3.1 General

Insulating covers are used to provide protection against **brush contact** with **energised** equipment or equipment at different potential.

Insulating covers are not intended to provide long term insulation and should not be allowed to touch both an **energised** surface and an **earthed** surface for an extended time unless two levels of insulation is provided.

Lineworkers shall not purposely make contact with insulating cover except with rated **insulating gloves** or insulating stick.

2.5.3.2 Styles of Insulating Covers

The two main styles of covers available are:

- (a) rigid covers that are made from polyethylene or ABS plastic; and
- (b) flexible covers that are made from natural or synthetic rubber.

2.5.3.3 Use of Insulating Covers

Insulating covers rated for the line voltage shall be used. On structures that support the multiphase system from which the SWER system derives, the insulating covers rated for the multiphase system shall be used.

2.5.4 Temporary Dropout Tools

2.5.4.1 General

Temporary dropout tools may be used to provide fuse protection during live line maintenance. They are installed onto the line using a **live line stick**. The fuse size shall grade with the existing protection.

2.5.4.2 Temporary Dropout Tools

Temporary dropout tools shall be inspected prior to use to ensure that:

- (a) The fuse carrier is free to open and close on the hinge.
- (b) The electrical cable and clamp is electrically adequate for the load it is required to carry.
- (c) All electrical connections are secure.

2.5.4.3 Before Use Cleaning of the Insulating Portion of Temporary Dropout Tools

The insulating portion of temporary dropout tools shall be cleaned prior to use.

2.5.5 Temporary Insulated Jumpers

2.5.5.1 General

Temporary insulated jumpers are used to electrically bypass the work area where equipment is under repair. They shall have a current and insulation rating adequate for the task.

2.5.5.2 Inspection of Temporary Insulated Jumpers

Temporary insulated jumpers shall be visually inspected prior to use to ensure that all electrical connections and clamps are secure and that the cable is not damaged.

2.5.5.3 Testing

The recommended maximum testing intervals are defined in the appropriate standards listed in Appendix A. A summary of the testing frequencies is set out in the table below. **The testing intervals below should be reduced for equipment with high usage.**

Equipment	Testing Intervals
Live line sticks, gin poles and handling devices	not exceeding 12 months
Insulating line hoses, connectors, covers	not exceeding 12 months
Live line rope	not exceeding 6 months
Conducting boots	not exceeding 12 months
Temporary dropout tools	not exceeding 12 months
Insulated jumpers	not exceeding 12 months

2.6 WORK CONSIDERATIONS

2.6.1 Integrity of Insulation – Up To 33 kV

2.6.1.1 Visual Inspection of Insulators in the Immediate Work Zone Prior to Work

All insulators in the immediate work zone should be visually inspected prior to work to ascertain the existence and extent of any damage. This damage should be carefully assessed to ensure that the insulation is safe to approach and work on.

2.6.1.2 Treatment of Insulators or Insulator Strings Exhibiting Physical Damage or Signs of Electrical Distress

Any insulator or insulator string exhibiting physical damage or signs of electrical distress, such as elevated noise levels or surface discharging, shall be approached with care and appropriate safe working techniques adopted to minimise the risk of flashover and consequent injury to workers.

2.6.1.2.1 Outer Protective Covers

Where reduced insulating properties are known or suspected, electrical hazards such as step and touch potentials may exist at the structure. Appropriate safe work practices should be adopted such as:

- (a) performing an earth leakage test before climbing;
- (b) undertaking the work from an EWP; and
- (c) covering the insulation with one or more mats.

2.6.1.3 Live Line Work is to be Performed in Close Proximity to Strings

Where **live line work** is to be performed in close proximity to strings containing porcelain disc insulators on conductive structures and crossarms, each disc should be electrically tested. This testing should preferably be performed immediately prior to starting work.

NOTE: This is because porcelain disc insulators may puncture in service resulting in reduced insulating properties. Punctures in porcelain discs are not readily identified by visual inspection and may not create audible noise.

2.6.2 Integrity of Insulation – Above 33 kV

2.6.2.1 Insulators in the Immediate Work Zone

All insulators in the immediate work zone should be visually inspected prior to work to ascertain the existence and extent of any damage. This damage should be carefully assessed to ensure that the insulation is safe to approach and work on.

