SC1000
Substation Entry
January 2005

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1. Introduction

This course has been designed for employees or contractors who are required to enter in EnergyAustralia substations. The course delivers instruction on EnergyAustralia's transmission and distribution network, reviews the Electrical Safety Rules and gives an introduction to basic electrical terms, earthing systems and the functions they are required to perform.

Safety and environmental procedures are discussed in general terms, but it should be noted that the task specific procedures for both of these should be considered before proceeding.

The following courses must be done prior to or in conjunction with this course and must be current:

- SR1000 'Release and Rescue from Live Low Voltage Mains and Apparatus'
- SE1000 'Electrical Safety Rules' Category A, B or C
- Standard Environmental Management Plan
- M1352 'Resuscitation'

2. Learning Outcomes

Learning Outcome 1

At the completion of this course the successful trainee will be able to:

Assessment Criteria:

1.1 Demonstrate knowledge of the relevant parts of EnergyAustralia's Electrical Safety Rules, safety equipment, and safe working procedures when working in substations.

1.2 Demonstrate the procedures for entering substations.

1.3 Demonstrate an awareness of the different types of substations used by EnergyAustralia.

1.4 Identify basic earthing systems.

1.5 Interpret basic electrical terms.

1.6 Recognise conditions of a confined space.

1.7 Identify requirements for working with asbestos cement conduits, pipes, ducts, troughing and other asbestos products.

1.8 Define the purpose of low voltage screening and high voltage robust barriers.

1.9 Demonstrate a knowledge of the EnergyAustralia Standard Environmental Management Plan.

Conditions: Learning will take place in a classroom environment and in the various substations required to be seen as part of this course.

Method of Assessment: Written and computer based examinations.

3. Basic OH&S

If you are unsure about the safety of the work, please ask for more information from your supervisor.

If you see someone working outside of the Electrical Safety Rules:

- inform them that they are working in an unsafe manner
- report to their supervisor what they are doing breeches the rules.

All safety equipment must be inspected by the user before use and replaced if necessary. Refer to TS 0650 '*Safety Equipment – Care, Use and Inspection*'. See attachment.

3.1 OHS Legislation

This section is designed to give you a general introduction to safety legislation in NSW with particular application to the electricity supply industry. All staff must be aware of and understand their responsibilities in law for the health and safety of all people in the workplace. This is to ensure compliance and maximise the efficiency of their operations in relation to health and safety at work. All staff need to appreciate that they have a duty of care and responsibility for safety in the workplace.

None of us are lawyers, however, we need to have some understanding of those parts of the law which are critical in our working environment.

3.1.1 OHS Act and Regulations

The OHS Act 2000 is the most important, the most demanding and can be the most threatening safety legislation used in NSW. Its ultimate aim is to secure the health, safety and welfare of people at work and to provide guidance in consultative processes to achieve its aim.

The OHS Act is supported by a number of Regulations. We will not consider these in any detail. However, it is worth mentioning OHS Regulation 2001, which provides for, among other requirements, the process of hazard identification in certain processes and Safe Work Method Statements.

3.1.2 Electricity Acts and Regulations

Many staff in EnergyAustralia also have to work to the requirements of the Electricity Supply Act, the Electricity Safety Act and associated Regulations.

The Electricity Supply (Safety Plans) Regulation 1997 is supported by a number of Codes of Practice. In particular, safe working distances, training and safe procedure requirements are detailed in EnergyAustralia's Electrical Safety Rules. You will be provided with specific training applicable to various regulations that impact on your work area.

3.1.3 Codes of Practice, Guides and Australian Standards

Requirements of Acts and Regulations are mandatory and must be followed at all times. They can be supported by many other Codes, Guides and Standards. You cannot be prosecuted for not following such a code, guide or standard unless called up by legislation; but they can be used as evidence in a proceeding that your practices are not at an acceptable minimum standard.

3.2 Pertinent Sections of the OHS Act

PART 1 - PRELIMINARY

PART 2 - DUTIES RELATING TO HEALTH, SAFETY AND WELFARE AT WORK

(Duty of Care)

The all-encompassing requirements for duty of care and to consult are embodied in Part 2 Division 1, 2, & 3 of the OHS Act 2000 under:

Division 1 Section 8 - Duties of employers

Employers shall ensure that:

- premises are safe and without risks to health. Including means of access to or exit from the premises.
- any plant or substance provided for use by the employees at work is safe and without risks to health when properly used.
- systems of work and the working environment of the employees are safe and without risks to health.
- people (other than the employees of the employer) are not exposed to risks to their health or safety arising from the work being carried out.

Employers shall provide:

- Information, instruction, training and supervision as may be necessary to ensure the employees' health and safety at work
- Adequate facilities for the welfare of the employees at work.

Division 1 Section 9 - Duties of self-employed persons

Ensure that people (other than the employees of the person) are not exposed to risks to their health or safety arising from the work that they are doing.

Division 1 Section 10 - Duties of controllers of work premises, plant or substances

- Ensure that the premises are safe and without risks to health.
- Plant or substance used by people is safe and without risks to health when properly used.

Division 1 Section 11 - Manufacturers and suppliers responsibilities

- Ensure that the plant or substance is safe and without risks to health when properly used,
- Provide or arrange for adequate information about the plant or substance to the persons to whom it is supplied to ensure its safe use.

(Manufacture plant includes assemble, install or erect plant.)

Division 2 Section 13 - Duty for employer to consult

An employer must consult with the employees to enable them to contribute to the making of decisions affecting their health, safety and welfare at work.

Division 3 Section 20 - Related duties (Duties of employees)

- Take reasonable care for the health and safety of people who are at the employee's place of work and who may be affected by the employee's acts or omissions at work.
- Co-operate with his or her employer or other person to enable compliance with any requirement that is imposed in the interests of health, safety and welfare.

Employees must not:

- Interfere with or misuse things provided for the health, safety or welfare of persons at work. E.G. rescue kits, first aid kits, safety glasses etc. (OHS Act 2000 Division 3 Section 21)
- Obstruct attempts to give aid or attempts to prevent a serious risk to the health and safety of a person at work. E.G. Not following work procedures. [OHS Act 2000 Division 3 Section 24 (1)]
- Refuse a reasonable request to assist in giving aid or preventing a risk to health and safety. E.G. Failure to raise a recognised hazard to a workgroup. (OHS Act 2000 Division 3 Section 24 (2))

Procedure for Refusal to Work on Grounds of Unsafe or Hazardous Work

Parts 1,2 and 3 of the Occupational Health and Safety Act 2000 provide, among other things, that employees are obliged to cooperate with their employer in matters of safety and have a right to refuse to work on the ground of either unsafe or hazardous work. Other persons working on EnergyAustralia's property and equipment have the same obligation and right.

OHS Committees (OHS Act 2000 Part 2 Division 2 Sections 13 to 19)

EnergyAustralia is committed to workplace safety and employee consultation. OHS Committees and other representatives are a valuable contribution to these processes and are established in line with the regulatory guidelines.

However, any statement made or any information or answer given or furnished by a natural person in compliance with a requirement under this Division is not admissible in evidence against the person in criminal proceedings (except proceedings for an offence under this Division) if:

(a) the person objected at the time to doing so on the ground that it might incriminate the person, or

(b) the person was not warned on that occasion that the person may object to making the statement or giving or furnishing the information or answer on the ground that it might incriminate the person.

(3) Documents admissible

Any document produced by a person in compliance with a requirement under this Division is not inadmissible in evidence against the person in criminal proceedings on the ground that the document might incriminate the person.

(4) Further information

Further information obtained as a result of a document produced, a statement made or information or an answer given or furnished in compliance with a requirement under this Division is not inadmissible on the ground:

(a) that the document, statement, information or answer had to be produced, made, given or furnished, or

(b) that the document, statement, information or answer might incriminate the person.

3.3 Accident Reporting

If there is an accident, it must be reported using one of the following report forms.

SH&E Report Accident report form

SH&E/IW Investigation Work sheet.

Alert copy (*buff*) — To section

Records copy (*pink*) — Environment to Branch/Division
OH&S to Branch/Division OHS Unit

Investigation copy (*white*)

↓

Supervisor — If Workers Compensation claim likely
Supervisor to fax in copy

↓

Completes internal investigation work sheet

↓

Branch Section Manager — OH&S
Environmental
Both

First Aid Injury Report

Claim for Compensation under the Workers Compensation Act 1987
(available from Corporate Management - Manager - Workers Compensation).

WorkCover Authority Accident Report - ANF 1
(available from Safety Management, local or Manager - Workers Compensation, Corporate).

Accident Reporting, Investigation and Prevention and Workers' Compensation
(available from Line Management, local or Manager - Workers Compensation, Corporate).

Hazard/Incident Alert Booklet
(available on stores issue stock code No. 144097).

IMPORTANT: All accidents involving electric shock, electrocution or rotating machinery (powered by electricity) must be reported to the Minister for Energy Utilities.

The Minister for Energy Utilities, Electricity Distribution Division - Electrical Accident Advice - form EAA – 3
(available from Safety Management, local or Manager - Workers Compensation, Corporate).

3.3.1 General Guidelines For SH&E Report

Further details on reporting can be found in the OH&S Management System Manual clause 5.5 and Environmental Management System CE7.9P4 and CE7.9P4F1.

A report can be initiated by any person who is either involved in or witnesses an injury or incident. Supervisors have the responsibility for completing such reports and conducting an appropriate level of investigation.

The report should be completed as soon as possible after an event.

Sample of Safety, Health and Environment Report

energyAustralia

Rev: 1
Date of Issue: June 96
Ref: CE7.9P4F1
OHS Mgt System:

Safety, Health & Environment Report — Alert Copy

Alert Copy (Buff) – Branch Manager Records Copy (Pink) – Division OHS Contact
Investigation Copy – Supervisor → ..... → ..... → ..... → Division
(White) Senior Line Manager OHS Unit/Contact OHS Committee
(For Environmental Incidents replace OHS Contact with Branch Environment Coordinator)
Please print clearly. Cross box (x) for best choice from available incidents.

Type of report ☐ Injury ☐ Occupational illness ☐ Safety incident ☐

1. Source

Division ..... Branch/Group ..... Depot/subsection .....
Date of injury/incident ... Time .. Date reported ....

2. Type of event

Injury/occ. Illness ☐ Fatality ☐ Lost time injury ☐ Selected duties ☐
Type of casualty ☐ Employee ☐ Contractor ☐ Visitor ☐ *Public* ☐ *Not*
Incident type ☐ Environmental ☐ Vehicle collision ☐ Off-the-job
☐ Fire ☐ Explosion ☐ Property damage est. $
☐ Other (state) .....

3. Details of injured person

Name ..... Service no ..... Classification .....
Address .... Date of birth ....
Start time on day of injury ..... Classification experience (task carried

4. Details of injury/occ. illness

Part of body injured and nature injury/illness .....
Treatment received ..... Provided by .....
Did employee cease work? ☐ Yes ..... ☐ No ..... When?
Full days lost ..... as at (date) ..... Returned to work ☐ Yes ☐ No
Do you think the injury is a recurrence of a previous condition ☐ Yes ☐ No

5. Details of event

Location of incident .....
Briefly describe what occurred

.....
Employee's signature (optional)

6. Notifications

WorkCover Required ☐ Yes ☐ No ☐ Undecided Completed ☐ Yes ☐ No
Office of Energy Required ☐ Yes ☐ No ☐ Undecided Completed ☐ Yes ☐ No
EPA Required ☐ Yes ☐ No ☐ Undecided Completed ☐ Yes ☐ No

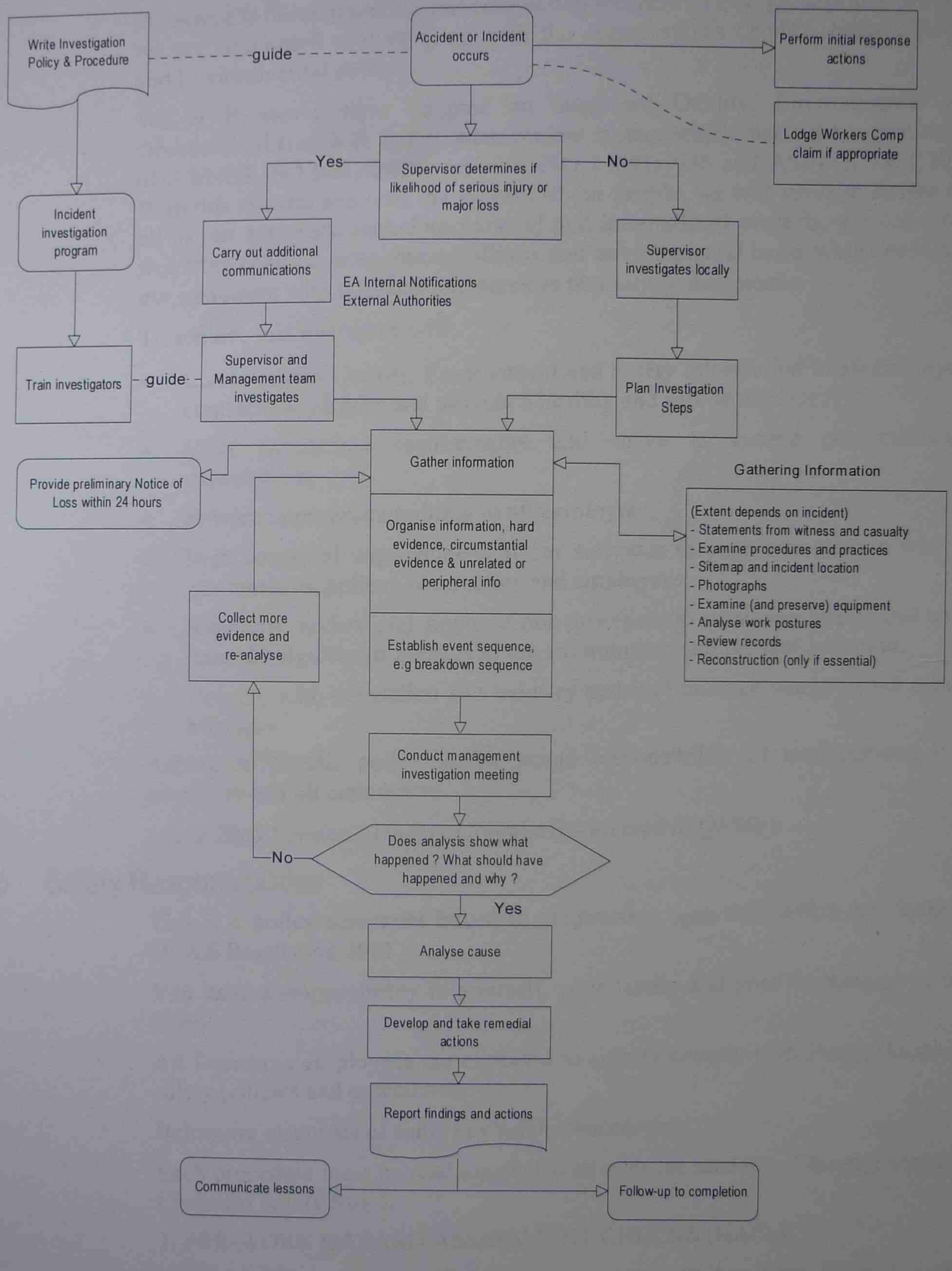
7. Additional information for Supervisor

Does an Investigation team need to be arranged? ☐ Yes ☐ No
Are you satisfied that the injury was sustained by the employee as reported above? ☐ Yes ☐
Supervisor to send a copy of this page to Workers' Compensation Health & Safety Section, HOB for injuries incurring medical costs, lost time and/or where Employee Workers' Compensation

Supervisor ....
Name Signed Phone no Date

See attached sheet for Guidelines on completing this report

Injury/Incident Investigation Flow Chart



3.4 Quality, Safety, Health and Environmental Policy

Enerserve is the engineering and contracting business of EnergyAustralia. As such we are committed to complying with the organisation's Quality, Safety, Health and Environmental policy.

We at Enerserve have adopted an integrated Quality, Environmental and Occupational Health & Safety management system which meets the requirements of AS/NZS ISO 9001:2000, AS/NZS ISO 14001:1996 and AS/NZS 4801:2001. With this system, and with the support of our people, we will strive to ensure that all of our activities, including national and international projects, are conducted free from injuries, occupational illness and environmental harm whilst providing our customers with products and services that satisfy their needs.

To achieve this Enerserve will:

- Communicate Quality, Environment and Safety information to all employees, contractors, visitors and provide a healthy and safe workplace.
- Meet contractual requirements and strive to exceed our customers' expectations.
- Provide appropriate training to all employees.
- Seek continual improvement of our activities through consultation with our customers, suppliers, contractors and employees.
- Regularly review and improve our processes to minimise health and safety hazards, significant impacts to the environment and prevent pollution.
- Comply with legislation and industry codes of practice wherever we conduct business.

Adherence to this policy is the prime responsibility of management, every employee and all contractors.

(April 2003 Version - Updated Regularly - located in QES01)

3.5 Safety Responsibilities

This is a policy statement issued in conjunction with the OH&S Act 2000 and OH&S Regulation 2001.

You have a responsibility to yourself, your family and your workmates to work safely.

All Enerserve employees are expected to strictly comply with EnergyAustralia's safety policies and procedures.

Below are examples of some key safety procedures.

Each procedure must be read together with relevant sections of EnergyAustralia's Electrical Safety Rules.

1. PRE-WORK HAZARD ASSESSMENT CHECKS (HACs)

HACs must be carried out in accordance with OHS Act 2000, OHS Regulation 2001, Clause 4.4 of the Electrical Safety Rules and Enerserve procedure QES 29 before commencing any job.

This means you must complete a HAC before commencing any job and revise the HAC if the job changes in any way.

2. LIVE LOW VOLTAGE WORK

Work on live low voltage must be carried out in accordance with Clause 7.3 of the Electrical Safety Rules and, in particular Corporate Directive CD 03/1998 'Use of insulating gloves when working on or near exposed live low voltage mains and apparatus'.

This means you must wear an insulating glove and protective outer glove on each hand and apply temporary Insulation to all live exposed conductors except the one on which you intend to work.

Failure to comply with clause 7.3 of the Electrical Safety Rules is a critical breach of the Safety Responsibilities.

3. ACCESS PERMITS

Work or test on or near de-energised, isolated, earthed and short-circuited High Voltage conductors or apparatus and work/test on or near Low Voltage conductors or apparatus 'under access' must be strictly in accordance with the conditions on the access permit and the requirements of the Electrical Safety Rules.

This means that you must complete, issue, check, sign, follow and cancel the requirements of an Access Permit.

4. WORKING ALIVE ALOFT

Persons working aloft on or near live mains and apparatus must at all times wear an insulating glove and protective outer glove on each hand, approved safety headwear, closed front long sleeve cotton shirts buttoned at the wrists, long cotton trousers and safety footwear. In addition, approved fall arrest equipment must be used when working aloft. When working on the ground or attending others aloft in public thoroughfares, high visibility vests must be worn at all times.

This means that when working aloft on or near live conductors or apparatus you must wear regulation protective clothing including safety helmet, insulating gloves, protective outer gloves, electrical worker's shirt and trousers. High visibility vests must be worn when working on the ground in the area from boundary to boundary in urban areas or within 5 metres of trafficable lanes in rural areas.

5. SERVICE POLARITY TESTS AND NEUTRAL IDENTIFICATION

When any Low Voltage distribution network or customer installation is connected or re-connected you must carry out appropriate tests or checks in accordance with clause 7.4 of the Electrical Safety Rules.

This means that you must conduct a 'final test' including the earthing system and neutral after energising any LV installation.

Any breach of these safety responsibilities or other safety provisions is a violation of the EnergyAustralia code of conduct and may result in re-training in addition to the following:

- the first proven breach of any safety responsibility or other safety breaches will result in disciplinary action which will lead to:
  - a letter of admonishment being issued; or
  - more serious disciplinary action being taken which may include suspension or downgrading for blatant critical or multiple breaches of these responsibilities.

- a second proven breach of any safety responsibility will result in more serious disciplinary action being taken in accordance with EnergyAustralia's discipline policy.
- a third proven breach of any safety responsibility within any two year period may lead to dismissal.

4. Electrical Terms

Voltage	Pressure. Voltage is measured in Volts (V) or Kilo Volts (kV) sometimes expressed as Potential Difference. High voltage – More than 1000 V Low voltage – From 50 V to 1000 V Extra low voltage – Less than 50 V
Current	Flow. Current is measured in Amps.
Conductor	A conductor is any wire, bar, tube or object that forms part of an electrical circuit.
Resistance	Impedance to flow. Resistance is measured in Ohms.
Inductance	Magnetic forces around high voltage and current creating a voltage in adjacent conductors. Inductors and are found in motors or fluorescent lamps.
Capacitance	Electrical forces around high voltage and current creating a voltage in adjacent conductors. Capacitors are used in electronics and power circuits.
Conductors of Electricity	All metals are conductors. Copper, Aluminium and Steel are used as conductors in electrical circuits the more current the bigger the conductors (examples- wires, cables and busbars), but many other materials can be conductive under the right conditions. All materials must be treated as conductive, including liquids and gasses, unless you have definite knowledge otherwise.
Insulators	Although insulators will not allow electrical current to pass, the higher the voltage the more insulation is needed (larger air gap and insulators). Insulators are rated for a particular voltage and will not be insulators if applied voltage exceeds rated voltage. This breakdown may take the form of surface arcing over the material, a puncture through the material or arcing across an air gap. They will also break down if their mechanical integrity is reduced by damage, such as cracking or chipping of the insulator.
Busbars	A means of distributing electricity within a substation.

Transformers

Also known as Power Transformers convert the voltage levels of the system to that which is required. Typical levels are:

IN	OUT	System
132kV	66kV or 33kV	Sub-transmission
132kV, 66kV or 33kV	11kV	Zone
11kV	415V/240V	Distribution

Current Transformers (CT)

Convert high current levels to low current values in proportion to the winding ratio of the CT. The low values are then used for metering or protection purposes.

Voltage Transformers (VT)

Convert voltages at higher levels, to voltages at lower levels in proportion to the winding ratio of the VT. The lower values are used for metering or protection purposes.

Important Safety Notice on CTs

Current Transformer Secondary Circuits

Mounted below the High Voltage Switchgear in most substations are circular devices (black doughnuts) called current transformers. These are designed to indicate the amount of current that flows through the cable.

If the connecting wires are cut or dislodged them the current transformer will make a high voltage, so we must take care not to damage them if we are working around this area.

ESR	6.22

5. The Electricity Network

EnergyAustralia purchases electricity from power generating companies at very high voltage levels (usually 132kV, 66kV and 33kV).