2.6.2.2 Insulator or Insulator String Exhibiting Significant Signs of Electrical Distress

Any insulator or insulator string exhibiting significant signs of electrical distress, such as louder than normal audible noise levels and/or intermittent visually apparent surface discharging, shall not be tested or changed using live line techniques, irrespective of the number of apparently sound discs in the string.

2.6.2.3 Live Line Work is to be Performed in Close Proximity to Strings

Where **live line work** is to be performed in close proximity to strings containing porcelain disc insulators, each disc should be electrically tested. This testing should preferably be performed immediately prior to starting work.

Note: This is because porcelain disc insulators may puncture in service resulting in reduced insulating properties. Punctures in porcelain discs are not readily identified by visual inspection and may not create audible noise.

2.6.2.4 Reduced Insulating Properties are Known or Suspected

Where reduced insulating properties are known or suspected electrical hazards such as step and touch potentials may exist at the structure. Appropriate safe work practices should be adopted such as performing an earth leakage test before climbing, or undertaking the work from an **EWP**.

2.6.2.5 Instruments For Testing Insulators

Instruments for testing insulators shall be capable of reliably detecting electrically defective insulators. Where testers that measure the actual voltage are used, the voltage

across each disc in the string shall be recorded so that discrepancies in the normal voltage gradient pattern can be readily observed. Buzz type testers shall not be used on AC lines.

2.6.2.6 The Minimum Number of Electrically Sound and Functioning Disc Insulators

During **live line work** the minimum number of electrically sound and functioning disc insulators, in addition to any shunted discs, should be:

Nominal Line Voltage	Minimum Number of Electrically Sound Standard Profile Insulators
50/66 kV	3
110 kV	4
132 kV	4
220 kV	7
270 kV d.c.	7
275 kV	8
330 kV	11
350 kV d.c.	10
500 kV	16

2.6.2.7 Disc Insulators with Significant Damage to Their Sheds, or Glass Discs Missing Their Sheds

Disc insulators with significant damage to their sheds, or glass discs missing their sheds, shall also be considered as electrically unsound for the purpose of determining minimum insulation present.

2.6.2.8 Live Line Work May Be Performed With Fewer Sound Disc Insulators Than Shown Provided

Live line work may be performed with fewer sound disc insulators than shown provided that specific approved work practices are utilised for that situation, or an appropriate engineering check is undertaken to determine the adequacy of the available insulation. These may include properly co-ordinated temporary air gaps or surge arresters fitted in the vicinity of the worksite.

2.6.3 Insulator Washing

Detailed requirements for insulation washing are given in ANSI/IEEE Standard 957.

2.7 GENERAL WORK PRACTICES

2.7.1 Constraint of Working Clearances Between Phases

Where working clearances between phases are constrained, eg. on distribution structures and where lineworkers are positioned in close proximity, live line stick work is

performed on only one phase at a time. This reduces the chance of phase to phase contact.

2.7.2 Insulating Barriers on Distribution Structures

On distribution structures **insulating barriers** shall be applied to components in the immediate work area to minimise inadvertent phase to phase or phase to earth contact.

2.7.3 Restraint of PPE and Tooling

The free end of body belts, pole straps and ropes shall be restrained from tangling with equipment or infringing the live line minimum approach distance and tangling with equipment.

2.7.4 Marking of the Insulating Stick

The **live line minimum approach distance** should be indicated on the insulating stick for the voltage being worked.

2.8 MINIMUM REQUIREMENTS FOR LIVE LINE STICK WORK

A holder of a certificate in **live line stick** shall have the following competencies additional to those listed in Section 1.4:

2.8.1 Non Load Bearing

2.8.1.1 Up to and Including 33 kV

The holder of a certificate in **live line stick** (up to and including 33 kV - non load bearing) must have the following competencies additional to those listed in Section 1:

- (a) Use **live line stick** techniques on lines to:
 - (i) Safely deal with lost conductors and restore electricity supply.
 - (ii) Connect and disconnect spur lines and line equipment, fittings and hardware.
 - (iii) Apply, remove and move line and hardware covers.

2.8.1.2 Above 33 kV

The holder of a certificate in **live line stick** (above 33 kV - non load bearing) must have the following competencies additional to those listed in Section 1:

- (a) Use **live line stick** techniques on lines to test insulators and installation of dampers, corona balls and measuring devices.

2.8.2 Load Bearing up to 110 kV (with or without underbuilt)

The holder of a certificate in **live line stick** (up to 110 kV - load bearing with or without underbuilt) must have the following competencies additional to those listed in Section 1:

- (a) Safely deal with lost conductors and restore electricity supply.

- (b) Evaluate the condition of conductors to ensure that they are able to be displaced using live line stick methods.
- (c) Determine safe conductor loads.
- (d) Use **live line stick** techniques to work on lines with and without underbuilt circuits.
 - (i) Apply, remove and move line guards, barriers and cover-up gear if appropriate to that voltage to ensure there is no unintended contact between phase and earth or phase to phase.
 - (ii) Install and remove binders if appropriate to that voltage.
 - (iii) Connect and disconnect spur lines, line equipment, fittings and hardware if appropriate to that voltage.
 - (iv) Displace conductors to:
 - Install, change or replace line hardware.
 - Install, change or replace crossarms.
 - Install, change or replace poles, including strain poles.
 - Install, change or replace line equipment.
- (e) Displace conductors with and without the use of a crane or a Hiab and on systems with underbuilt conductors present if appropriate to that voltage.

2.8.3 Load Bearing 33 kV and Above (without underbuilt)

The holder of a certificate in **live line stick** (above 33 kV – load bearing without underbuilt) must have one or more of the following competencies additional to those listed in Section 1. Certificates of Competency shall list the competencies for which the certificate is issued.

- (a) **Suspension Insulators**
 - Test insulators and install dampers, corona balls and measuring devices.
 - Change suspension insulators and fittings on poles and towers.
- (b) **Tension Insulators**
 - Test insulators and install dampers, corona balls and measuring devices.
 - Change suspension insulators and fittings on poles and towers.
 - Change tension insulators and fittings on poles and towers.
- (c) **Pin and Post Insulators**

- Test insulators and install dampers, corona balls and measuring devices.
- Change suspension insulators and fittings on poles and towers.
- Change vertical pin and post insulators on poles

(d) **Pole Replacement**

- Test insulators and install dampers, corona balls and measuring devices.
- Change suspension insulators and fittings on poles and towers.
- Change pin and post insulators.
- Change poles and crossarms and associated fittings on pole structures.

(e) **Change 'V' and 'Y' Suspension Insulators**

- Test insulators and install dampers, corona balls and measuring devices.
- Change 'V' and 'Y' suspension insulators and fittings on poles and towers.

(f) **Special Insulators**

- Test insulators and install dampers, corona balls and measuring devices.
- Change horizontal vee brace or strut insulators

APPENDIX A: REFERENCE DOCUMENTS

A1.1 New Zealand Live Line Training Unit Standards

National Qualifications Framework administered by the New Zealand Qualifications Authority.

A1.2 Joint Australian/New Zealand Standards (AS/NZS)

Until joint Australian/New Zealand Standards (AS/NZS) are developed, equipment used for **live line work** shall comply with appropriate internationally recognised standards.

A1.3 Live Line Standards Organisations

As a guideline, the following is a list of Standards Bodies that have produced standards that have some relevance for live line work. This is not an exhaustive list:

- 1 ASTM (The American Society for Testing and Materials)
- 2 ANSI (American National Standards Institute)
- 3 IEEE (The Institute of Electrical and Electronics Engineers Inc USA)
- 4 CAN/CSA (Canadian Standards Association)
- 5 IEC (International Electrotechnical Commission)
- 6 SIA (Scaffold Industry Association incorporated in America)

A1.4 Live Line Standards

As a guideline, set down in Table 1 below is a list of standards as at the preparation date of this Code. There are also several new standards currently in preparation or circulated in draft form, which will be issued subsequent to the printing of this Code. Readers should check with Standards New Zealand from time to time for any new or updated standards. Contact details are as follows:

Standards New Zealand, Radio New Zealand House, The Terrace, Private Bag 2439, Wellington.
Phone (04) 498 5991