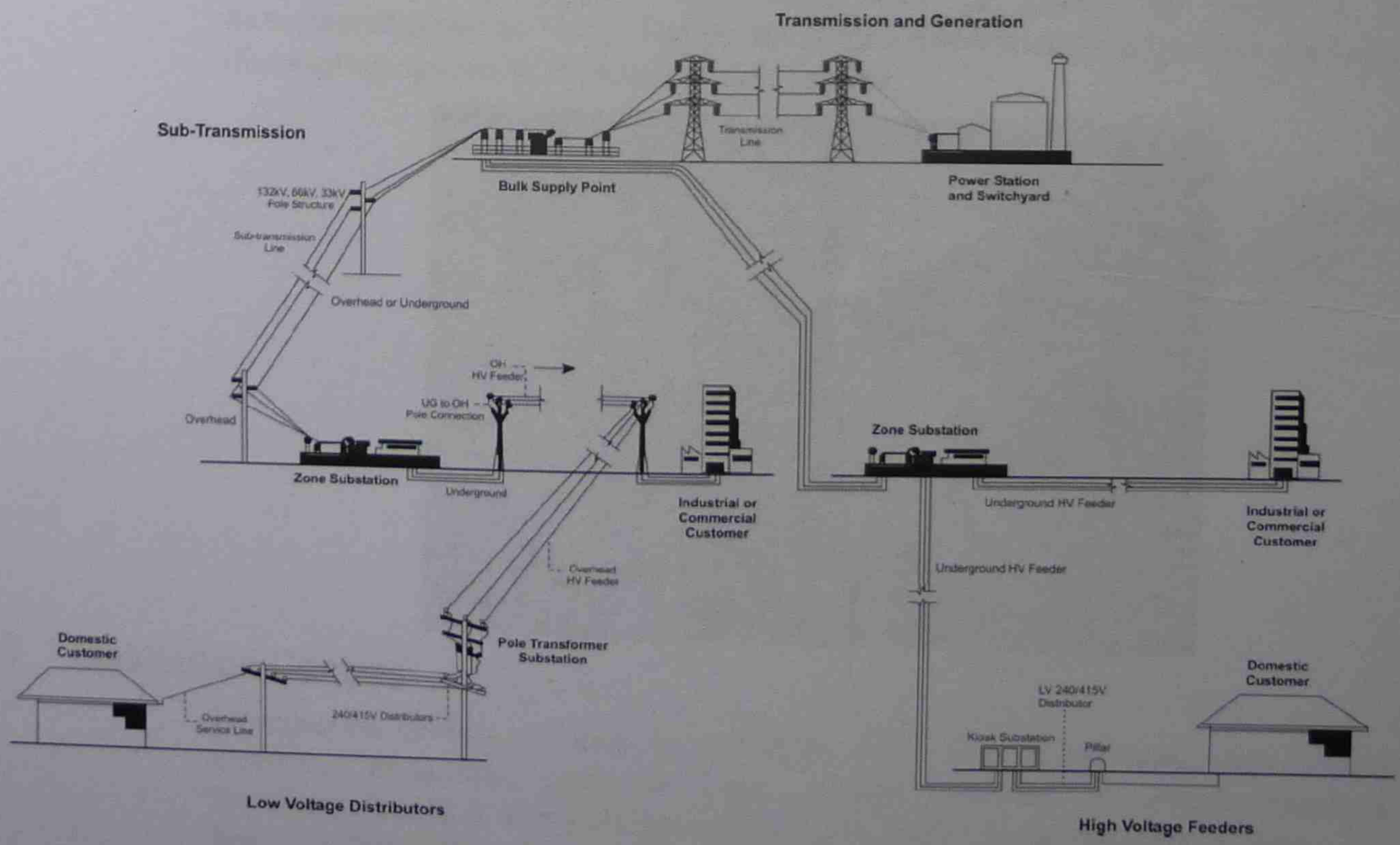
High voltage is used because electricity can be moved long distances more efficiently at high voltage. It is then transmitted to zone substations by underground or overhead sub-transmission feeders.

At zone substations electricity is transformed from sub-transmission voltages to 11kV. Substations are places where the voltage levels can be changed. They contain transformers, (which change the voltage levels) control switches and protection equipment.

The electricity is then transmitted by overhead or underground feeders to distribution centres. When these feeders are overhead, the distribution centres are usually pole transformer type substations. However, if the feeders are underground, then the distribution centres can be kiosks, outdoor enclosure substations, indoor substations, underground substations, or even pole transformer substations

At distribution centres the electricity is transformed from 11kV to the standard 415/240 V, 3-phase, 4-wire supply. It is then distributed via the low voltage network to be sold to the customer.

To minimise the loss of supply to customers in the event of a breakdown of part of the supply system, each zone is kept separate, the 11kV feeders are usually operated as radials and the supply from each distribution centre is also separated from adjacent distribution centres.

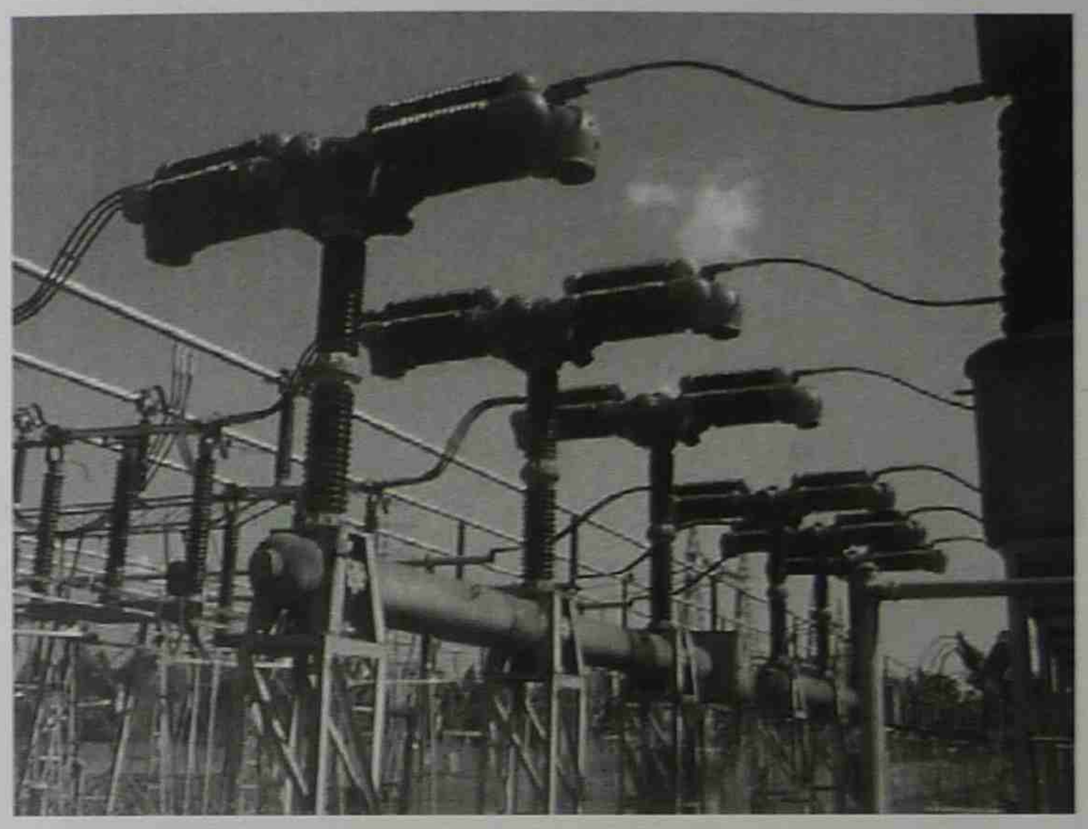


Electricity distribution

6. Types of Substations

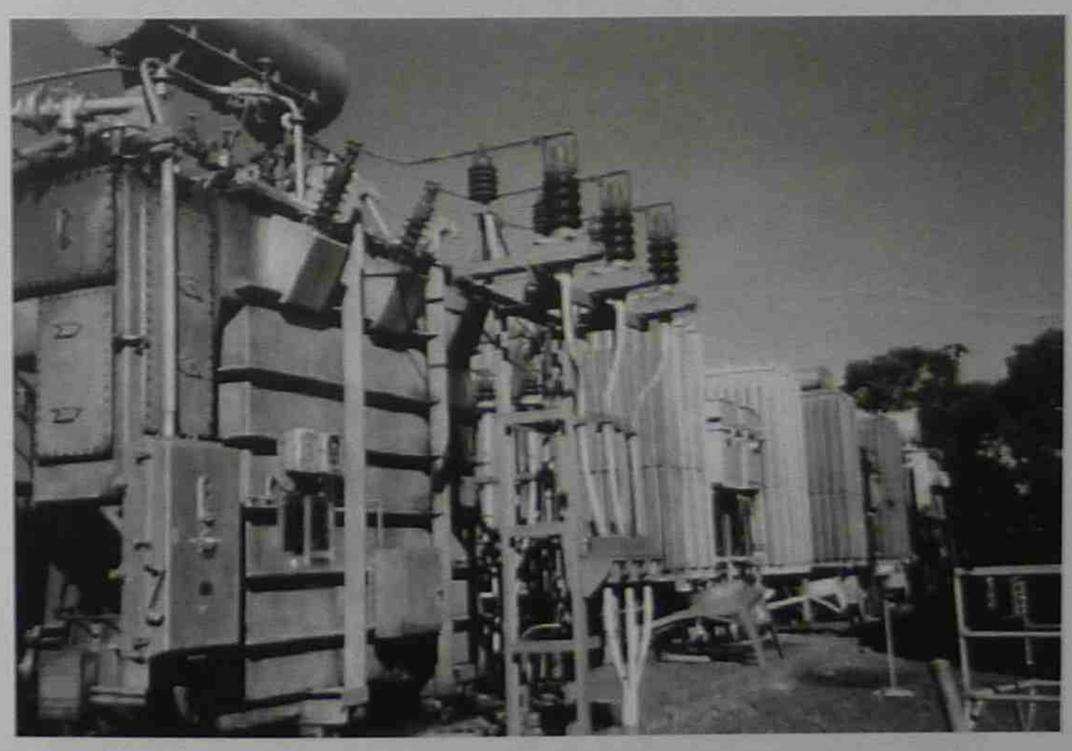
6.1 Sub-transmission Substations and Switching Stations

These are centres where electricity is purchased from the power station at a high voltage level usually 132kV. The lines are either switched in a Switching Station and/or the voltage is transformed down to 33kV or 66kV and then carried on underground or overhead mains to Zone Substations.



6.2 Zone Substations

These are usually supplied at 132kV, 66kV or 33kV. The power is then transformed down to 11kV. The power is then distributed through the high voltage distribution system to the Distribution centres.



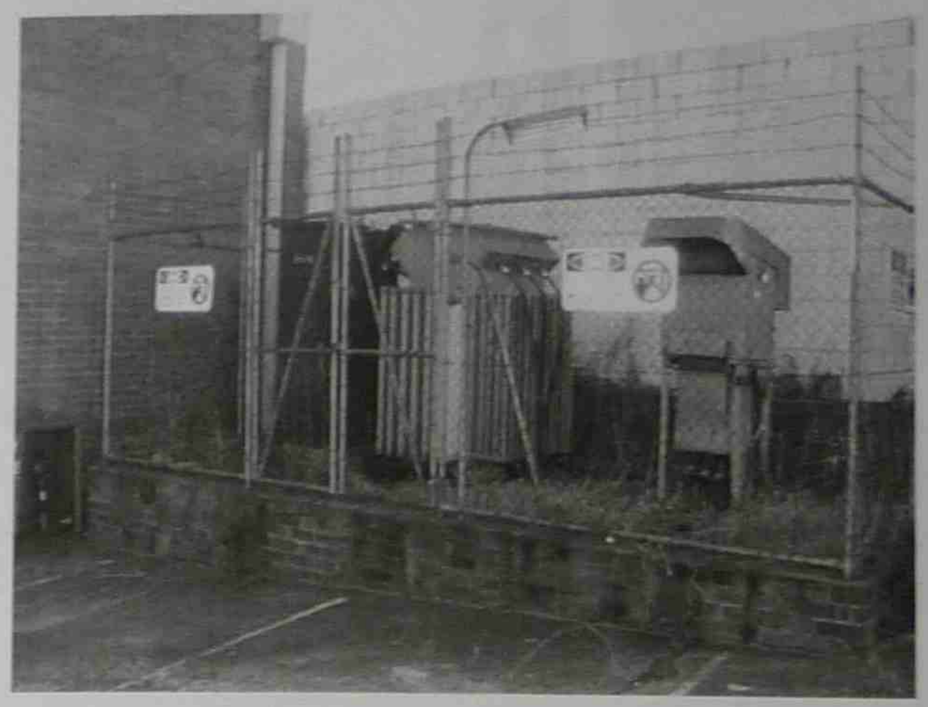
6.3 Distribution Centres

Distribution centres are used to transform 11kV to 415/240 volts, they contain electrical apparatus, such as high voltage switches or circuit breakers, transformers and a low voltage switchboard, with circuit breakers or fuses that feed 415/240volts to the customer.

Most customers are supplied power at low voltage. However, some large users of power are supplied at high voltage and have their own substations. Distribution substations can be divided into a variety of designs to suit the requirements of the area.

6.3.1 Enclosure

An enclosure type substation has the apparatus surrounded by a chain link fence. This substation is normally found in industrial areas.



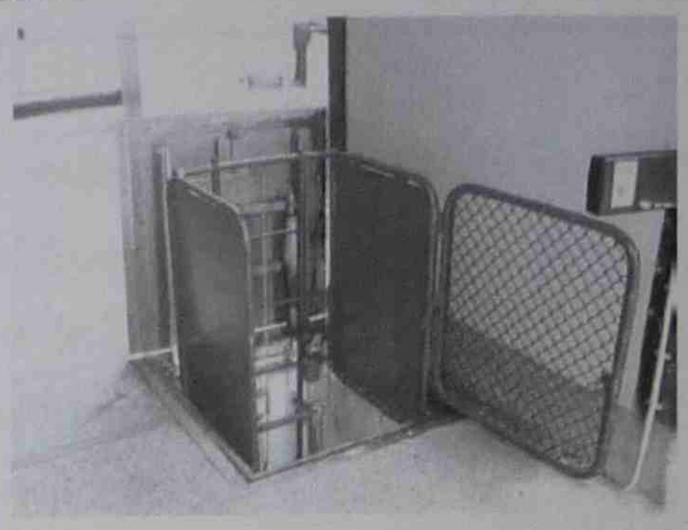
6.3.2 Surface Substation

These substations are usually found in industrial areas or older suburbs.

Integrated with building

Free standing surface substation

6.3.3 Underground and Basements



These substations are predominantly found in the Sydney and North Sydney CBD areas. Both types of substation are as the names suggests built below the ground line, the difference being that an underground type has been built in the footpath/road and a basement type is in the basement of a building.

6.3.4 Upper Level Substations

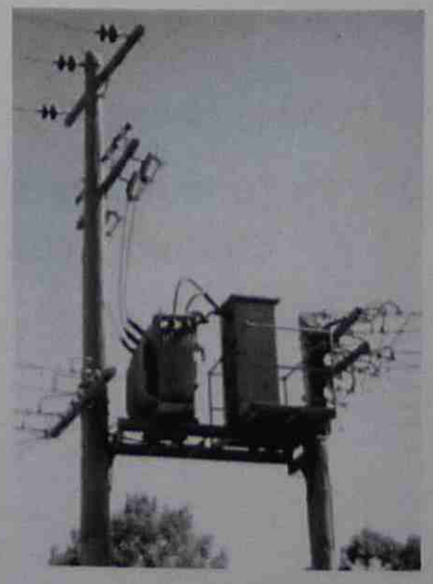
These substations are built on various floors of high rise buildings, with high voltage switches in the basement control point. All transformers and circuit breakers in a substation are air insulated, so no gases or oils are present that can leak through building should problems arise.

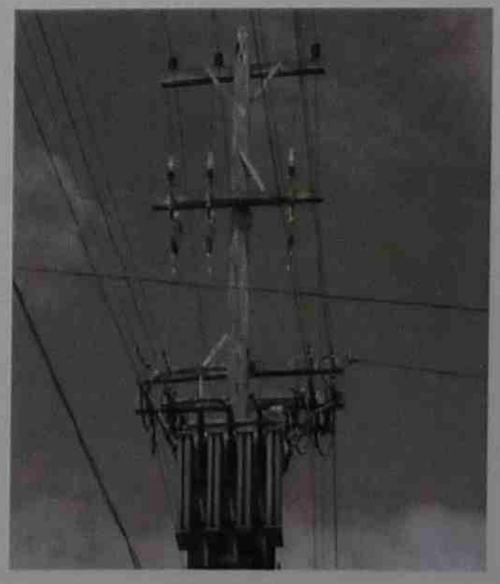
6.3.5 Kiosks

Kiosks come in a large number of designs. These are the most noticeable of all the types of substation used by EnergyAustralia because they are usually built on the footpath. They are normally painted green but may have been painted to suit the surroundings.

6.3.6 Pole Transformers

These substations are usually built in areas that have or had overhead high voltage mains. They have exposed high voltage and low voltage switchgear.





7. City Distribution Substation

All City Distribution substations work in threes. They each have:

- 3 x 11kV feeders
- 3 x HV switches
- 3 x transformers
- 3 x LV switches
- 3 x sets of protection.

Due to the heavy loading and high density of customers in the city, this triplicated system allows repairs and maintenance of the system whilst maintaining supply to customers.

7.1 The Entryway

City Distribution substation entryways contain important equipment such as:

- pull out gear
- signal marshalling cabinet
- electrical signal to fibre-optic signal conversion boxes
- phone
- number and name of substation
- fire extinguisher
- Pilot isolation boxes to send HV trips to the Zone substation
- inside chamber at entryway door and all other exits is positioned the Emergency Push Button.

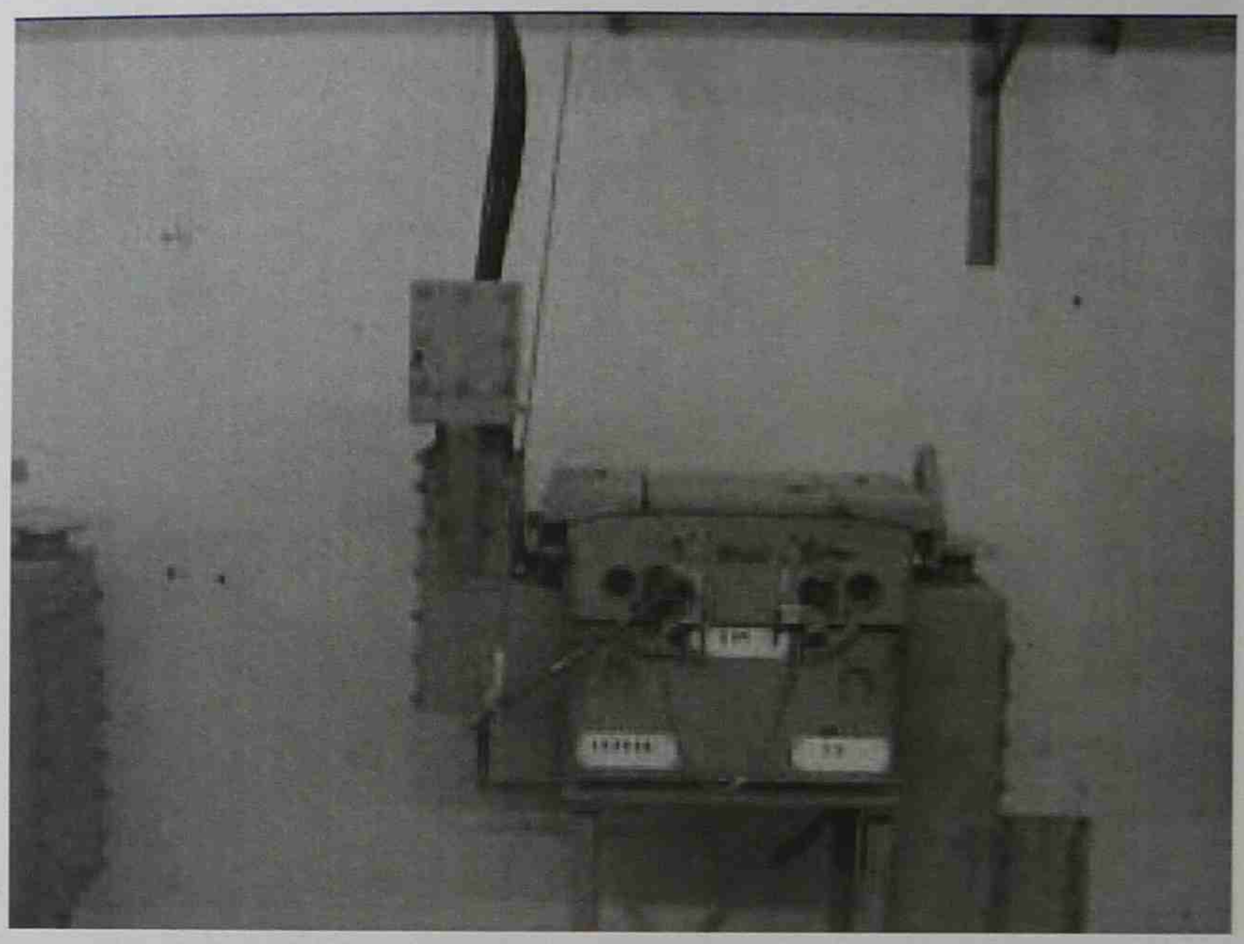
7.2 High Voltage Switches

High voltage switches can be easily put into two categories:

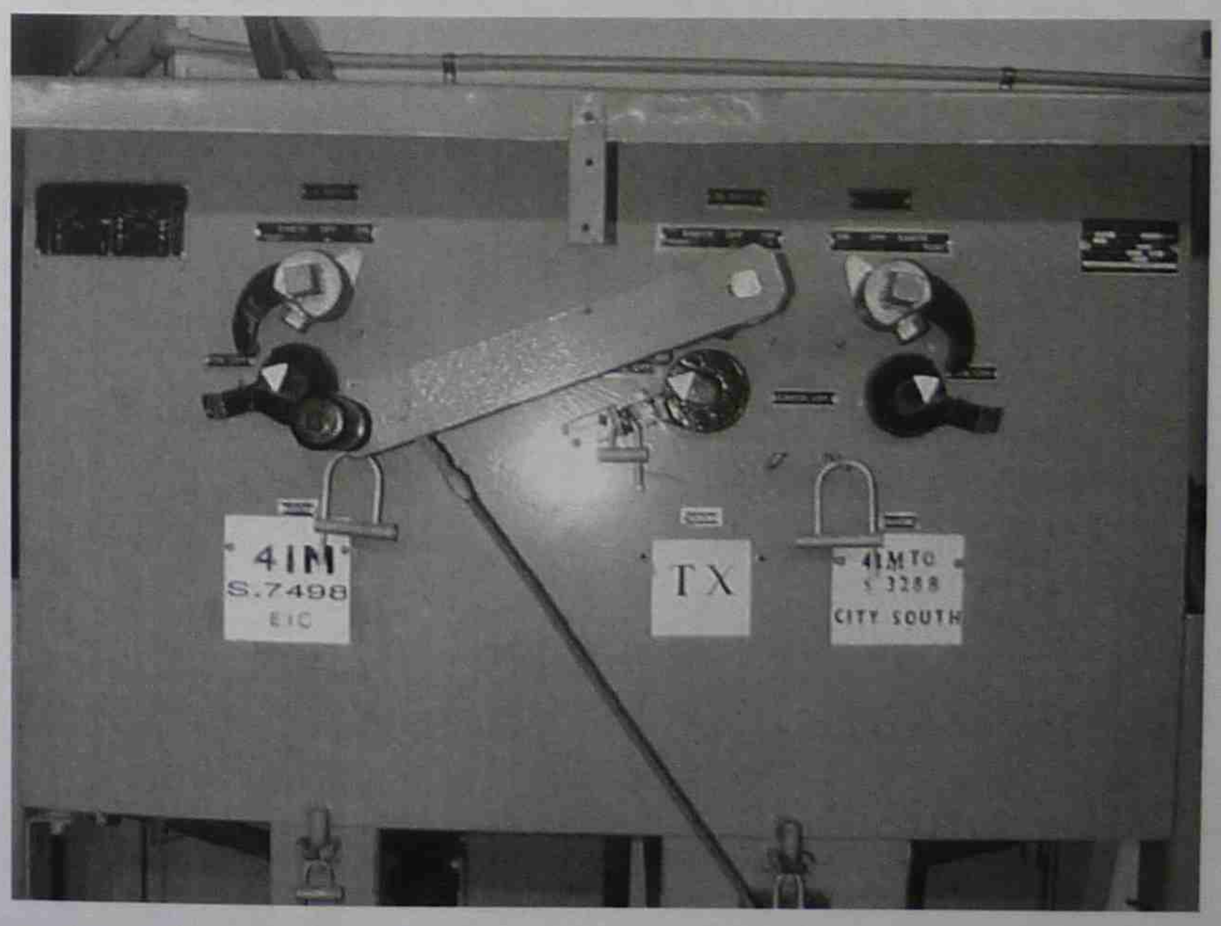
(a) I&E Switches or Isolating and Earthing Switches

The feeder cable enters on one side of the switch and the transformer is connected to the other side of the switch.

One type of I&E Switch is the B&S (name of manufacturer) which can open and close only load current. The feeder must be de-energised before attempting to reclose the switch.