TABLE A1
LIST OF LIVE LINE RELATED STANDARDS

Types of Live Work	Standard Number	Latest Issue Date*	Title
All	ANSI/IEEE:978	1984	Guideline for In-Service Maintenance and Electrical Testing of Live Line Tools
All	ANSI/IEEE:935	1989	Guide on Terminology for Tools and Equipment to be used in Live Line Working
All	ANSI/IEEE:516	1995	Guideline for Maintenance Methods on Energised Power-Lines
All	ANSI/IEEE:957	1995	Guideline for Cleaning Insulators
BH, S	IEEE 1067	1996	Guideline for In-Service Use, Care, Maintenance and Testing of Conductive Clothing for Use on Voltages up to 765kV AC
BH,S	ANSI Z41.3	1991	Men's Conductive Footwear
G&B, S	ANSI/SIA A92.2	1990	Vehicle Mounted Elevating and Rotating Aerial Devices

Types of Live Work	Standard Number	Latest Issue Date*	Title
G&B, S	AS 1418 Part 10	1996	SAA Crane Code - Elevating Work Platforms
G&B, S	AS 1418		Crane Code
G&B	ASTM:D120	1995	Standard Specification for Rubber Insulating Gloves
G&B,S	ASTM:D1048	1999	Standard Specification for Rubber Insulating Blankets
G&B, S	ASTM:D1049	1998	Standard Specification for Rubber Insulating Covers
G&B, S	ASTM:D1050	1999	Standard Specification for Rubber Insulating Line Hose
G&B, S	ASTM:D1051	1995	Standard Specification for Rubber Insulating Sleeves
G&B, S	ASTM:F478	1999	Standard Specification for In-Service Care of Insulating Line Hose and Covers
G&B, S	ASTM:F479	1995	Standard Specification for In-Service Care of Insulating Blankets
G&B	ASTM: F496	1999	Standard Specification for In-Service Care of Insulating Gloves and Sleeves
G&B	ASTM: F696	1997	Standard Specification for Leather Protectors for Rubber Insulating Gloves and Mittens
All	ASTM:F711	2000	Standard Specification for Fibreglass – Reinforced Plastic (FRP) Rod and Tube used in Live Line Tools
G&B, S	ASTM:F712	1995	Standard Test Methods for Electrically Insulating Plastic Guard Equipment for Protection of Workers
G&B, S	ASTM:F1564	2000	Standard Specification for Structure Mounted Insulating Work Platforms for Electrical Workers
S, BH	IEC 60895 (Prev 895)	1987	Specification for Conductive Clothing for Live Working at Nominal Voltages up to 800 kV a.c.

* As at date of preparation of this Code.

The following is a list of all issued IEC standards relating to live working at the date of preparation of this Code:

IEC 60050-651 Ed. 1.0 (1999-07)	Chapter 651 of the International Electrotechnical Vocabulary: Live working
IEC 60417-1 Ed. 1.0 (1998-08)	Graphical Symbols for use on Equipment - Part 1: Overview and Application
IEC 60743 Ed. 1.0 (1983-01) Amendment 1 (1995-01)	Terminology for Tools and Equipment to be used in Live Working
IEC 60832 Ed. 1.0 (1988-04)	Insulating Poles (Insulating Sticks) and Universal Tool Attachments (Fittings) for Live Working
IEC 60855 Ed. 1.0 (1985-01)	Insulating Foam-Filled Tubes and Solid Rods for Live Working
IEC 60895 Ed. 1.0 (1987-12)	Conductive Clothing for Live Working at Nominal Voltage up to 800 kV a.c.
IEC 60900 Ed. 1.0 (1987-12) Amendment 1 (1995-08)	Hand Tools for Live Working up to 1000 V a.c. and 1500 V d.c.
IEC 60903 Ed. 1.0 (1988-03)	Specification for Gloves and Mitts of Insulating Material for Live Working
IEC 60984 Ed. 1.0 (1990-02)	Sleeves of Insulating Material for Live Working