(b) RMI Switches or Ring Main Isolators

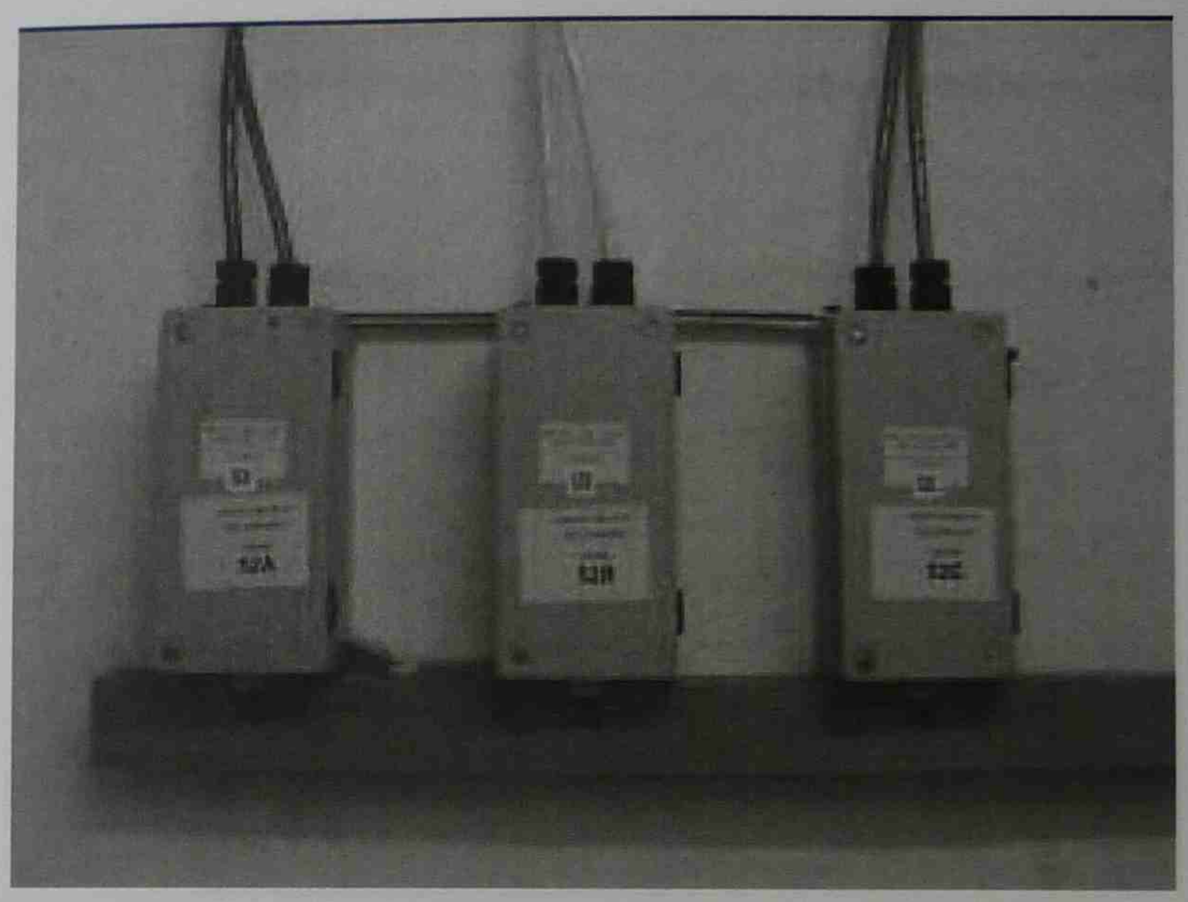


The feeder cable enters on one side of the switch and leaves from the other side with the transformer tapped off the centre through a its own switch.

This allows power to be fed from either side or through the switch, meaning it is possible to draw power from an alternate zone or feeder and maintain supply.

7.2.1 Buchholz Pilot System

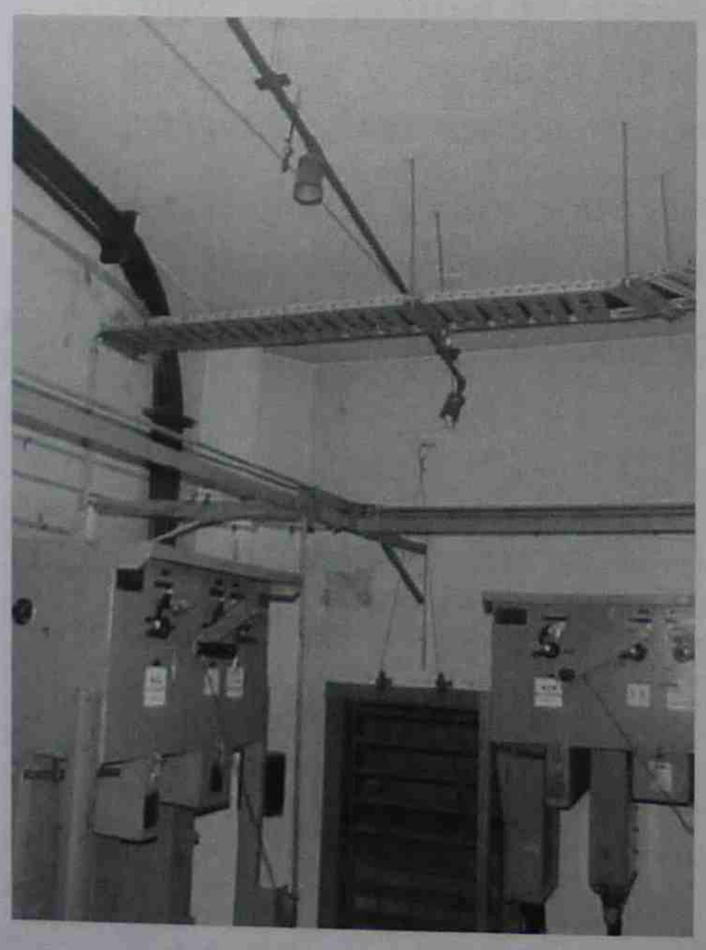
All HV switches in city distribution substations are not designed to break fault currents so a trip is sent to the zone via the 'Buchholz pilot cable to trip the 11kV feeder circuit breaker at the zone substation.



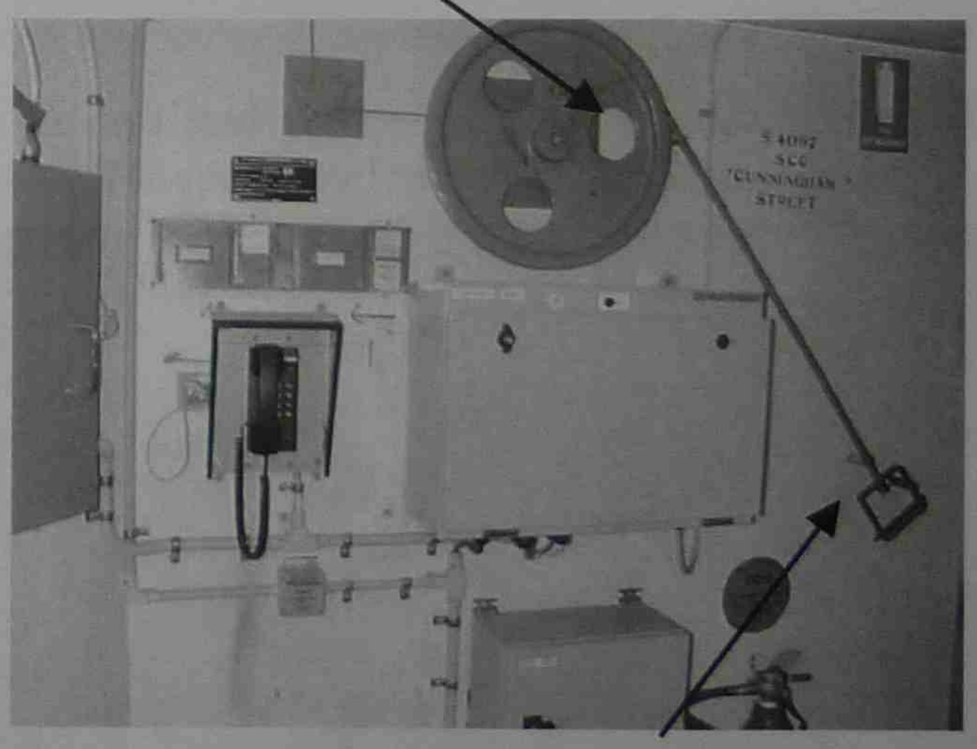
Buchholz pilot boxes that take the trip to the Zone substation

7.2.2 Pull out Gear

The cable connects to the control arm of the high voltage switch and if there is an emergency in the substation requiring all high voltage to be isolated, the handle is pulled the length stated on the handle, isolating all three HV switches.



Pull out gear wheel



Pull out gear handle

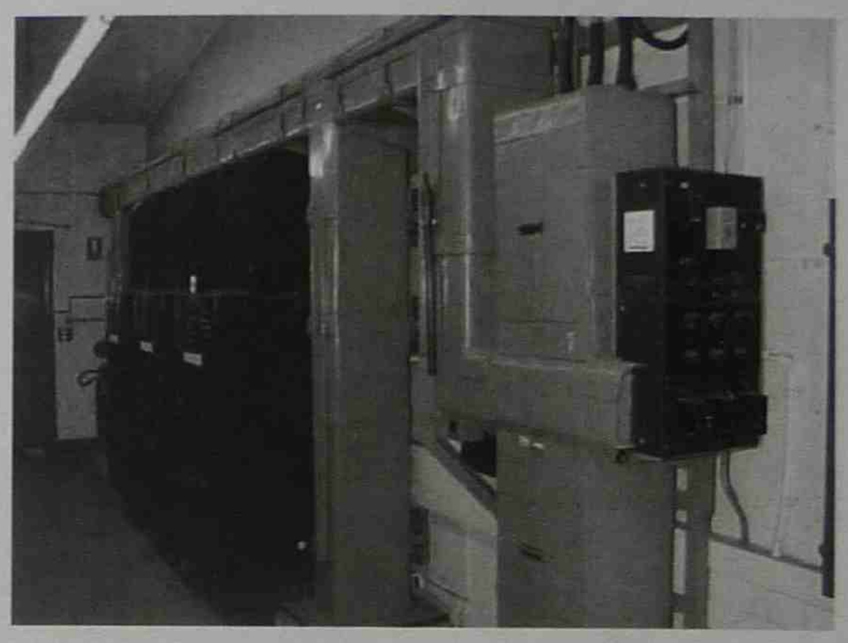
7.3 Low Voltage Switchgear

There are many different types and styles of low voltage switches in use in the City Distribution substations but all fit into one of two categories.

7.3.1 Network Protectors

A network protector is a circuit breaker with internal sensing and relays. The relay detects power flowing in the reverse direction (ie- back into the system) and trips that network protector.

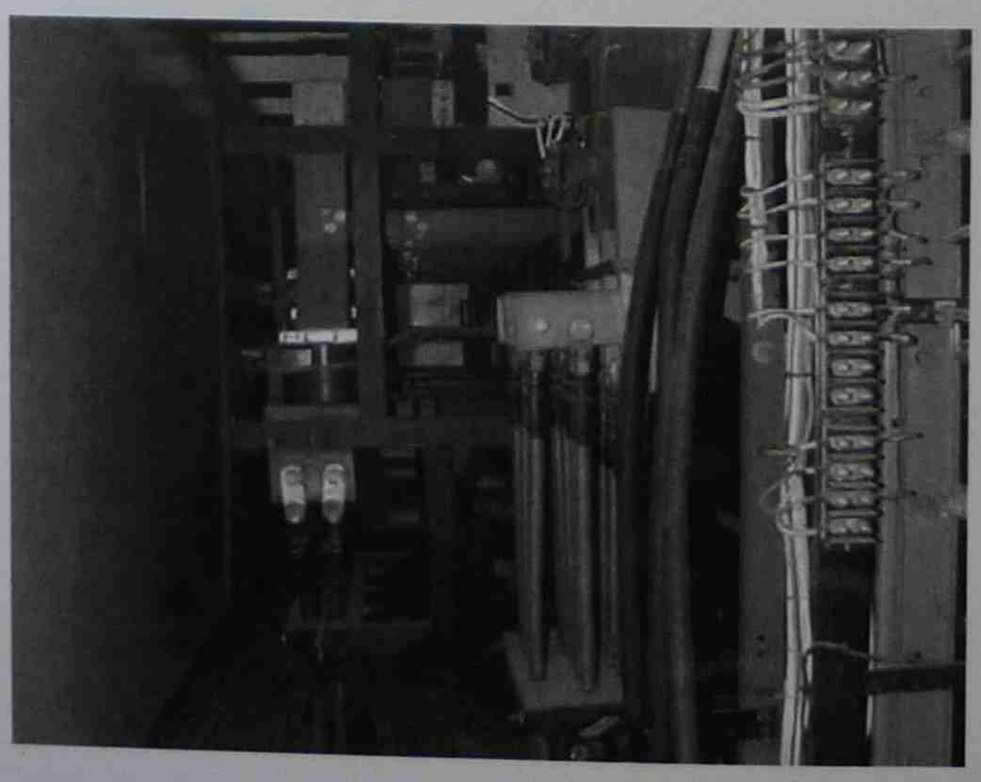
The network protector can also be tripped via the normal external forms of protection.

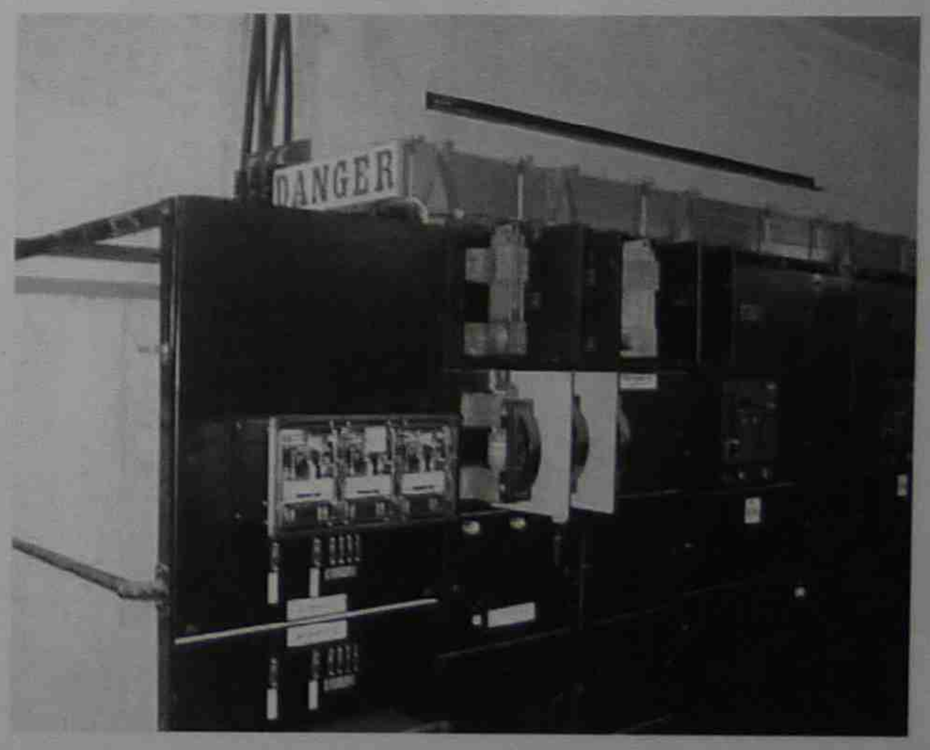


7.3.2 LV Circuit Breakers

Use only the normal external forms of protection to trip the circuit breaker but are also connected to the 11kV feeder circuit breaker at the zone. The 110V zone battery volts are connected through feeder circuit breaker pallets, through the Buchholz pilot cable to a pilot interlocking relay at the distribution substation. The 'PIR' is energised by these volts and allows the circuit breaker to close and applies trip volts when zone circuit breaker opens de-energising the 'PIR'. This prevents power reverse feeding from low voltage into any system faults.

These circuit breakers are always air insulated and can be found in cabinets much like network protectors or built into a 'H-type' panel as shown in these photos.





Important **H-Type substations have many exposed LV busbars and connections. All screening and minimum safe working rules must be followed.**

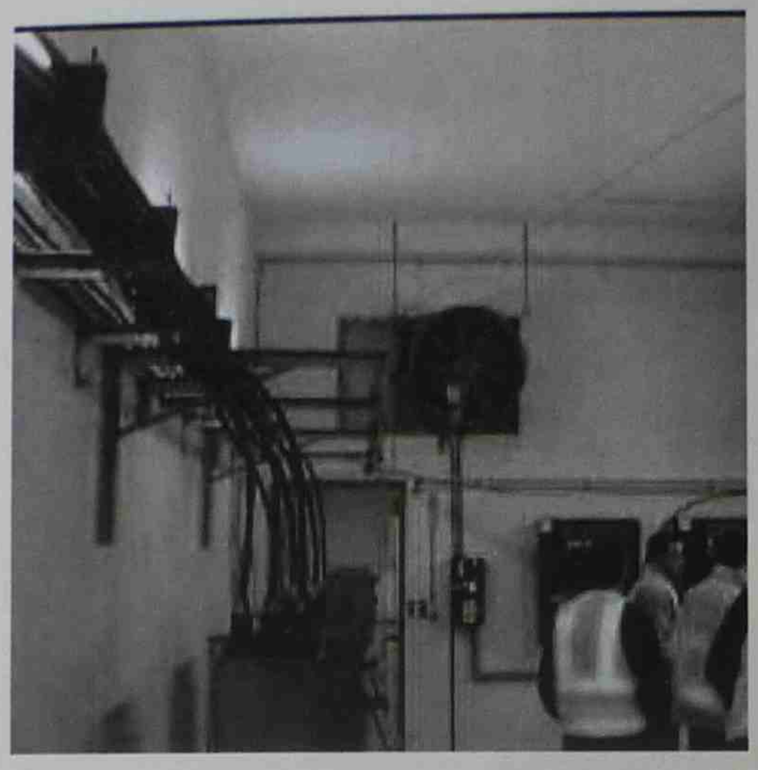
7.4 Fans

The two transformers (usually) furthest from the fan contain thermals, which turn the fan on. They operate when the skin of the transformer reaches 60 degrees Celsius.

The fan is fitted with a vane, which detects air movement, and it connects to a fan failure relay, which sends a signal to the control room if the fan fails.

The fan failure relay operates for poor air movement or loss of fan supply.

All fans can be manually operated with the control switch on the fan panel.



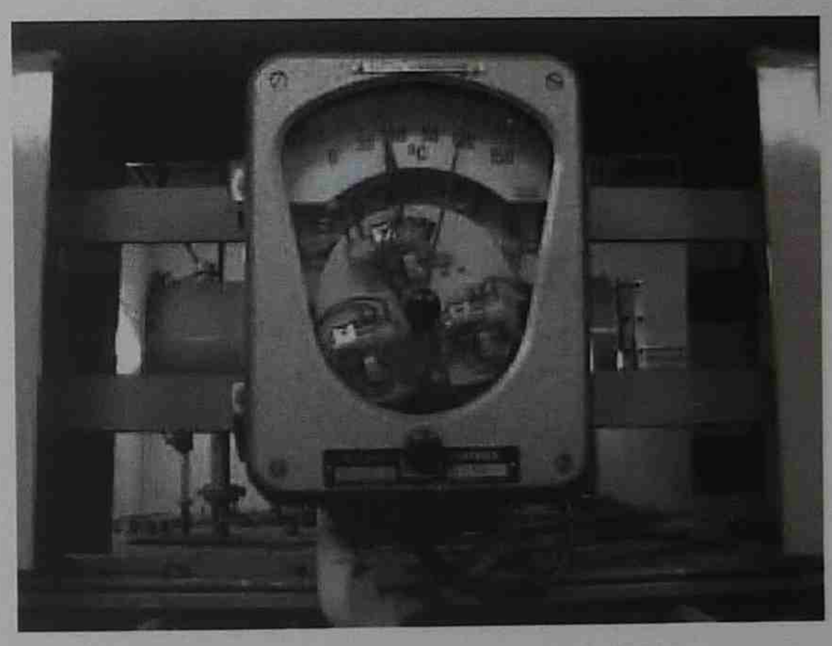
7.5 Other Signals

(a) Water Float

Excess water in a city substation is pumped into a water truck and filtered at Pyrmont Sub-transmission substation before discharging into sewer.

(b) Thermals

Sends signal at transformer temperature of 90 degrees. If Transformer is overheating the situation is investigated and extra fans or load shedding may be required.

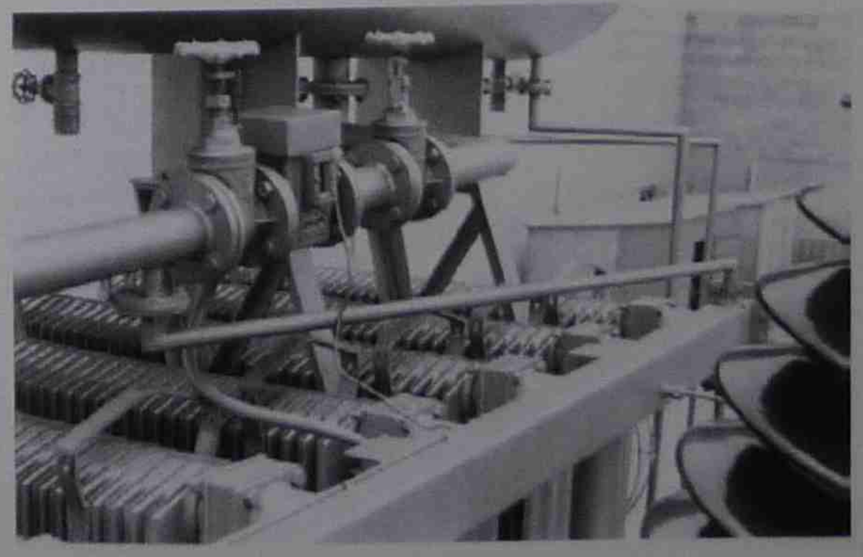


(c) Floodgate

The old underground substations are fitted with floodgates to stop substation flooding. Signal is sent when float operates the floodgate.

(d) Low Oil

Operates off (Buchholz) Relay when oil level drops in Transformer. This can also indicate an accumulation of gases from arcing inside transformer.



7.6 Fire System

All substations contain portable fire extinguishers.

Some city distribution substations have a CO^2 box on street level where the fire department can inject CO^2 to flood the substation.

Above the transformers a wire system with thermal links connects to the air vent shutters, cutting off airflow in event of fire.

8. Voltage Recognition

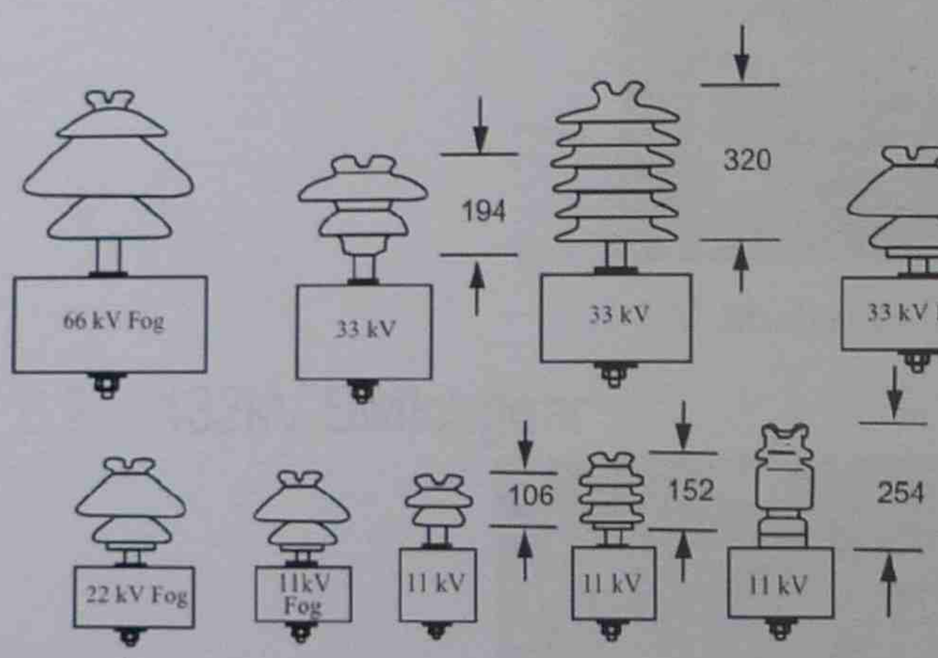
Although conductors are commonly referred to as high voltage conductors and low voltage conductors, this terminology is misleading because there is no difference between the conductors used on high and low voltage circuits. High voltage refers to a voltage normally exceeding 1000 V. Low voltage refers to a voltage not normally exceeding 1000 V.

All domestic appliances and the majority of industrial equipment operate at low voltage.

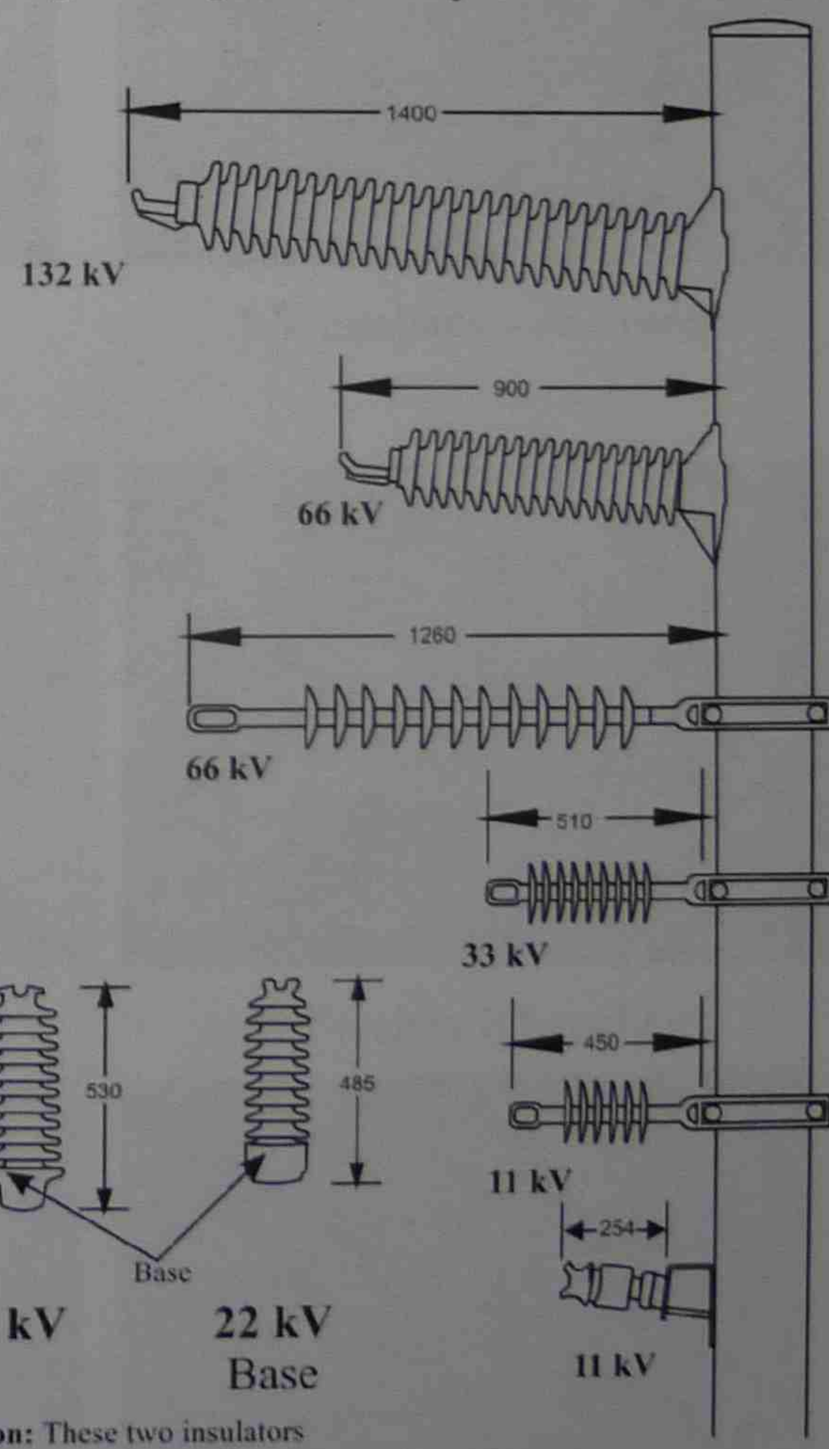
The difference is in the insulation of the circuit. Bare overhead line conductors are supported on porcelain or glass insulators, and the size and shape of the insulators can determine the voltage of these circuits.

The following contain pictures which can be used to assist you in determining the voltage levels of the equipment you may be working near.

High Voltage Pin Insulators

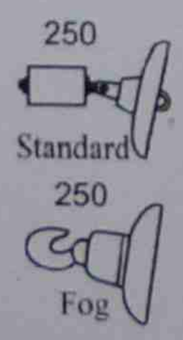


High Voltage Post and Synthetic Insulators



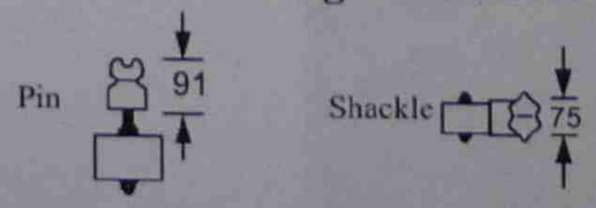
Caution: These two insulators look very similar.

High Voltage Disc Insulators



Line Voltage	Number of Discs
11 kV	1 or 2
22 kV	2 or 3
33 kV	3 or 4
66 kV	5 or 6
132 kV	8 to 14
330 kV	18 or more

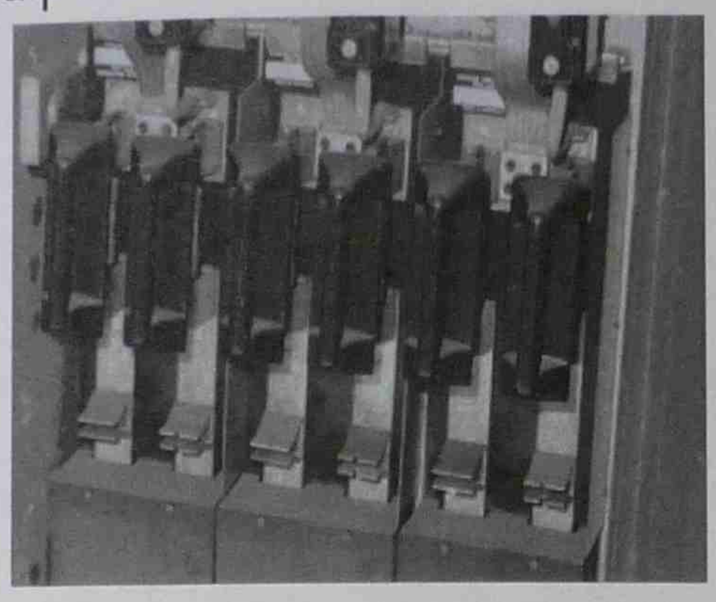
Low Voltage Insulators



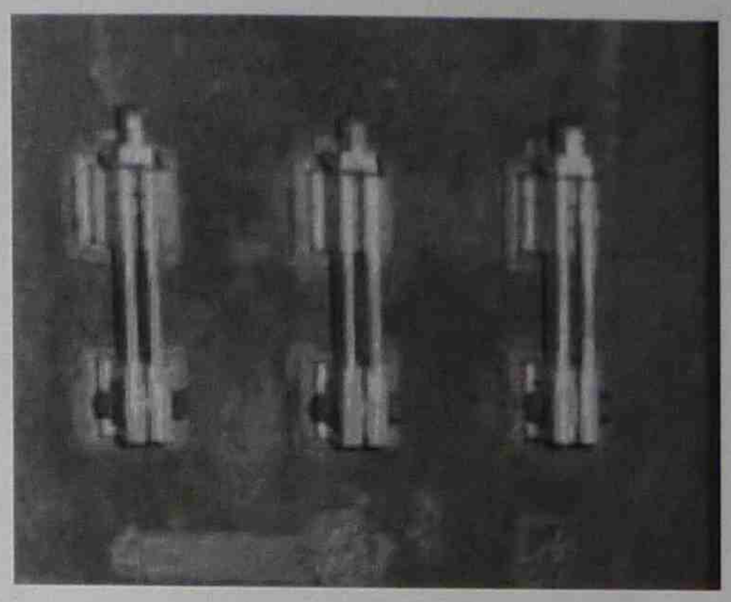
All dimensions in millimetres

All dimensions in millimetres

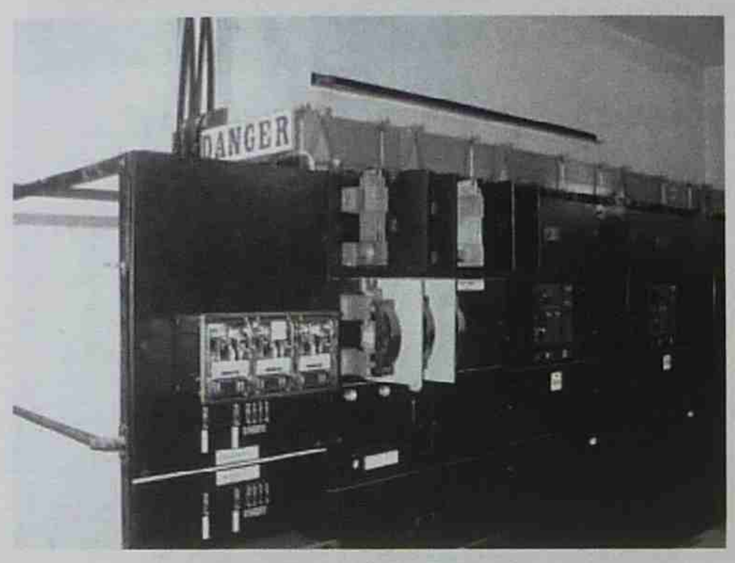
8.1 Low Voltage Equipment



LV fuses



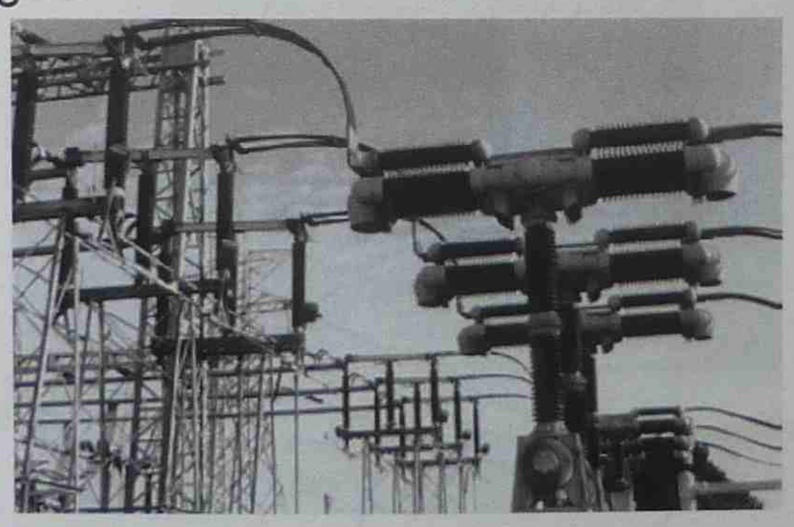
LV links (one type)



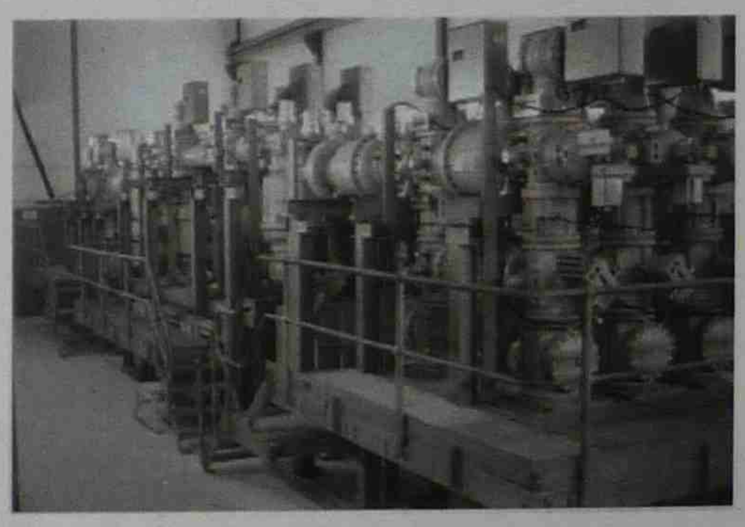
LV busbars – exposed

LV busbars – enclosed

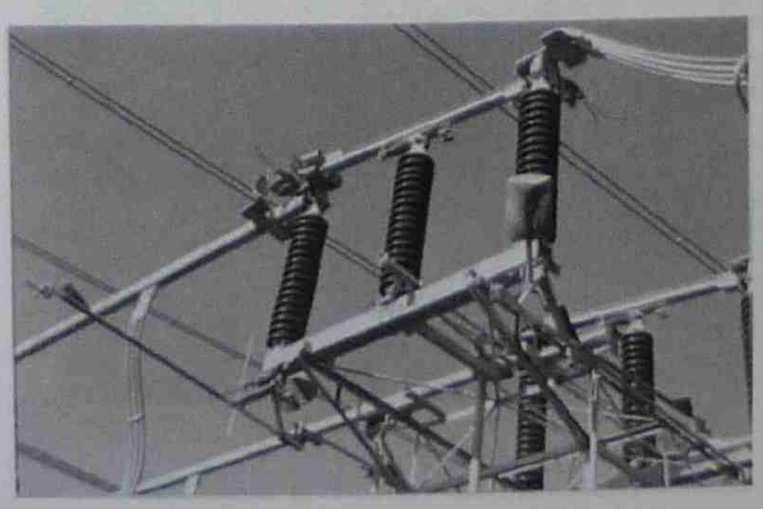
8.2 132kV Switchgear



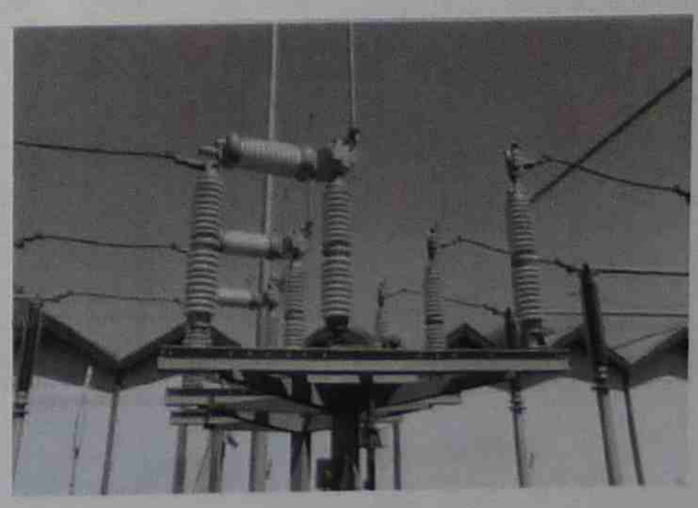
Air blast circuit breaker



SF6 circuit breaker



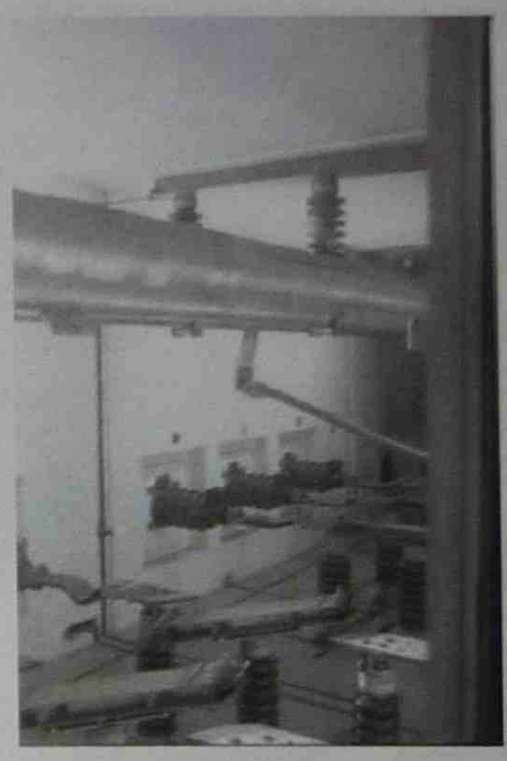
Air break switch



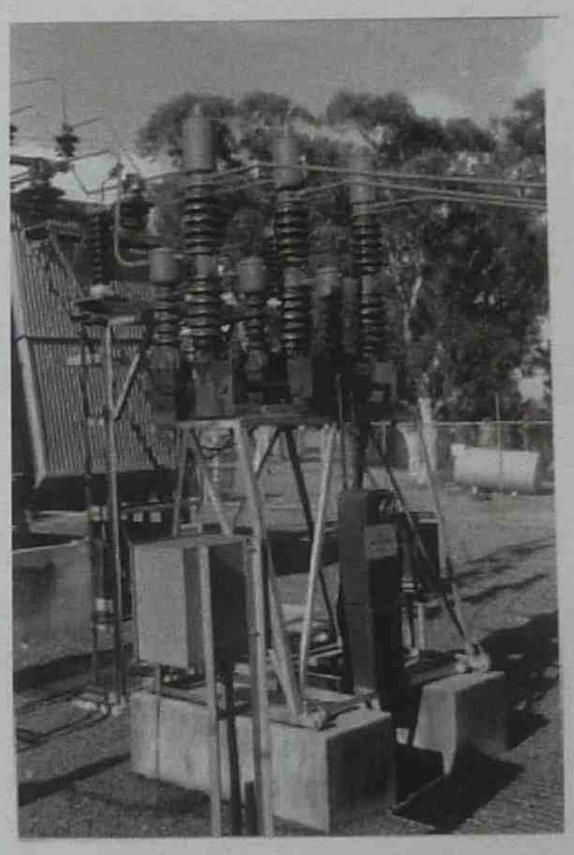
Circuit switcher

8.3 33kV Switchgear

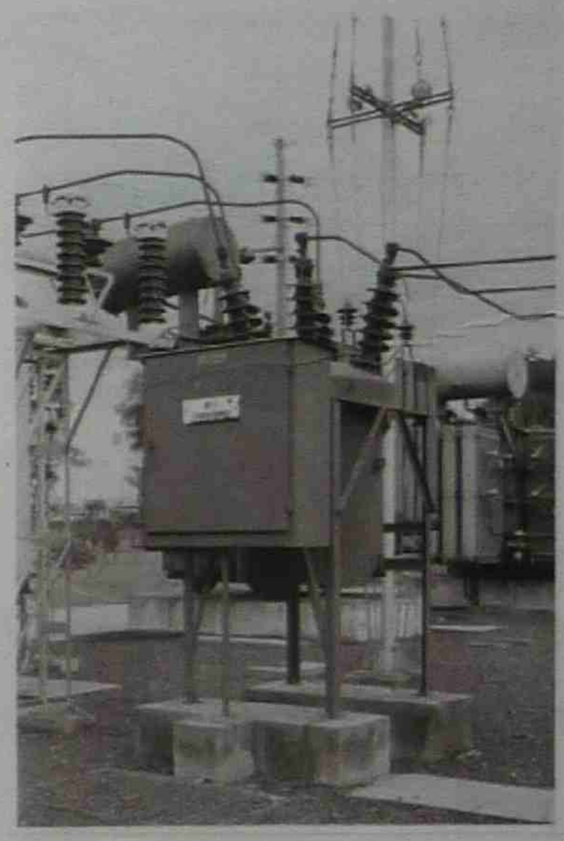
Indoor SF6 circuit breaker



Air break switch

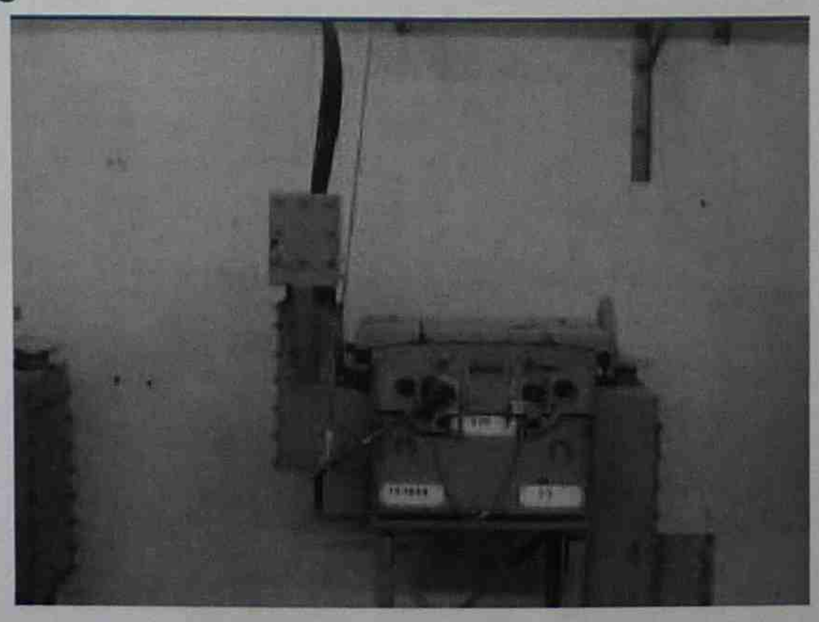


Minimum oil circuit breaker



Bulk oil circuit breaker

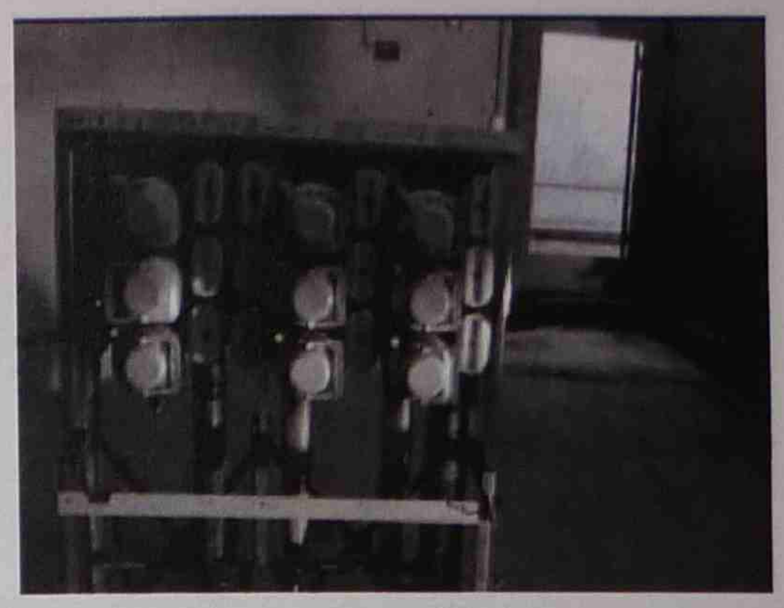
8.4 11kV Switchgear



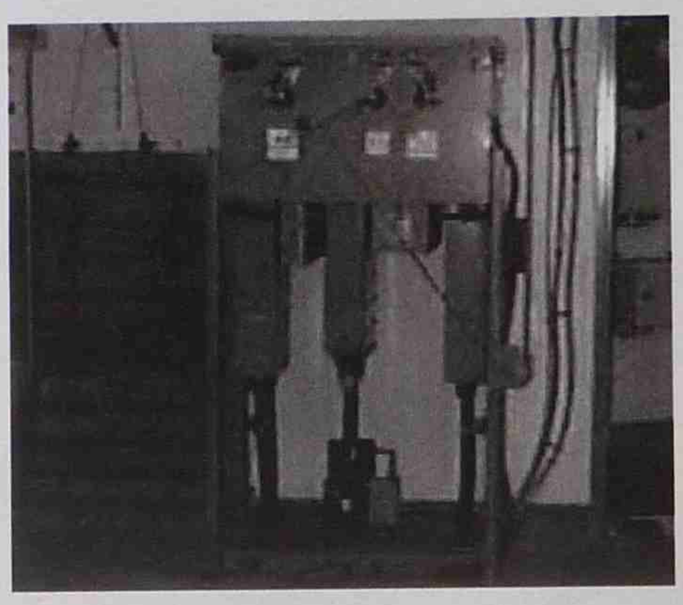
Isolating and Earthing Switch

Fuse switch

Metal clad



Magnafix



Ring Main Isolator

Cubical

8.5 415/240V Switchgear

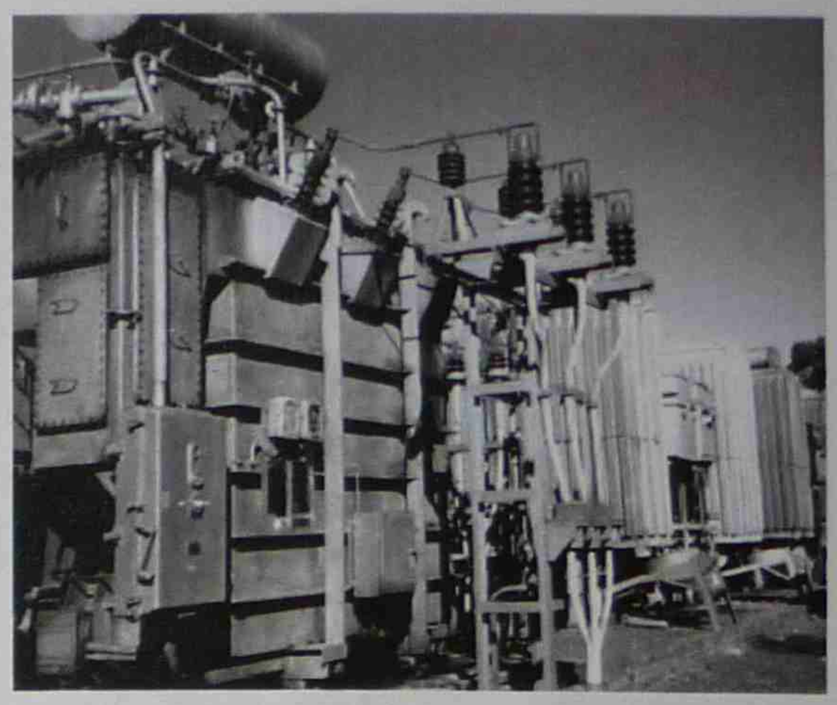
Network protectors

ACB H-type board

Typical Air Circuit Breaker

8.6 Transformers

Sub-transmission 132kV to 33kV



Zone with exposed bushings 33kV to 11kV (can be 132kV to 11kV)

Zone with end boxes 33kV to 11kV (can be 132kV to 11kV)

Distribution with end boxes 11kV to 415/240V

8.7 11kV Miscellaneous Equipment

Capacitor Cage

Used for power factor correction.