IEC 61057 Ed. 1.0 (1991-06)	Aerial Devices with Insulating Boom used for Live Working
IEC 61111 Ed. 1.0 (1992-12)	Matting of Insulating Material for Electrical Purposes
IEC 61112 Ed. 1.0 (1992-12)	Blankets of Insulating Material for Electrical Purposes
IEC 61219 Ed. 1.0 (1993-10)	Live Working — Earthing or Earthing and Short-Circuiting Equipment using Lances as a Short-Circuiting Device — Lance Earthing
IEC 61229 Ed. 1.0 (1993-07) Amendment 1 (1998-02)	Rigid Protective Covers for Live Working on a.c. Installations
IEC 61230 Ed. 1.0 (1993-09)	Live Working — Portable Equipment for Earthing or Earthing and Short-Circuiting
IEC 61235 Ed. 1.0 (1993-09)	Live Working — Insulating Hollow Tubes for Electrical Purposes
IEC 61236 Ed. 1.0 (1993-08)	Saddles, Pole Clamps (Stick Clamps) and Accessories for Live Working
IEC 61243-1 Ed. 1.0 (1993-11) Amendment 1 (1997-10)	Live Working – Voltage detectors — Part 1: Capacitive Type to be used for Voltages Exceeding 1 kV a.c.
IEC 61243-2 Ed. 1.0 (1995-10) Amendment 1 (1999-10)	Live Working - Voltage Detectors - Part 2: Resistive Type to be used for Voltages of 1 kV to 36 kV a.c.
IEC 61243-3 Ed. 1.0 (1998-10)	Live Working - Voltage Detectors – Part 3: Two-Pole Low-Voltage Type
IEC 61243-5 Ed. 1.0 (1997-06)	Live Working – Voltage Detectors - Part 5: Voltage Detecting Systems (VDS)
IEC 61278 Ed. 1.0 (1997-01)	Live Working – Guidelines for Dielectric Testing of Tools and Equipment
IEC 61318 Ed. 1.0 (1994-08)	Live Working — Guidelines for Quality Assurance Plans
IEC 61328 Ed. 1.0 (1995-08)	Live Working – Installation of Transmission Line Conductors and Earthwires - Stringing Equipment and Accessory Items
IEC 61472 Ed. 1.0 (1998-11)	Live Working – Minimum Approach Distances. Method of Calculation
IEC 61813 Ed. 1.0 (2000-09)	Live Working – Care, Maintenance and Inservice Testing of Aerial Devices with Insulating Booms
IEC 61911 Ed. 1.0 (1998-12)	Live Working – Installation of Distribution Line Conductors - Stringing Equipment and Accessory Items
IEC 61942 Ed. 1.0 (1997-09)	Live Working - Gloves and Mitts with Mechanical Protection

The following is a list of all Draft IEC draft standards relating to live working at the date of preparation of this Code:

IEC 60417-1 Ed 2.0 Amendment 1	Graphical Symbols: 5216 Pr 'Suitable for Live Working'
IEC 60743 Ed. 2.0	Terminology for Tools and Equipment and Devices to be used in Live Working (Revision of IEC 60743 Ed. 1.0)
IEC 60895 Ed. 2.0	Conductive Clothing for Live Working at a Nominal up to 800 kV a.c. or \pm 600 kV d.c. (Revision of IEC 60895 Ed. 1.0)
IEC 60903 Ed. 2.0	Specification for Gloves and Mitts of Insulating Material for Live Working. (Revision of IEC 60903 Ed. 1.0)
IEC 61057 Ed. 2.0	Aerial Devices with Insulating Boom used for Live Working. (Revision of IEC 61057 Ed. 1.0)
IEC 61243-1 Ed. 2.0	Live Working - Voltage Detectors — Part 1: Capacitive Type to be Used for Voltages Exceeding 1 kV a.c. (Revision of IEC 61243-1 Ed. 1.0)

IEC 61477 Ed. 1.0	Guidelines for Use of Tools and Equipment for Live Working
IEC 61478 Ed. 1.0	Live Working - Ladders of Insulating Material
IEC 61479 Ed. 1.0	Live Working - Conductor Covers (Line Hoses) of Insulating Material for Electrical Purposes
IEC 61481 Ed. 1.0	Portable Phase Comparators for Voltages of 1 kV to 36 kV
IEC 61482-1 Ed. 1.0	Live Working - Clothing for Thermal Protection Of Workers; Thermal Hazards of an Electric Arc - Part 1: Test Methods
IEC 61482-2 Ed. 1.0	Live Working - Clothing for Thermal Protection Of Workers. Thermal Hazards of an Electric Arc - Part 2: Performance Requirements
IEC 62192 Ed. 1.0	Live Working – Ropes of Insulating Material
IEC 62193 Ed. 1.0	Live Working – Telescopic Sticks
IEC 62237 Ed 1.0	Live Working - Mobile Insulating Hoses used with Hydraulic Tools for Live Working
IEC PNW 78-324 Ed. 1.0	Live Working – Guidelines for the Installation and Maintenance of Optical Cabling – Part 1 : Overhead High-Voltage Power Supply Lines