Cage is locked. Must wait 10 minutes after de-energising before entering.

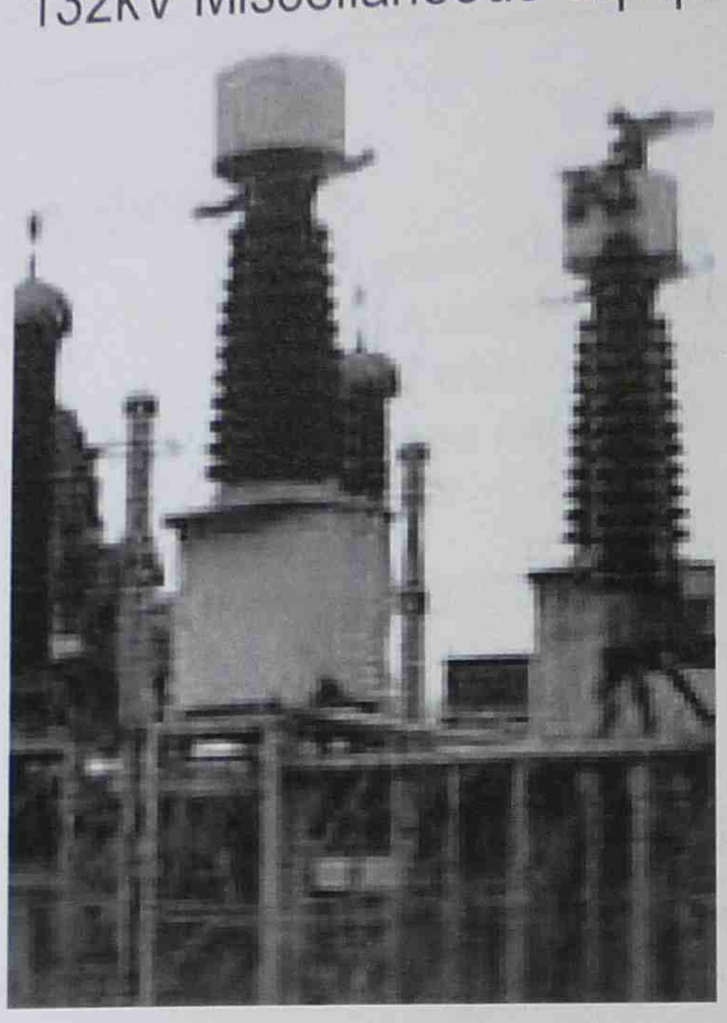
Capacitors earthed both sides.

Frequency Injection Unit (FIU)

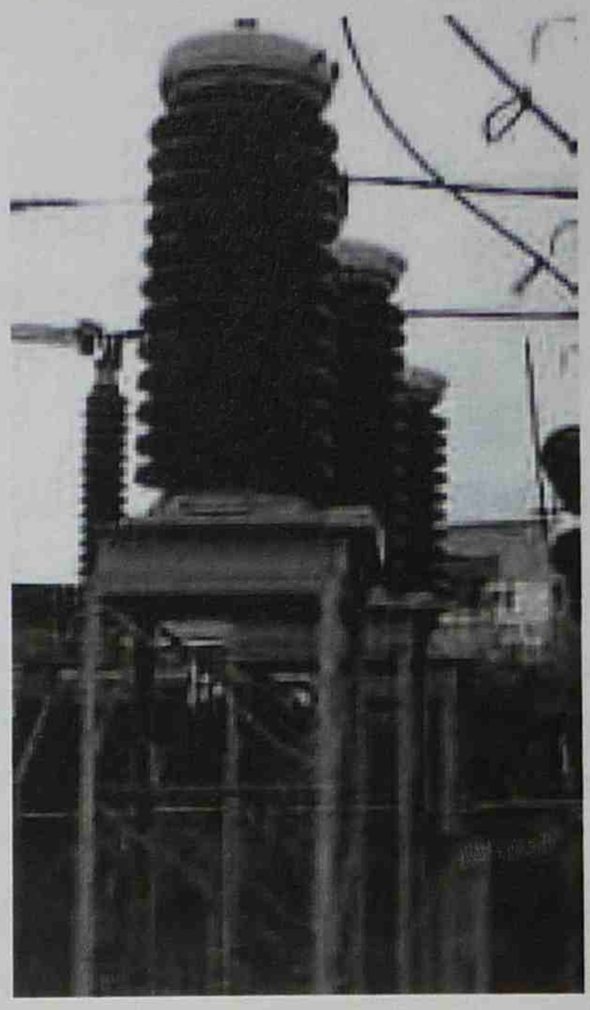
Hot water control can be done with a time clock but frequency injection is also used.

This equipment sends a high frequency signal at low power to turn the off peak hot water on and off.

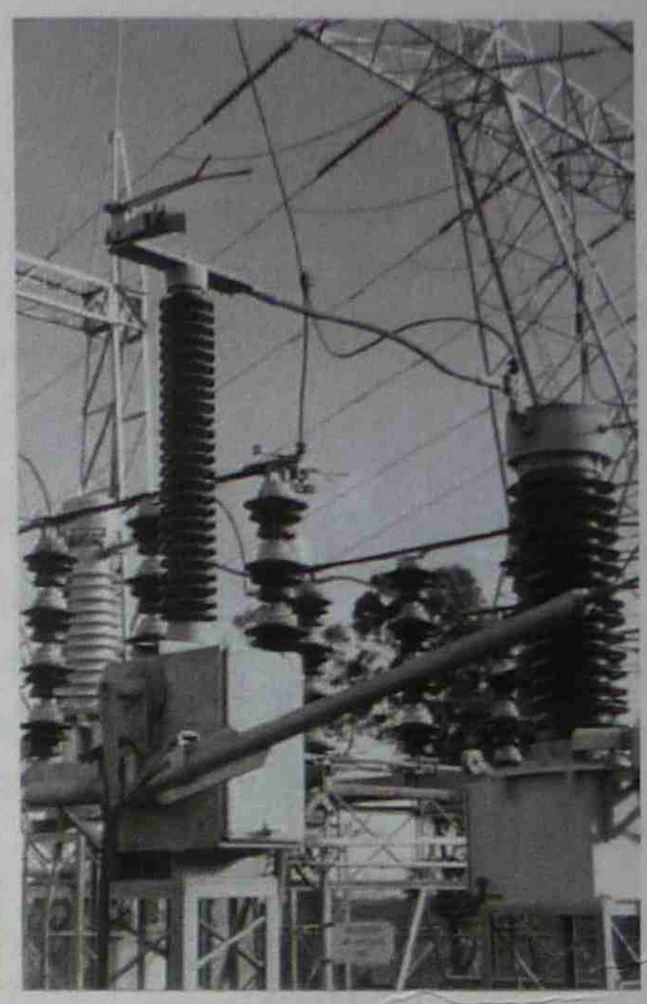
8.8 132kV Miscellaneous Equipment



Current transformer

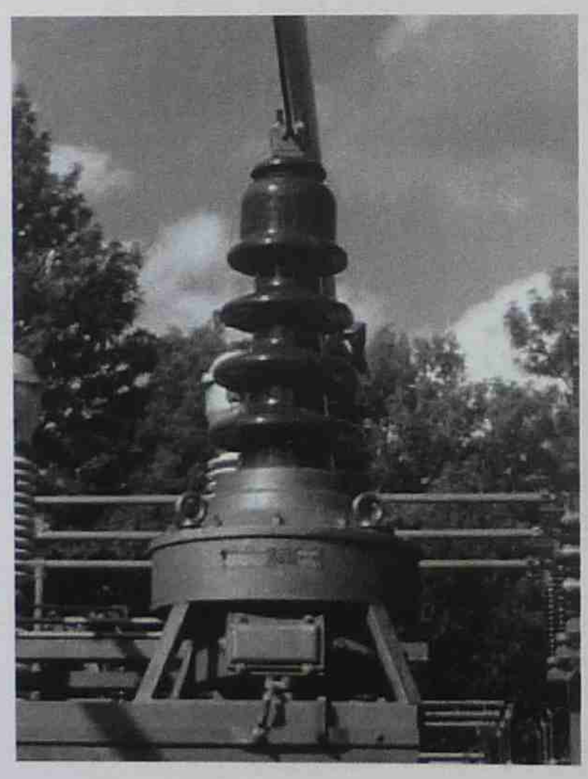


Voltage transformer

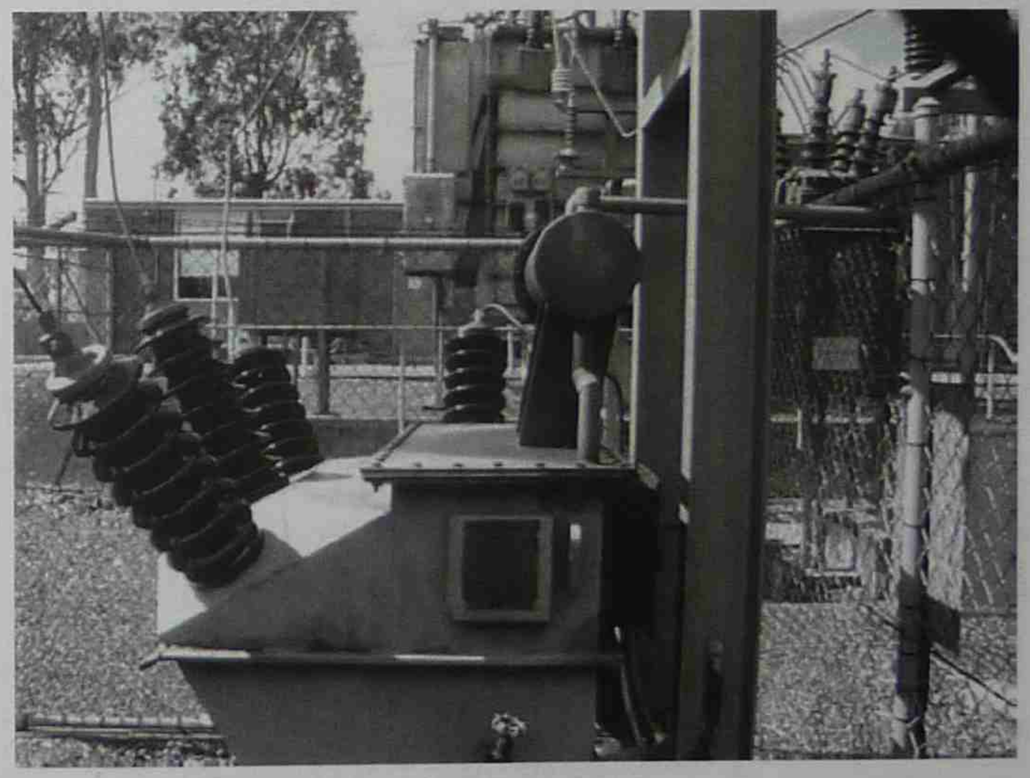


Fault thrower

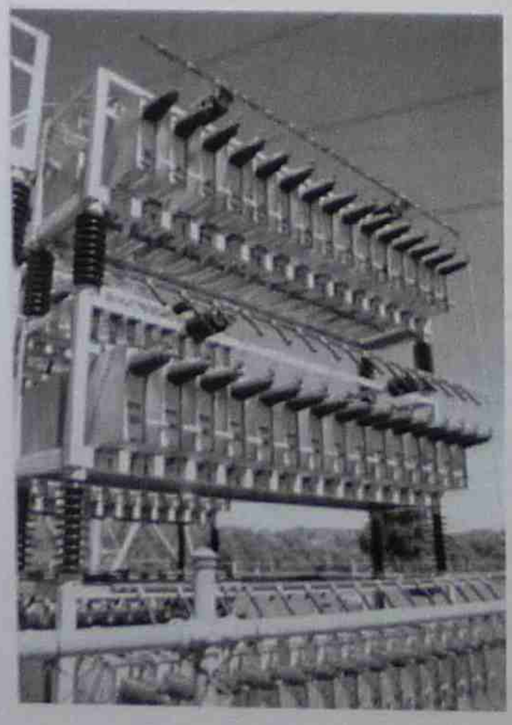
8.9 Miscellaneous 66kV or 33kV Equipment



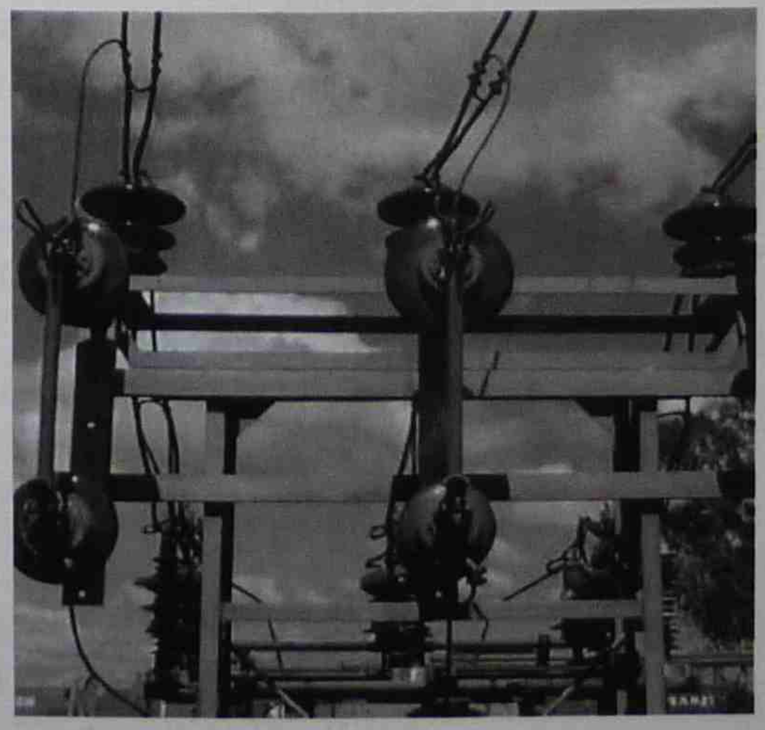
66kV voltage transformer



33kV voltage transformer



Capacitor cage



Drop out fuses

Reactor

9. Work Site Requirements

9.1 Authorisation

You must have (on site) your EnergyAustralia Network Passport, or an EnergyAustralia Authorisation Card with current authorisation recorded for all relevant training. You must not work on or *near exposed mains and apparatus*, unless you are qualified, as specified in EnergyAustralia's Network Management Plan.

9.2 Low Voltage Rescue Kit/First Aid Kit/Electrical Safety Rules

A Low Voltage Rescue Kit must be located on-site before commencement of the works. The kit must be easily accessible to all persons working on the site. You must have a first aid kit and copy of Electrical Safety Rules on site and they must also be easily accessible to persons working on the site.

Note: Work in Confined Spaces, work on poles, towers or from an EWP require appropriate emergency rescue kits on site.

Associated Rules	**ESR No**
First Aid Kits	4.1.3
Emergency Rescue Kits	4.1.4

9.3 Appropriate Clothing

9.3.1 In General

Clothing must comply with AS 2919 *Industrial Clothing* and have flame-retardant properties not inferior to cotton drill. Synthetic materials (eg as used in high visibility vests) must have flame retardant properties not inferior to Category 1 materials of AS/NZS 1249.

Note that hard hats, safety shoes, long sleeve work shirts, and long work trousers are to be worn at all times on designated construction sites, and as required by the Electrical Safety Rules.

Footwear must comply with AS/NZS 2210.3 *Occupational protective footwear – Specification for safety footwear*, and have the Standard compliance symbol marked on the footwear.

Rules on Appropriate Clothing	**ESR No**
Safety Clothing and Personal Protection	4 and 4.3
Safety Clothing not Insulation	9.5.2
Insulating Glove	4.1.2

9.3.2 Special Conditions in Switchyards or as Directed

All persons working in a substation around underground cables must wear rubber boots and gloves complying with AS 2225 *Insulating Gloves for Electrical Purposes*. They must be worn while operating any power tools such as sawcutters or jackhammers.

For work situations other than as indicated above, unless wearing of insulating gloves is specified by the EnergyAustralia Electrical Safety Rules or the Contract

Manager, persons may determine whether or not to wear gloves on a case by case basis as part of the hazard assessment process. In the hazard assessment, consideration shall be given to the likelihood of sweaty hands inside insulating gloves causing uncontrolled hand tools to injure the user or to strike other workers on site or to come into contact with live busbars or other equipment.

Insulating gloves will not protect a worker from the dangers of high voltage cables, but should protect a worker from hand contact with low voltage, such as from low voltage control cables or yard light and power cables. The Contract Manager may be requested to determine the types of cables in the area to be excavated.

9.4 Ladders

Only portable ladders made of non-conductive materials such as fibreglass or timber must be used for work on or near live electrical mains and apparatus. Conductive ladders, including ladders made with wire-reinforced stiles, must not be used for work on overhead lines, except for lines, which are supported by steel towers. Conductive ladders must not be brought closer than the appropriate minimum safe working distance to exposed live mains and apparatus. Timber and fibreglass ladders which have metallic components such as brackets, rungs or platforms, these metallic components must not be brought closer than the appropriate minimum safe working distance to exposed live mains and apparatus.

Portable metal ladders or wooden ladders with wire reinforcement must not be used in substations. Special purpose ladders approved by the Contract Manager are excepted, provided their usage complies with the requirements of the Electrical Safety Rules.

ESR No	4.1.10

9.5 Fall-Arrest Equipment

Any person working or climbing where there is a risk of falling 2 metres or more must be attached at all times with approved fall-arrest equipment. This includes all work in elevated work platforms, or on poles, towers, awnings or other structures. Fall-arrest equipment is also required for fixed ladders where the slope exceeds 70°, includes transformer ladders, pole transformer ladders and underground substation ladders.

ESR No	4.1.1

9.6 Safety Equipment

You must check all safety equipment before use to make sure it is in good condition and safe to use. Any safety equipment, which is not in good condition or is considered unsafe, must be replaced before commencing work.

ESR No	4..2

9.7 Measuring Tapes

Metal measuring tapes or fabric measuring tapes with a metal reinforcing thread are conducting objects. Use these tapes only where you can maintain minimum safe working clearances. (ESR 6.10)

ESR No	6.10

9.8 Storage of Materials

When materials are left in an area which contains exposed conductors then they will be placed away from the equipment. Do not block doorways, obstruct passages, prevent normal operation or work or bloc access to fire extinguishers, telephones, control switches and other operating equipment.

This is just good house keeping.

ESR No	6.11

9.9 Work Benches and General Tidiness

Work benches or work areas must not be set up where they will obstruct passageways, entrances, exits or access to in service equipment. Drill bits, pieces of pipe, rod, leads, ropes, slings or similar items must not be left on the floor or anywhere where someone may trip over them during normal movements about a substation.

9.10 Unanswered Questions

If you have any unanswered questions, DO NOT START WORK. If you have any doubts about the safety of your work or the work site you must request further information from the person in charge. The Electrical industry is one where you DO NOT GUESS.

ESR No	6.5.3

10. Substation Entry Checklist

When entering a substation there are several things you must first check for:

- Entry
- Exit
- Lights
- Fire Extinguishers
- Battery *(if available)*
- Exposed Conductors
- Hazards
- Phone *(if available)*

Note: You must check all safety equipment before use to make sure it is in good condition and safe to use.

If there are any doubts about the safe performance of any work that has been assigned to you on or near live exposed conductors, you must request further information from the person in charge of the workgroup. (Refer ESR 6.5.3)

10.1 Entry Requirements

10.1.1 Are you at the Right Substation?

Always get the substation number as well as the address. Many substations have similar addresses, for instance Kent and Market Streets in the city has eight substations on its corners with similar uses of the street names.

The only sure way to identify a substation is to check the substation number on the door, hatch or substation entryway. These numbers are individual to each substation.

10.1.2 Related Electrical Safety Rules

Associated Rules	**ESR No**
Authority to Enter	6.6
Special Requirements for Persons not Authorised	6.6.1
Stand-by Person	2.1
Entries and Exits	6.6.2

10.1.3 Special Requirements for Authorised Stand-by Person

Before entering a substation or switching station, an EnergyAustralia *stand-by person* must instruct all unauthorised personnel of the hazards that exist, the precautions that must be observed, and any areas that they cannot enter.

A *stand-by person* must be equipped and capable of carrying out rescue and resuscitation procedures in an emergency, *de-energise* the appropriate *live mains and apparatus* if the control mechanism is at the site and communicate with the control room to remotely *de-energise* the appropriate *live mains and apparatus* if the control mechanism is remote from the site.

10.1.4 Giving Access to Premises

Do not admit any person to any part of a substation or the network without proof of identity, authorisation and qualification – and unless they are wearing appropriate protective clothing, PPE and identification tag.

District Operators must not issue Access Permits to persons without proof of identity, qualification or authorisation.(ESR Clause 12.3.1)

Individuals who may be at risk or who may pose risks on work sites must be accommodated in the risk assessment (HAC) process.

In addition the following should be remembered:

Substation doors and gates must be closed and locked when not in immediate use.

Substation security issues must be reported to the Security Section. (refer Clause 20.4).

Do not admit any person to an EnergyAustralia facility without proof of identity, authorisation and qualification. This includes buildings, training areas, transport workshops, laboratories, test facilities, pole stores, construction sites and depots housing dangerous goods stores and magazines.

10.1.5 Duties of the Authorised Person on Entry

As you go into a substation or switching station, the *authorised person* must carry out the following duties, depending on the layout of the installation:

- at a surface substation; ensure that any alternative exits can be opened easily and are not obstructed.
- in an underground or basement substation with two entrances; open both entrances.
- at a substation with only one entrance and an emergency exit; ensure that the entrance is secured open and check that the emergency exit can be opened and is not obstructed. In the case of brief entries for inspection you do not have to check the emergency exit.

When entering a substation, **everyone is responsible** for taking notice of all warning signs and any associated instructions, noting the locations and condition of equipment (Including lights, fire extinguishers, batteries, exposed conductors, screening, phone and access permit taped areas) and accessing site hazards.

Always notify the *Area Operator of:

- any audible or visual alarms, and the operation of any protection relays.
- unusually high air temperature - this may indicate electrical overload or a ventilation problem.
- any other dangerous condition; such as unusual noises, abnormal electrical discharges, oil spills, or open trenches.
- any limitations on the operation of electrical apparatus, either during the work, or on completion of the work.

*Phone numbers are found near the substation phone, if available, or in the 'phone numbers for emergency aid' in the front of the EnergyAustralia Electrical Safety Rules book.

10.1.6 Key Codes and Functions

All Zone and Sub-transmission substations and all new substations have new locks. Distribution Substation changeover has begun but old locks still exist at this level. To be issued a key other than an amenities key, staff members or contractors will need to have completed the Substation Entry course and have their training passports stamped for Substation Entry. All associated training must be current (within the last 12 months).

Code	Function	Replaces
A000	Exclusive access to substations, cable risers (where they give access to live substation areas). Secure all live or operating equipment and control equipment except as below	A2, A3, SK, SKN, SS, PS
AA0X	Shared access. (eg where Customer meters are located in EnergyAustralia sub)	SKON
AB0X	Contractor lock. For temporary installation where contractors have been granted access to a substation or substations for an extended period of time.	SKN/C
AC0X	Substations where telcos have been granted permission to install and maintain equipment	(new)
AD01	Air break switch handle lock	SKN, A2
AD02	Amenities. For access to showers, toilets etc in substations and general access by suitably authorised persons to substation areas that are separated from live exposed equipment. This key also gives access to easements access tracks, SLCPs etc.	A1, PLN, PLKT, PL
BA01	Operating switches, handles or buttons Note both large and small padlocks are available	OP1, OP2 OP3, A4,
BA02	Switches which can be operated by a person with limited operating qualifications (Tx tee switches in subs). Note both large and small padlocks are available	A4, OP3
BA03	Earthing equipment storage (in zone & distribution subs)	EL, ELN
BB01	Gas charging points for gas pressure cables (sub-transmission)	D116
BB02	Oil pressure cable monitoring points for oil filled or fluid filled cables (sub-transmission)	D139, M28, M440

Note: X above indicates a series of keys are available, eg AB01 through AB25 may be used for contractor locks.

The above codes will be marked on keys with a serial number unique to each key, which will also have a coloured dot.

Operator's locks will be installed on doors or switches where use is restricted to operators. Shutter locks shall continue to be used as at present, however, where a keyed lock is required, a BA01 (or BA02) lock shall be used.

Locations where access is restricted to District/Class 1 Operators (using BA01 locks) includes:

- Gates to HV cages in zone substation yards
- Feeder switches and bus sectionalising type switches in distribution centres

- RMI/RMCB's in kiosk substations
- Switches in single CB substations
- Ladders providing access to the top of transformers with bushing terminations
- Doors to rooms containing equipment which is only accessible with an access permit

Note: Class 1 operators restricted to certain geographic areas will be able to access BA01 locks (same as at present). The new padlocks have key retention, so that the padlock must be locked before the key can be withdrawn, so it is not possible to leave unlocked padlocks without a key in the keyhole.

Locations where persons are granted limited operating authority (using BA02 locks) includes:

- transformer control switches in multiple transformer substations that can be operated by persons with limited operating authorities.
- locations in certain areas of the Hunter where Class 1 authorities are issued to persons in order that they may issue access permits but where they are restricted in what operating work they may carry out.

Persons issued with a BA01 (or BA00 master) key will also be able to open BA02 locks but the reverse will not apply.

Note: 33kV indoor switch bays with individual keying for each bay are a special situation and will be considered separately.

Access to amenities (AD02): Where amenities such as toilets, lunch rooms, showers, telephone are provided in a substation, and access to them is possible without entering any of the restricted areas described above, they will be accessed using a AD02 lock or padlock.

Shared locations: In some substations, special locks granting access for limited classes of person as follows may replace the A000 locks. All of these locks may also be opened using an A000 key.

AA0*X* – where customer metering is located in an EnergyAustralia substation building, an AA0*X* lock shall be installed. Only the customer shall be issued with AA0*X* keys.

AB0*X* : Where a contractor is required to work at one or more substations for an extended period and safety observers or stand by staff are not provided, the locks and padlocks providing access to their approved access areas may be changed to AB0*X* lock.

AC0*X* – where telcos (Telstra, Optus, Powertel, etc) have been granted permission to install equipment in a substation, AC0*X* locks may be installed in order to ensure that they are restricted to agreed substations. **Note:** Telcos have already been given access to some areas in city zone subs, which require them to pass through live areas or cable basements etc.

10.1.6.1 Old Key System

Sydney Area: SKN and SK substation keys and Newcastle Area: A2 substation key. PLN, SKON, SKN-C, PL and A2 were the limited access keys.

10.2 Exits

All emergency exits appropriate to your work site should be checked on entry to the substation.

10.2.1 Duties When Leaving a Substation or Switching Station

Check the following points before leaving a substation or switching station:

- Clean up and remove all rubbish.
- Make sure you have accounted for all tools and materials. This is essential because if something has been left behind it could stop the protection from working. In substations with frame leakage busbar protection, take particular care that the intended earthing path is not accidentally short-circuited by tools or other equipment left in contact with switchgear panels.
- Make certain that all items, which have been removed during the course of work, such as chequer plates, covers and barriers, have been replaced. If you cannot replace these items, you must erect barriers or warning signs to prevent injury.
- Switch off normal and auxiliary lighting. This extremely important where the CO^2 fire points contain an indicating lamp connected to the lights. If the lamp is out the lights are on and the fire department assumes someone is inside and sends in a rescue crew. If the lamp lights then the lights are off no one is inside and CO^2 is injected.
- Check that all fire doors are closed.
- Check that entrances and exits are secured.

10.3 Lights

There must be sufficient light to complete your work. Should sunlight be considered sufficient, in an indoor situation, it is suggested that lights be turned on to give an indication of problems that may occur on the system.

Example: A car bringing down powerlines or system switching can cause momentary dimming of the lights and warn you of impending trips or work in your area.

10.4 Fire Protection Equipment

Different types of extinguishers exist in EnergyAustralia Substations to assist in a workers escape from a substation fire. Fire extinguishers are also required at field sites and on vehicles.

Australian Standard 1851.1-1995 *Maintenance of Fire Protection Equipment* sets out the requirements for keeping records, inspection and service criteria and maintenance schedules.

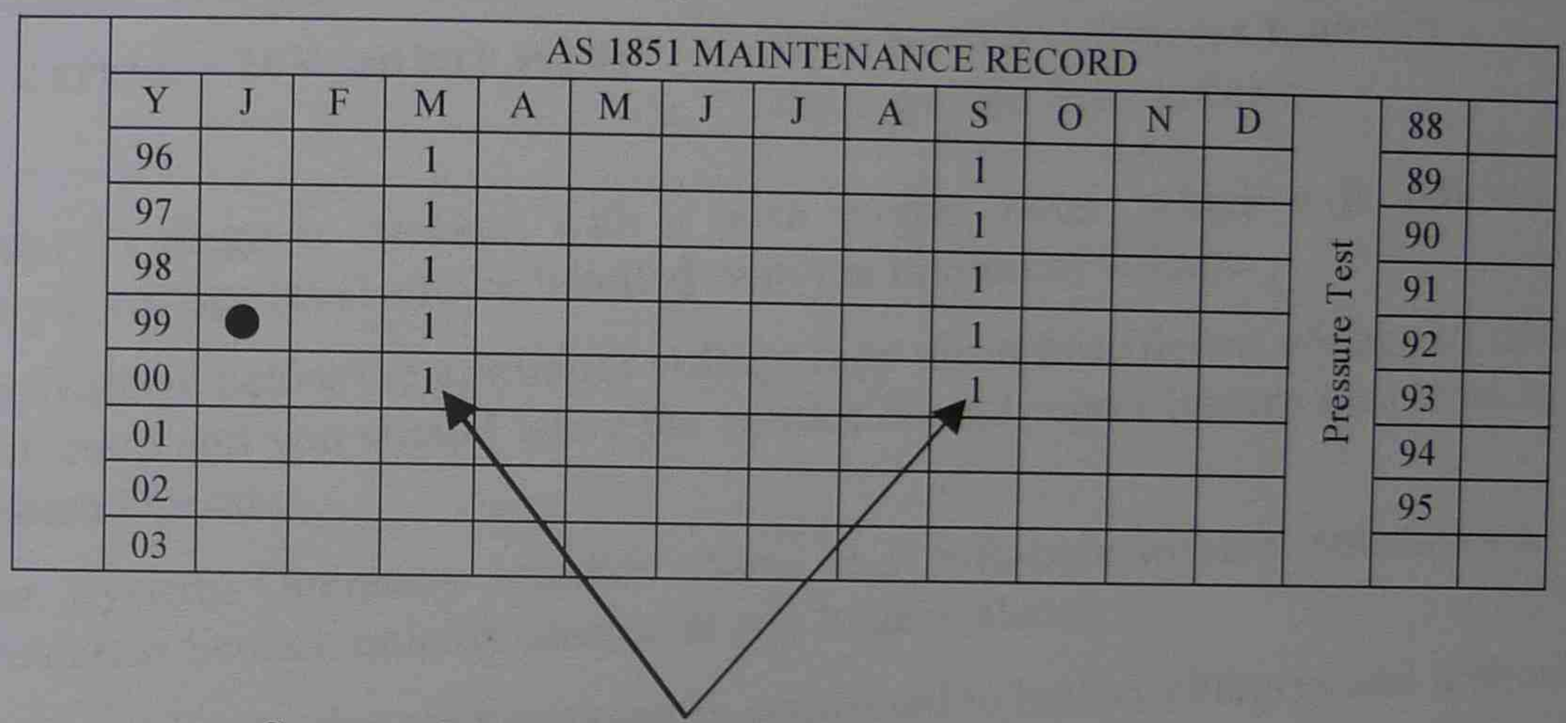
Maintenance of fire protection equipment kept on premises within EnergyAustralia depots is the responsibility of Enerserve's Projects and Contracts Group and/or Corporate Property and Insurance group.

Fire Extinguishers Pre-work Assessment

Item	Component or function	Action required
1	Accessibility	Check that the extinguisher is conspicuous, readily accessible and in its assigned location
2	Anti-tamper device	Check that the anti-tamper device is intact
3	Maintenance Record Tag	Check inspection date within six-month

10.4.1 Maintenance Record Tag

For Maintenance record tag purposes, the number '1' denoting the six-monthly inspection shall be stamped in the appropriate location for the month and year. The tag will be attached to each extinguisher.



Stamped No. 1 indicating service

Before starting work the extinguishers must be checked:

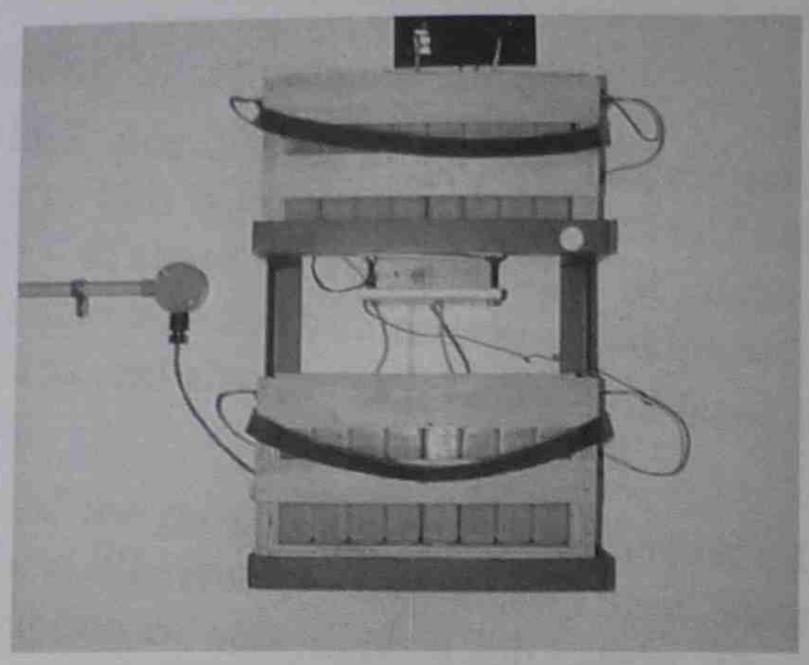
(a) Ensuring that the fire extinguisher is checked for inspection currency during the Pre-work Hazard Assessment Check.

(b) Reporting to your supervisor immediately where the extinguisher has been used or requires inspection.

ESR No	6.10e

10.5 Substation Batteries

Distribution Substations contain 20V batteries (safe range 18V to24V) or 30V batteries (safe range 27V to 35V).



2 crates – 20V battery set up

Push button voltmeter found in Distribution Substations

Battery voltage is checked with a push button meter, which will indicate the current voltage level and be labelled with the minimum voltage.

Any voltage below the minimum voltage may mean insufficient voltage to operate protection and you should leave the substation and report battery problems to the System Operator.

The System Operators monitor Zone and Sub-transmission substations, the Protection Section quickly attends to any battery alarms.

Note: All batteries are permanently connected to battery chargers and it should be assumed are always on charge.

ESR No	6.23

10.6 Exposed Conductors

Exposed means that a *conductor* is not effectively guarded or protected by one or more of the following:

- a fixed barrier of suitable material in sound condition;
- insulation adequate for the *voltage* and in good condition under a relevant Australian Standard;
- an *earthed* metal barrier;
- an *earthed* metallic or non-metallic screen;
- *low voltage* terminal shrouding that complies with relevant standards.

Exposed	2.1 Exposed

Any exposed conductors pose a possible threat to an individual's health and safety and these dangers and precautions will be covered in sections 11 to 17 of these notes.

10.7 Safe Work Method Statement and Hazard Assessment Checklist

You must have a Safe Work Method Statement and a Completed Hazard Assessment Checklist before starting work on a site.

10.7.1 Safe Work Method Statements

OH&S Act 2000 and OH&S Regulations 2001, reinforces our commitment to safety. This legislation puts the onus of safety on all of us – both management and staff – to share the responsibility of keeping our workplace safe. We are expected to follow a more structured and disciplined approach – identifying not only known hazards, but also potential ones, and have controls in place to eliminate or manage them.

One of the most important components of the new regulation is the Safe Work Method Statement (SWMS). These statements are a written, step by step description of how to do a job safely. There are different ones for different jobs. They are a bit like an encyclopedia of safety and will become one of your most valuable tools. A Safe Work Method Statement explains, in detail, the appropriate safety framework for every job, and it works in conjunction with the HAC.

Our sites can be dangerous places. There is a lot of equipment on sites that need controlling. No one can control every single thing that happens on a site, buy you can identify the most dangerous situations and find ways of lowering the risk involved.

Safe Work Method Statements explain:

- The way or methods to do the job
- What equipment to use
- The quality of work expected
- What training, licences or qualifications workers need to do the job.

It is important to review safe Work Method Statements when there is a change of:

- Work materials
- Design
- People doing the job.

Safe Work Method Statements contain four key components:

- Authority
- PPE list, training, equipment and documentation
- Process Flow Chart/Task List
- Hazard Identification and Risk Control List.

As every job is different, it is obviously impossible to pre-determine every safety situation and this is where you come in. You should always use your field skills and basic common sense to ensure that you have covered all possible hazards before commencing the job. Those on site should take the relevant information from the Safe Work Method Statements and through a real time hazard identification and risk assessment carry out and complete a Pre-work Hazard Assessment Check.

If a SWMS is not safe enough, complete a HAC and discuss it with the team leader and supervisor and agree on a better work method to use before work starts, or otherwise stop the job.

10.7.2 Pre-Work Hazard Assessment Checks

10.7.2.1 Conduct of Worksite Hazard Assessment

Pre-work Hazard Assessments provide a key opportunity to review the safety and environmental needs of the job at that critical time immediately before commencement.

Hazard Assessment Checks (HAC) aim to:

- Identify, rate and control workplace hazards
- Focus on the safety needs of the job
- Identify correct procedures, practices and equipment for the job
- Eliminate unsafe conditions and actions from the worksite
- Ensure that all people on site are inducted to the site
- Provide feedback to supervisory staff and management on perceived health, safety and productivity risks at the work level
- Ensure a consistent and systematic method is adopted in the relation to hazard assessment.

10.7.2.2 On-Site Assessment

The duration and complexity of the assessment is determined by the nature of the hazards to be controlled. The HAC process does not replace requirements for Access Permits or other Permit to Work systems or statutory equipment checks. All equipment before being used on the job shall be subject to a check prior to use to ensure that it is operable and, if required, the equipment is within test date. This check is separate to the procedure for testing and tagging portable electric tools.

An approved HAC form, must be completed and signed by all on-site staff participating in the task – before work is started. Managers, Supervisors and visitors attending the site must also sign the HAC or complete a separate HAC, in accordance with of this procedure.

Where the scope of work changes significantly a new 'HAC' must be completed as above.

10.7.2.3 Contractors

Contracts ensure the requirements for the pre-work assessment process. Contractors may adopt the EnergyAustralia process or submit documentation of their own process, which satisfies the legislative requirements.

EnergyAustralia staff responsible for long term contracts will monitor compliance at random intervals by conducting or allocating the responsibility to conduct and document unannounced inspections of work practices on site. The outcome of these inspections must be recorded by using 'Planned Inspection - Hazard Assessment review record'.

10.7.2.4 Responsibilities

All staff are responsible for:

- Reviewing workplace hazards, as a group, before commencement of work in an effort to identify, rate and control the associated hazards.
- Using and monitoring appropriate control measures to ensure health and safety in maintained.
- Familiarising themselves with the site hazards and emergency procedures.

- Participating in team pre-work discussion/considerations and completing a HAC.
- Conducting pre-use checks on all mobile equipment designated as requiring a formal safety check prior to use.
- Reporting unresolved hazards via a Hazard Incident Alert booklet.
- Suggesting improvements to their supervision by placing comments on the HAC form or raising a QAR.

10.7.2.5 HAC Training

Managers, Supervisors and Project Managers must ensure all staff is adequately trained in the HAC and associated procedures.

EnergyAustralia staff and contractors using the EnergyAustralia HAC must be trained by the Safety and Health Section to gain the appropriate stamp in the Network Passport.

Any contractor using their own system must submit procedure and training list to the contract administrator to gain approval.

ENERSERVE
QUALITY, ENVIRONMENT & SAFETY MANAGEMENT SYSTEMS

Reference Document QES 29F2

PRE-WORK HAZARD ASSESSMENTS

Page: 1 of 2
Issue No: 2
Issue Date: 6/9/2001

Step 1: JOB DETAILS & JOB DISCUSSION

To Supervisor: Manager:

Work Location(s):

Job Description:

PRE-WORK DISCUSSION

	YES	NO		YES	NO
Have plant, equipment and tools been checked?			Is there safe access to the site?		
Has a site inspection been done?			Do we agree on the sequence of the job?		
Are there inexperienced staff on site?			Can the task be done safely & professionally?		
Is the work site/environment Unusual / difficult?			Is there a specific local emergency procedure/phone in place?		
Do we need additional staff, plant, equipment to perform the task?			Is there a first aid/rescue kit close by and are contents in order?		
Are we working in conjunction with other staff or contractors?					

Remarks:

ALL STAFF ON THE WORK SITE ARE TO PARTICIPATE IN AND ACKNOWLEDGE THIS ASSESSMENT

Name	Signature	Date	Time

CONTRACTORS OR VISITORS TO THE SITE MUST BE INDUCTED TO THE SITE BY USING THIS FORM

Step 2 Identify the Hazards → **Step 3 Assess the Risks** → **Step 4 Control the Risks**

Identify Hazards Refer to Table 1 on Folder	Matrix Rating	What Control Methods used? A B C D E F	Details of Controls & Reference Documents
Traffic Hazards		☐ ☐ ☐ ☐ ☐ ☐	Follow requirements of TS 0020 Specify Traffic Control Plan number: _____
Access to Job		☐ ☐ ☐ ☐ ☐ ☐	
Electrical hazards	1	☐ ☐ ☐ ☐ ☐ ☐	
Hazards from Falls / Heights		☐ ☐ ☐ ☐ ☐ ☐	
Hazards from Crushing		☐ ☐ ☐ ☐ ☐ ☐	
Manual Handling		☐ ☐ ☐ ☐ ☐ ☐	
Mechanical Hazards		☐ ☐ ☐ ☐ ☐ ☐	
Hazards to the Environment		☐ ☐ ☐ ☐ ☐ ☐	
Hazards to/from public		☐ ☐ ☐ ☐ ☐ ☐	
Confined space		☐ ☐ ☐ ☐ ☐ ☐	Follow requirements for Confined Space Entry Network Standard NUS 131
Other -		☐ ☐ ☐ ☐ ☐ ☐	
		☐ ☐ ☐ ☐ ☐ ☐	
		☐ ☐ ☐ ☐ ☐ ☐	

YES NO Has the team the appropriate training to implement the controls so the job can be done **SAFELY**

If NO, **DO NOT** continue with the job until you have the knowledge/equipment

Is it safe to commence work?

YES ☐ NO ☐ → Notify Supervisor immediately

Step 5: CONTINUALLY MONITOR

CONTINUALLY MONITOR AND ASSESS CONTROL METHODS.
NOTE: Attach additional information to the HAC form.

After completion of the work are there better METHODS to lessen the risk?
They include _____

WHY?
Give a brief explanation why the work could not be done/completed
_____
_____
_____
_____ Supervisors signature _____

Pre-work Hazard Assessment Sheet

10.8 Phones and Emergency Calls

All Sub-transmission, Zone and City Distribution substations have phones. Suburban Distribution substations do not have phones and it advisable that at least one mobile or radio-telephone be available.

Before entering a substation or switching station, make sure you know how to call for help in an emergency.

On entry to an installation that has a telephone, always check the telephone to make sure it is working.

If an emergency occurs, call the appropriate emergency service immediately.

The number 0 000 will work from any telephone, whether it is an EnergyAustralia telephone or a public telephone. If you remember 'four zero's' you do not have to decide (in the heat of the moment) what type of telephone you are using.

The number 112 will get the emergency services, on mobile phones that are:

- locked
- out of provider's service area
- have the SIM card removed.

In the front of the Electrical Safety Rules book is a list of phone numbers that are useful in emergency situations.

Emergency Details on Information Sheet

10.8.1 Manually Calling for Help

- Dial 0000 or 112 for mobiles. If you are using a radio telephone, ask the radio operator to place the call for you. Use the words "emergency call" to override all other uses.
- Ask for the service you need (Fire, Ambulance, or Police).
- The nature of the emergency (confined spaces, accident/injury fire, explosion, electric shock, etc).
- Say what type of installation you are in (substation, switching station, etc) and if the emergency is 'confined spaces' related ask for breathing apparatus.
- Give the exact address where the help is required. Include the substation number, the nearest cross street, name of the suburb and the city you are calling from.
- Say how many casualties there are.

  Example: 'This is an emergency call. Corner of Brown and Jones Streets, Smithfield, Sydney, NSW, suspected heart attack, one man unconscious in an EnergyAustralia substation'.

10.8.2 Responsibilities Regarding Dangerous or Emergency Conditions on the System

If you find a problem on the system, you must contact the System/Area *Operator* or report the matter to EnergyAustralia's Hazard Line.

Some examples would be:

- fallen mains and apparatus which may be alive
- damage to poles (from vehicles or otherwise)
- damage to substations, caused by fire, flood, storm, lightning strike, accident or vandalism.
- faulty doors, or locks
- any dangerous conditions, such as unusual noises, abnormal electrical discharges, oil spills, or open trenches.

10.8.2.1 Accidentally Tripped Circuit Breaker

If a circuit breaker is tripped, whether as a result of an emergency or any other cause, then you must leave it open and immediately inform the Area Operator.

There is no guarantee that you are responsible for any circuit breaker operation and switching on that circuit breaker could electrify any persons at the fault location.

10.8.3 Responsibilities Regarding Environmental Incidents

It is the responsibility of all personnel to comply with all environmental requirements and to report any environmental incidents to your supervisor.

If you become aware of a pollution incident:

Make sure the scene is safe, try to prevent any further pollution and follow relevant Response Plans

Immediately report the incident to your supervisor.

Note: Failure to report pollution can lead to a fine of $120,000 plus $60,000 for each extra day that it is not reported.

10.8.4 Responsibilities Regarding Minor/Non-life Threatening Hazards

If you find a problem on the system which is a minor hazard and not an immediate hazard to people's lives or health. They should be reported to the Project manager or the Substation Report Line (9269 2233).

This includes but is not limit to:

- Leaking Taps
- Loose Tiles
- Overgrown Weeds
- Rusting Framework
- Deteriorating or termite damaged woodwork

Remember any hazard left unreported will only get more dangerous over time.

10.8.5 Reporting of Security Incidents

An obligation rests on every member of the organisation including contractors, who discovers a security incident or any loss of property of EnergyAustralia, to immediately report the incident to their Supervisor. Report-

- Incidents where EnergyAustralia security has been breached.
- Any suspicious persons or activities on EnergyAustralia premises.
- Where the safety of any EnergyAustralia personnel is physically threatened.
- Any threatening or abusive phone calls, language or actions.

When an incident is reported to a Supervisor, the Supervisor concerned must immediately report the matter to the Manager, Security Operations, (02-9269 2266) or the Security Coordinator (0414 192 438) who will advise the supervisor on the correct course of action.

The Supervisor shall initiate a " Security Incident Report Form "' and forward it under cover to the Manager, Security Operations, Level 4, 570 George Street Sydney.

Should you require any further information regarding these procedures, please contact the Security Operations Manager on the EnergyAustralia Security Hotline 9269 2266.

10.8.6 Emergency Switches

Distribution substations in the CBD are fitted with emergency switches to automatically summon help.

Emergency switches are coloured red, and mounted at waist height, just inside the doors of transformer chambers.

The emergency switch alarm is on the same fibre optic cable and control box as the phone, so by testing the telephone you test the systems the emergency switch uses.

10.8.6.1 Using the Emergency Switch

To use the emergency switch, press the red button firmly. A two-tone alarm will then be heard, cycling on and off. The tone changes to a continuous two-tone alarm when the System Control Room acknowledges the call. The acknowledgment tone is automatically silenced after 30 seconds.

The operator will ring the substation to check whether the alarm is genuine. If there is no answer, the operator assumes the alarm is genuine and dispatches an ambulance.

10.8.8.2 Cancelling a False Alarm

If an emergency switch has been triggered accidentally, reset it by turning the knob clockwise. The spring loaded button will pop out.

Immediately contact the Region Operator or the System Operator and confirm the alarm is false, to avoid dispatching an ambulance unnecessarily.

If you reset the alarm within 10 seconds, no alarm will be raised in the System Control Room.

11. Electrical Dangers

11.1 Electric Shock

Electric shock occurs when a person becomes part of an electrical circuit and the current flows through their body. A fatal electric shock is called electrocution.

Electric shock can result from persons coming into contact with live exposed conductors, or from equipment becoming 'live' due to electrical faults, short circuit or a lack of maintenance. When electrical equipment is damaged, parts of the equipment that are not designed to carry electricity, may become 'live'. This means the equipment is electrically energised and, once touched, will carry the electrical current. A person touching the equipment becomes part of the circuit and may receive an electric shock.

Low Voltage

If the hands are in contact with a low voltage conductor, it may be impossible to let go. The contraction of muscles may make it impossible to utter a noise and the contraction of chest muscles may cause unconsciousness and asphyxia to set in soon after the shock.

The result of an electric shock depends, to some extent, on the path the current takes through the body. Where the current path does not include the heart, a victim may survive a greater shock than if the current does pass through the heart.

Possible effects of low voltage 50 Hz electricity on people

Current	*Effect*
0.1mA	Microshock fibrillation
0.5mA	Sensation through skin
1mA	Painful sensation
9mA	Can not let go
10-20mA	Muscle spasm
30mA	Breathing difficult and rise in blood pressure
100mA	Ventricular fibrillation
1000mA	Muscle burns

Note: mA=1/1000 of an Amp.

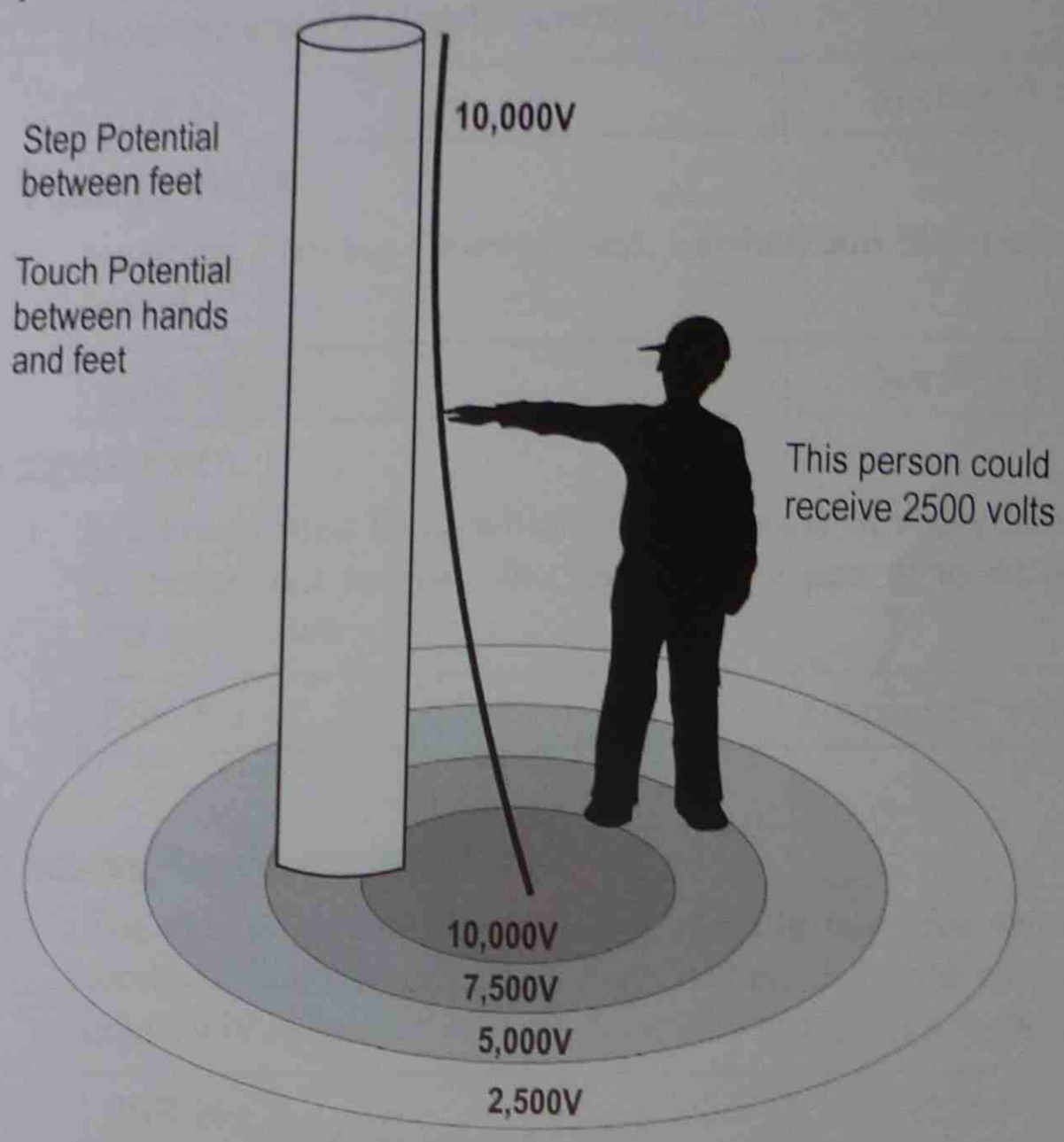
High Voltage

Shock from a high voltage source has a similar effect, except that due to the higher current passing through the body, the contraction of the muscles takes place much faster and more violently. This will very often have the effect of throwing the victim clear of the conductors. The shock can cause unconsciousness, asphyxia, severe external burns and internal heating and burning, but strangely will not usually cause cardiac arrest.

Should the person remain in contact with the live high voltage mains and apparatus, it is extremely unlikely that the person will survive. Immediately contact the emergency services and the area operator.

11.2 Step and Touch Potential

'Step Potential' is the radiating voltage from the point where electricity touches the ground to where it reduces to zero volts or true earth. The voltage level between steps reduces as you get further from the point of contact, and is dependent on the impedance of the ground.



Step and Touch potential

Substations have an earth grid built under the substation, which eliminates step potential. To avoid step potential your feet must be kept together with movement through 'feet shuffle' or 'bunny hop', however if you are ever in this situation it is much safer to remain still and wait until the area is made safe. If in a vehicle connected to wire, try to stay still but if there is a risk of fire jump clear with feet together and 'feet shuffle' or 'bunny hop' to a safe distance.

'Touch Potential' is when your hands and feet are at a different potential, due to the hand object being solidly earthed at a remote location.

12. Isolation and Access Permits

12.1 Low Voltage Work

Isolating and Proving De-energised

ESR No	Section 7

12.2 High Voltage Work

Isolating, Proving De-energised, Earthed and Short-circuited and an access permit issued.

ESR No	Section 8

12.3 An Access Permit

Is a pre-printed form which, when issued in accordance with these *Rules*, allows an *authorised person* who receives the permit to work or test, on or *near mains and apparatus*.

ESR No	2.1 Access Permit

12.3.1 When Access Permits are Required

The *access permit* for work is generally used for routine maintenance and repair work on EnergyAustralia's *high voltage network* where the work requires staff to come within minimum safe distances to *exposed high voltage conductors*.

ESR No	12.2.1

12.3.2 Who Will Issue Access Permits

There are various classes of *operators* but only a Class 1 Operator can issue *access permits* to other people for work on EnergyAustralia's *network*.

These *Operators* will make all the necessary precautions to allow work or test on or *near mains and apparatus,* print clearly in blue or black, these precautions on the access permit and hand *access permits* to Accredited Service Providers, non-electrical staff, *contractors* to EnergyAustralia and Specially Authorised persons. Before handing over the *access permit,* o*perators* must describe all the precautions that have been taken and give relevant warnings.

ESR No	12.3 and 12.3.1

12.3.3 Who Will Receive an Access Permit

An *employee* who is required to receive *access permits* must have been given the appropriate training and be authorised.

12.3.4 Training Contact

Contacts Name	Phone Number

12.4 Operators Locks and Danger Tags

Equipment that is used to limit the access to equipment or its operation is not to be tampered with, these are designed to protect other workers from danger.

When operator's locks and danger tags are fitted by an operator they can only be removed by an operator. When fitted by a work group they must be removed by or with permission of the person in charge of that work group.

Associated Rules	ESR No
Isolate/Isolated	2.1 Isolate/Isolated
Danger Tags	6.18.1
Securing Isolation	8.3

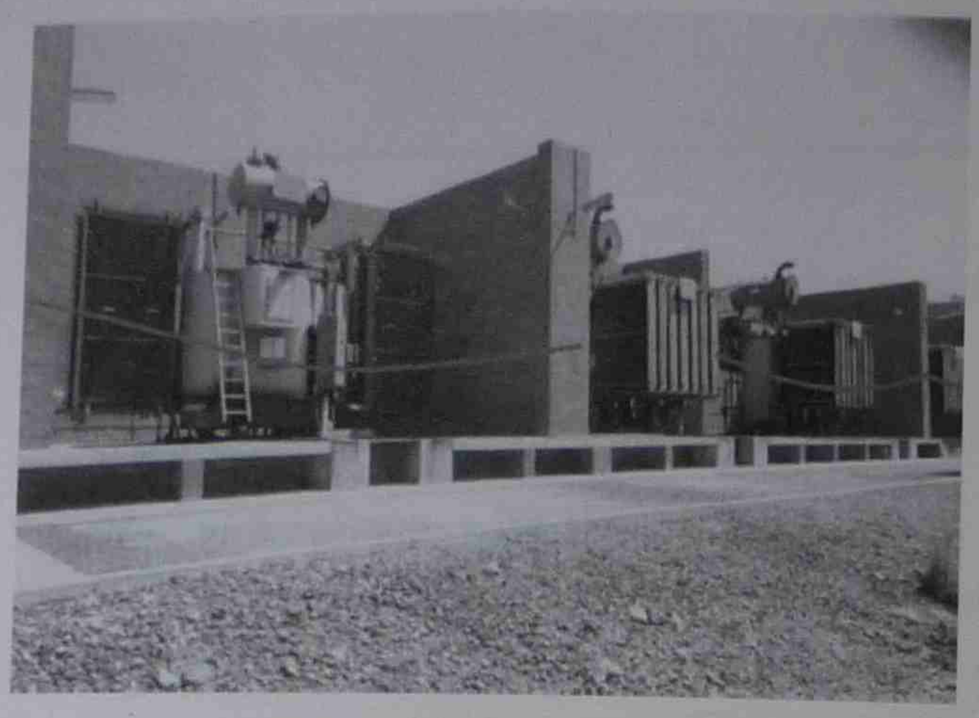
Danger Tag Securing Isolation Point can also be used to secure access permit earths

12.5 Red And White Tape

Red and white striped tape is erected by operators in substation areas that require an access permit. It is only used in conjunction with the issue of an access permit. It marks the boundaries of the safe area.

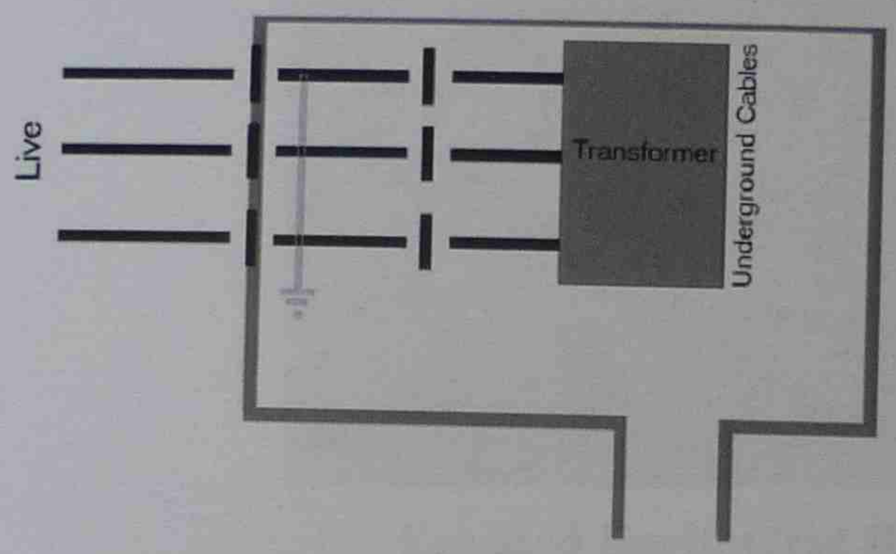
Associated Rules	ESR No
Red and White Taping	10.1
Warning Signs	10.2.1

IMPORTANT: **When red and white striped tape is erected you must not go over, under, through or move the tape. Erected tape can only have its position altered by an operator.**



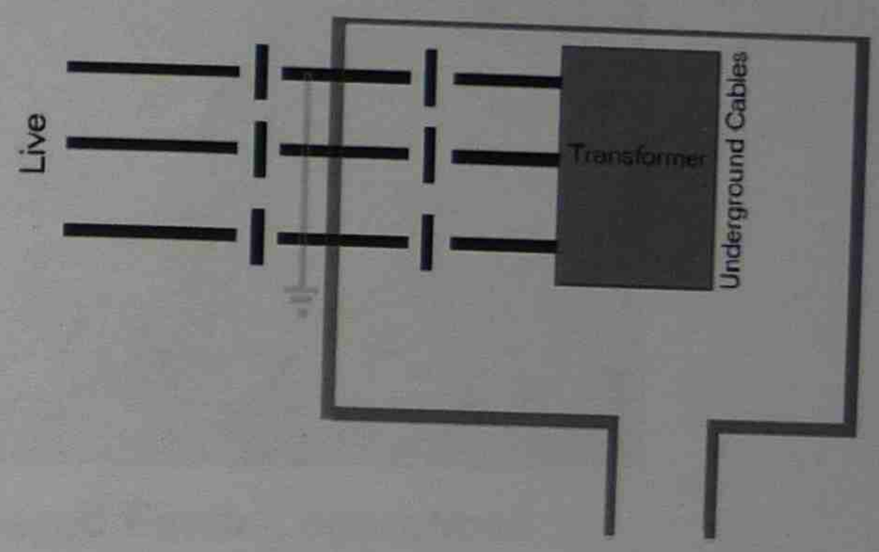
Transformer bay taping only the one under access is not taped off

Switchgear taping indicates safe work area between tapes



INCORRECT METHOD

Half the switch is alive so the entire switch must be outside the red and white taped zone



CORRECT METHOD

All live equipment is outside the red and white taped zone

13. Earthing

Earthing can be defined as electrically connected to the general mass of earth or the ground.

Earthing of the network has two purposes:

- as a reference for the system
- as a point where fault current can flow to

Earthing of the network is done through metal electrodes that are driven into the ground for up to 10 metres. The electrodes are connected in a grid then back to the transformers neutral earth connection.

Exposed Earth Grid Damaged Earth Connections

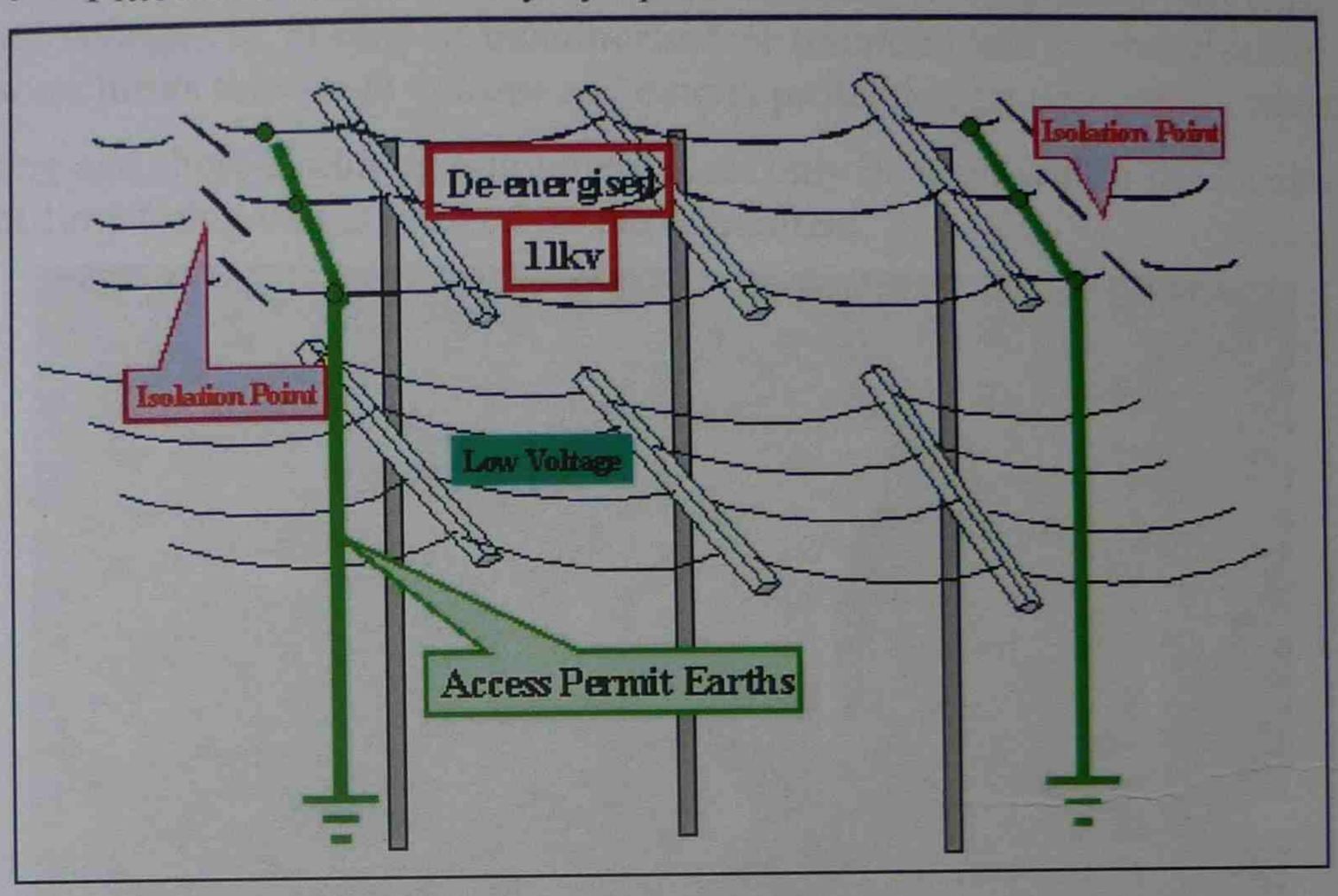
HV Cable Sheath Earthing Framework Earth Connections

Fence Earth Gate Earth

It is very important that the grid is not broken as this could mean that the fault current has no path to flow. This can make it hazardous for people working on and around the network, as unearthed structures could become alive and unequal to the ground potential.

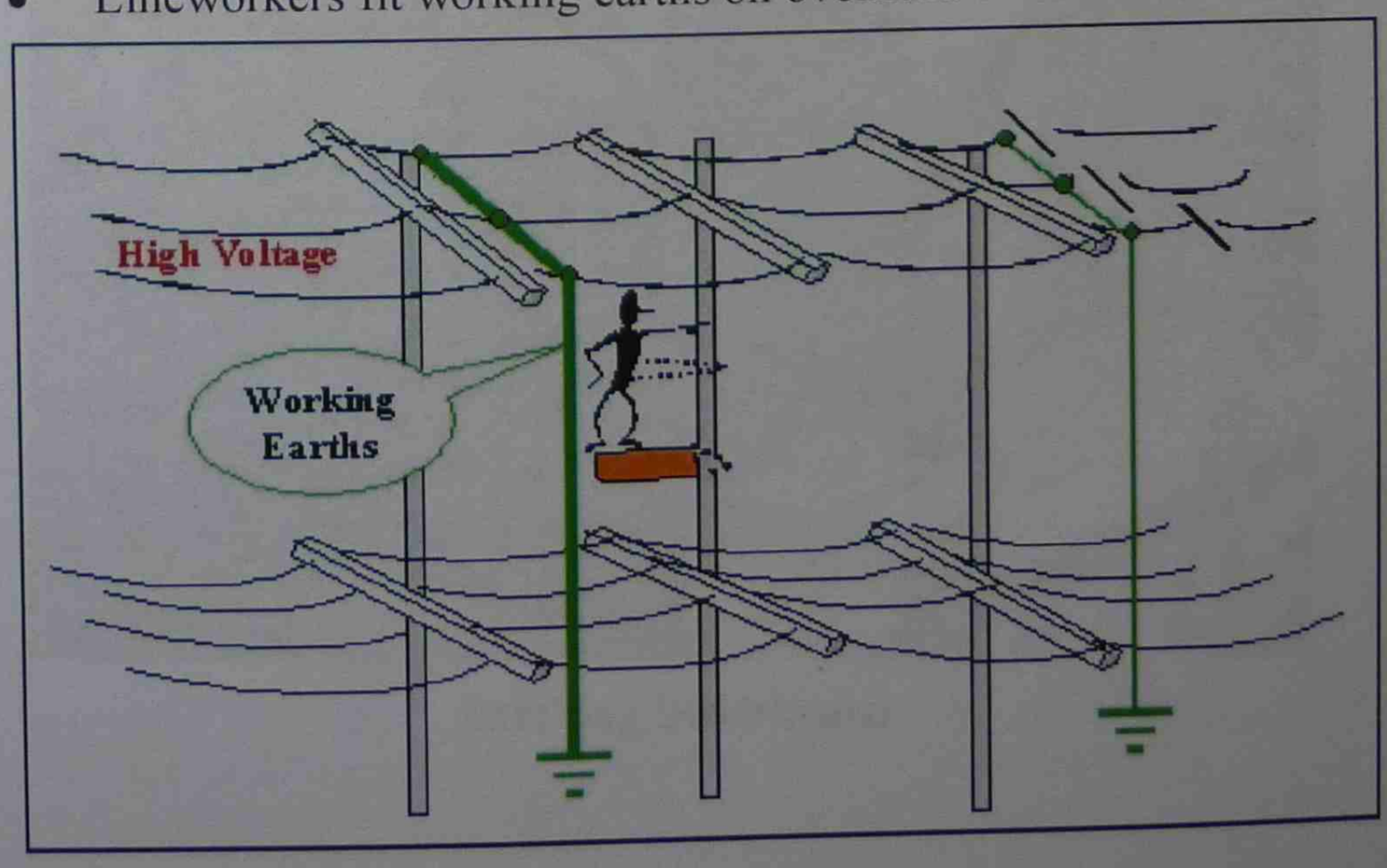
13.1 Access Permit Earths

- Earthing and short-circuiting equipment used on mains and apparatus and listed on the access permit.
- Requirements for issuing an access permit between source of high voltage supply and the work site.
- Fitted and removed only by operators.



13.2 Working Earths

- Earthing and short-circuiting equipment erected or applied in addition to access permit earths.
- Must be traced from access permit earth in order to apply.
- Fitted by worker before starting and removed by worker before signing off the access permit.
- Lineworkers fit working earths on overhead lines for non-electrical workers.



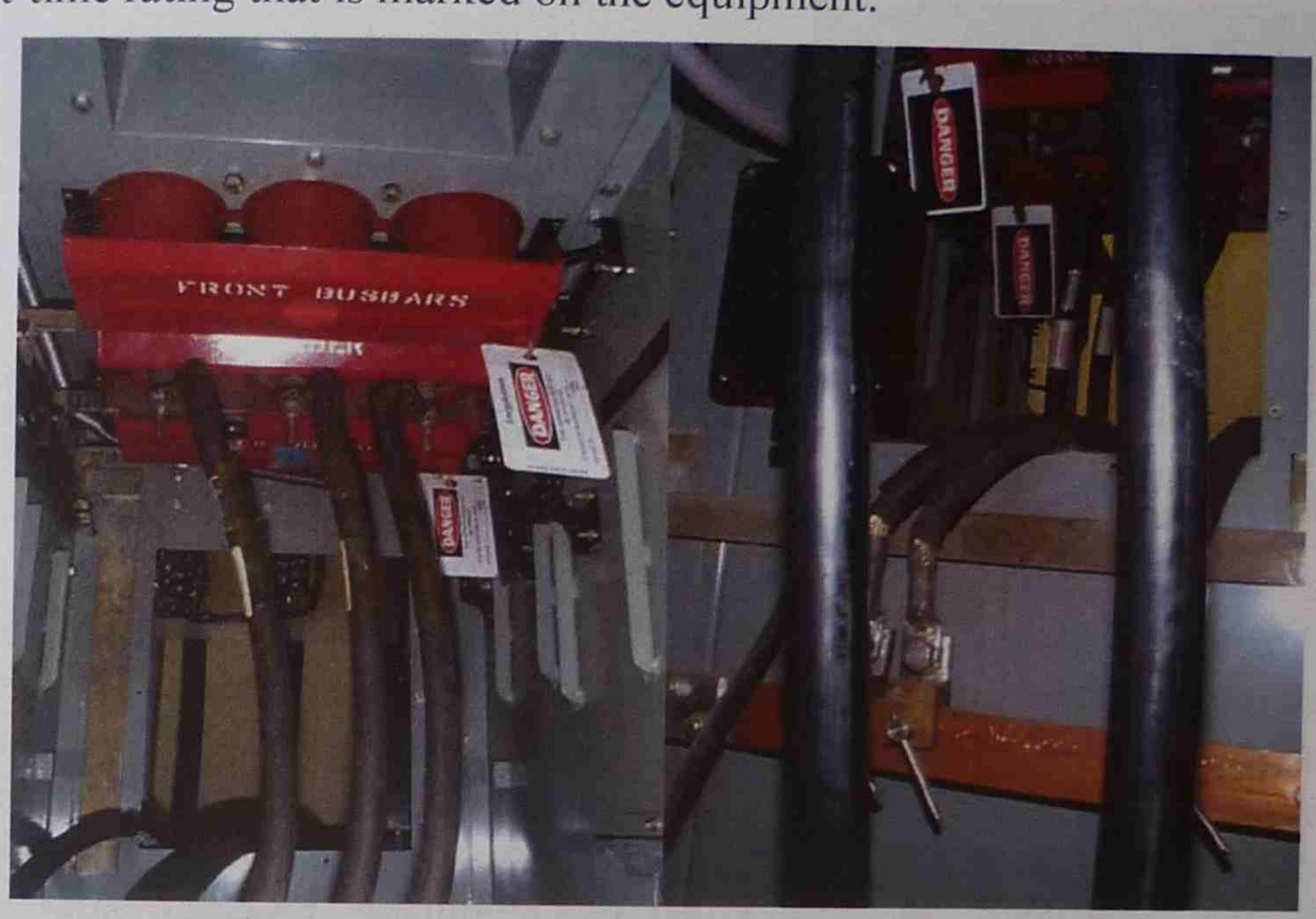
13.3 Earthing Facilities

Earthing connections must be made to known permanent earthing facilities. These can include a cable sheath connected to a permanent earthing system when working at a remote location.

13.4 Portable Earthing Equipment

Earthing and short-circuiting equipment is made up of clamps and flexible cables which are designed to carry short-circuit current between phases and to *earth*. These clamps and flexible cables are attached to *high voltage conductors* which have been *isolated* and proved *de-energised*. The reason that the *high voltage conductors* have been short-circuited and *earthed* is to protect workers from induced *voltages* or in case of unauthorised or unintentional re-energisation. This procedure limits the rise in *voltage* and causes protection equipment to operate.

Earthing and short-circuiting equipment must only be used within the limits of the current-time rating that is marked on the equipment.

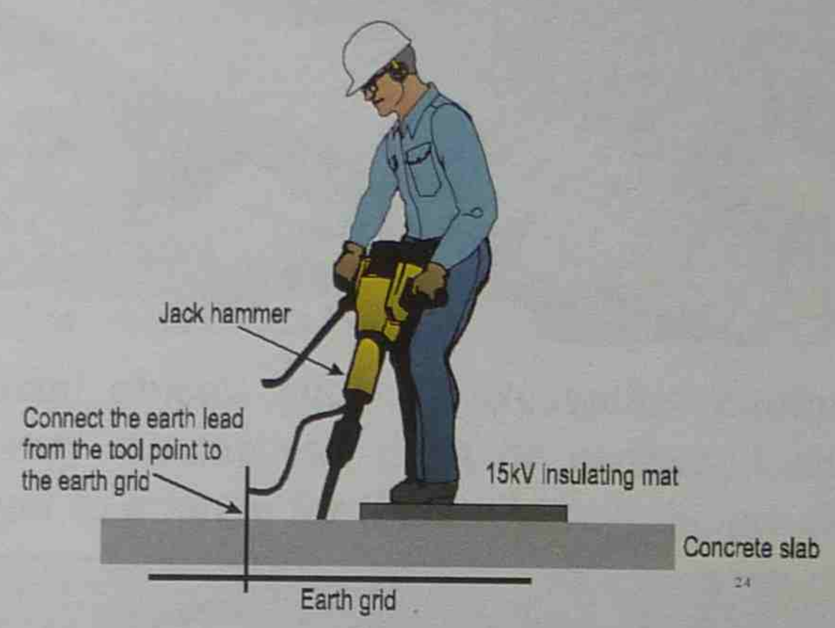


Earthing Metalclad Switchgear

Earthing Switchyard

13.5 Trailing Earth Mobile Plant and Equipment in Substations

All plant and equipment on site must at all times be electrically bonded to the substation earth mat using trailing earth leads. The contractor shall be responsible for complying with this requirement. EnergyAustralia will supply the trailing earth leads as considered necessary to comply with this requirement and will make the required connections to the substation earth mat and provide earth tails at sufficient points for connection of the trailing earth leads by the contractor. This requirement applies to all plant and equipment and includes things like backhoes, jackhammers, saw cutters, concrete delivery trucks, concrete pump trucks and vehicles with hiabs or cranes.

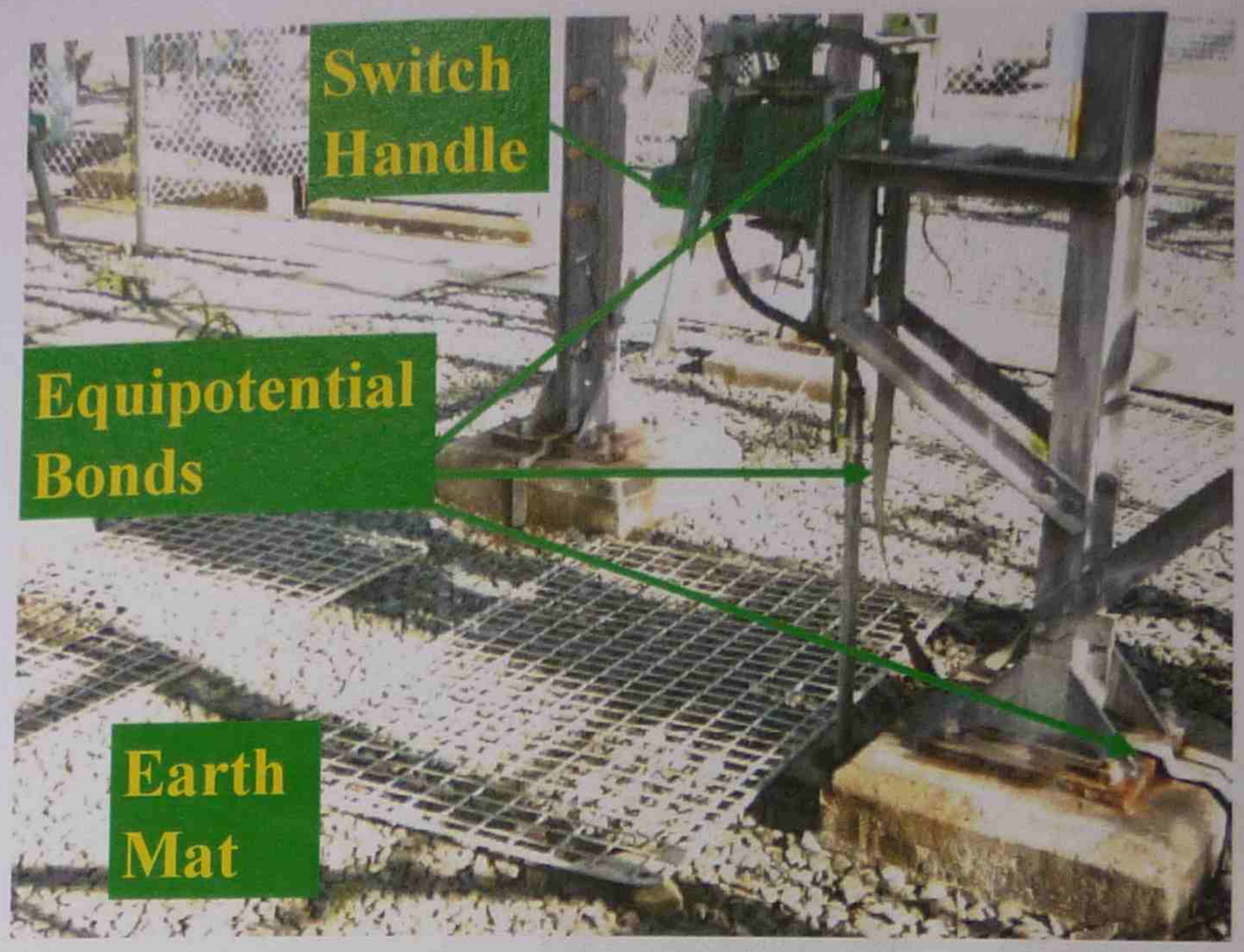


The trailing earth lead shall be insulated flexible copper conductor capable of carrying the maximum prospective fault current to the earth grid, and shall have a minimum cross sectional area of 70 mm^2. No clamp to clamp connections shall be allowed between earth leads. The earth leads shall comply with the requirements for earthing and short circuiting equipment in Electricity Supply Association of Australia (ESSA) document EC14, Guide to Electrical Workers' Safety Equipment.

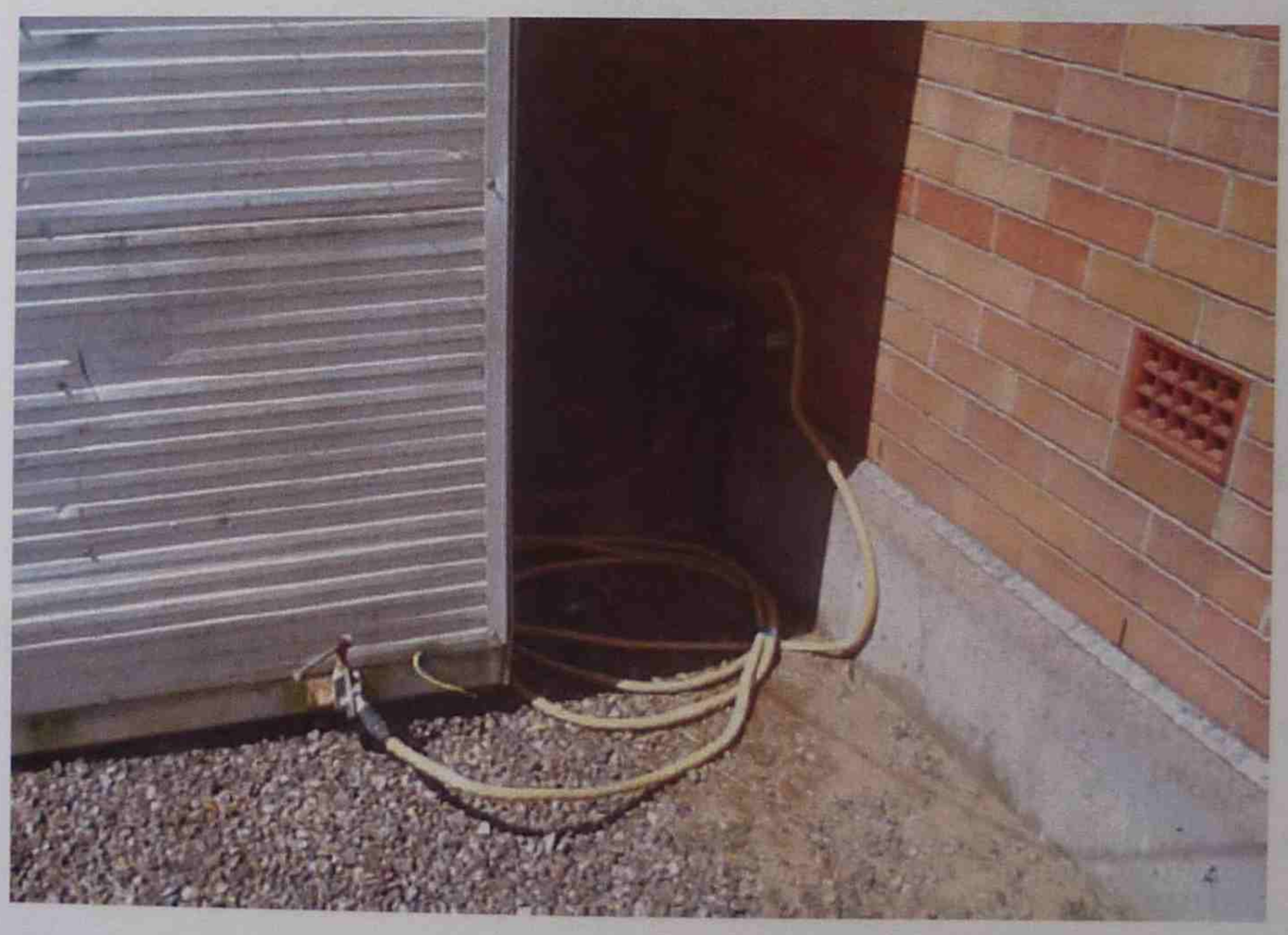
All portable earths are labelled with the fault current/time rating. A similar rating will be required on your trailing earths.

13.6 Earthing/Equipotential Bonding of Equipment

Equipotential Bonding is a method used to eliminate the risk of electric shock by connecting the work piece or operating handle to the platform or grid on which the worker stands.



All metal objects such as excavation equipment, sheds, shoring, road plates, temporary fencing etc, must be earthed. Contractors shall contact the Contract Manager to arrange for the earthing to be provided.



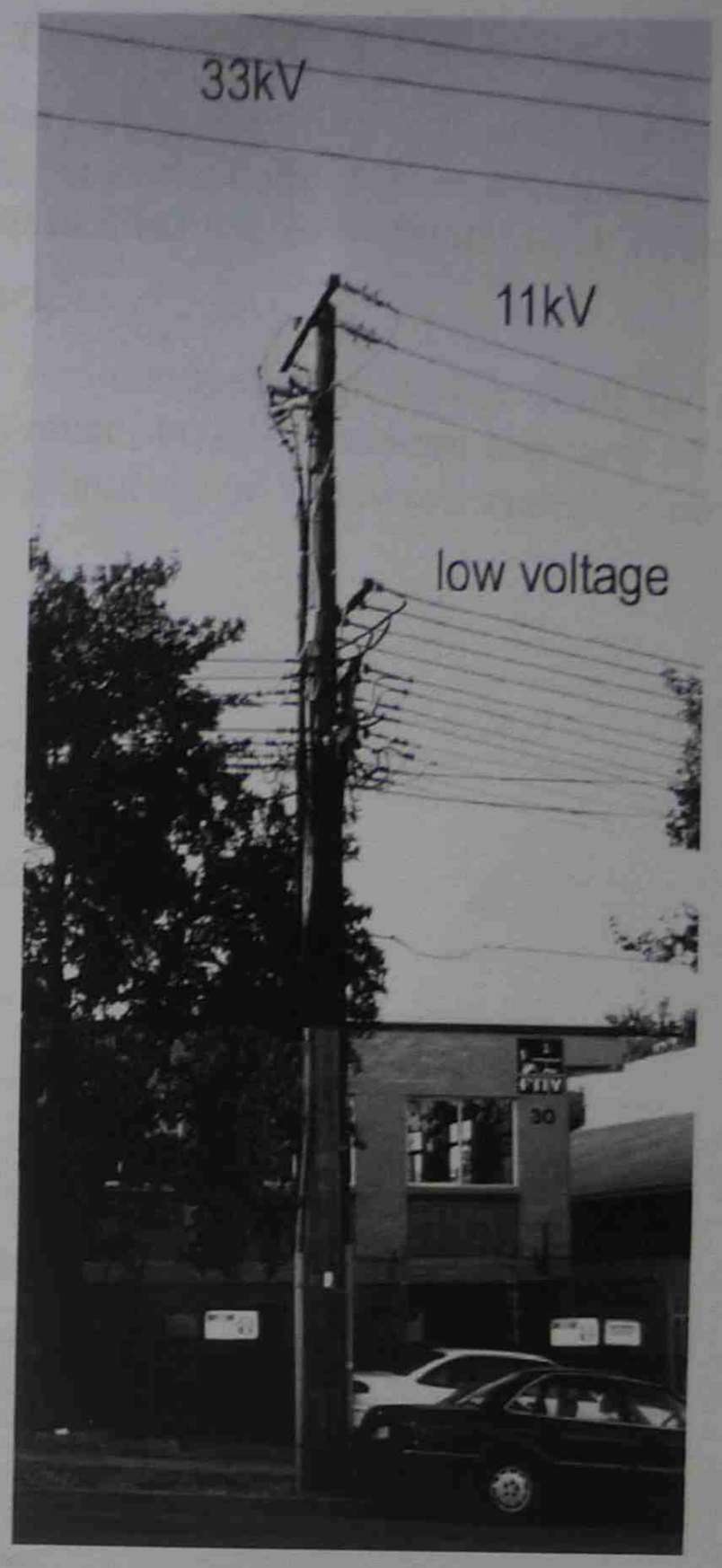
13.7 Electrical Induction

This occurs when a de-energised cable has a voltage imposed on it by power flowing in cables that are in the same duct or run. This normally only occurs at above 33,000 volts, although it has occurred in the city 11kV network.

If this phenomenon is occurring or has occurred then it must be referred to the person in charge of the work.

Any electric shocks must be reported to the person in charge of the work.

Try to avoid contact with any bare conductors.



The Live 33kV line can induce into the de-energised 11kV line

13.8 Transferred Earth Potential

A fault can cause a rise in *voltage* on the earth mat at a substation. Where *cable* sheaths or cores are connected, resulting in a *voltage* or potential difference between the *cable* sheath and the earth, pipes or other at a work site remote from the substation, this is called a **transferred** earth potential.

The risk to personnel receiving a shock from induced *voltages* or transferred earth potential when working on distribution *cables* is low under normal operating conditions. However, in some cases, it will be necessary to take precautions against this risk.

13.9 Protection from Induction and Transferred Earth Potential

Earthing and Equipotental Bonding

Take precautions to avoid the dangers of induction when working on *isolated electrical apparatus* located *near live electrical apparatus*. Ensure that equipotential conditions are maintained by ensuring that access permit earths are in place and applying additional *working earths*, short circuits and bonds as necessary.

Pilot, Signalling and Telephone Cables

Use an insulating mat when working on pilot *cables* (used for control / protection), signalling, and telephone *cables* terminating in a substation. *High voltages* can be induced in these cables by lightning or electrical system faults.

Shoring and Formwork

Only timber or other non-conductive materials shall be used for shoring and formwork. Contractors must obtain the written approval of the Contract Manager before arranging for any shoring or formwork materials not complying with this requirement.

Underground Cables

ESR No	6.24.3

Insulated Working Conditions

Bonded Earth Mat Conditions

Overhead Lines

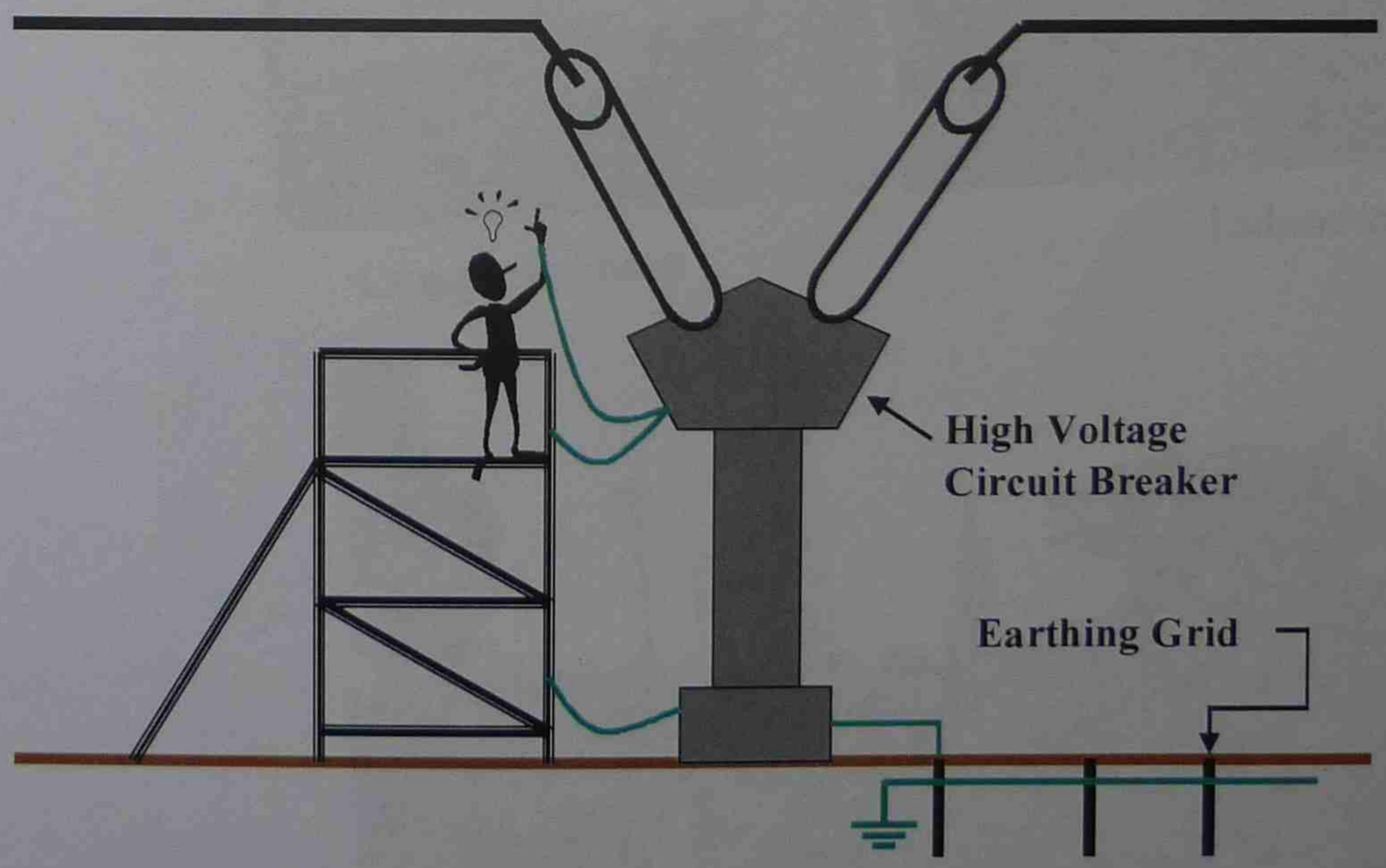
ESR No	6.24.4

Precautions against induced voltages

Precautions against Earth Potential Rise

Induction In 132kV Switchyards

ESR No	6.24.4



14. Cages and Enclosures

14.1 High Voltage Cages

ESR No	2.1

All substations are designed and constructed to ensure that the *live* exposed conductors maintain both statutory and design clearances in accordance with appropriate Australian and international standards and regulations.

Cages and other suitable barriers are erected to ensure that people cannot enter areas where minimum safe working distances can not be maintained.

To enter cages or go beyond barriers, you must be either:

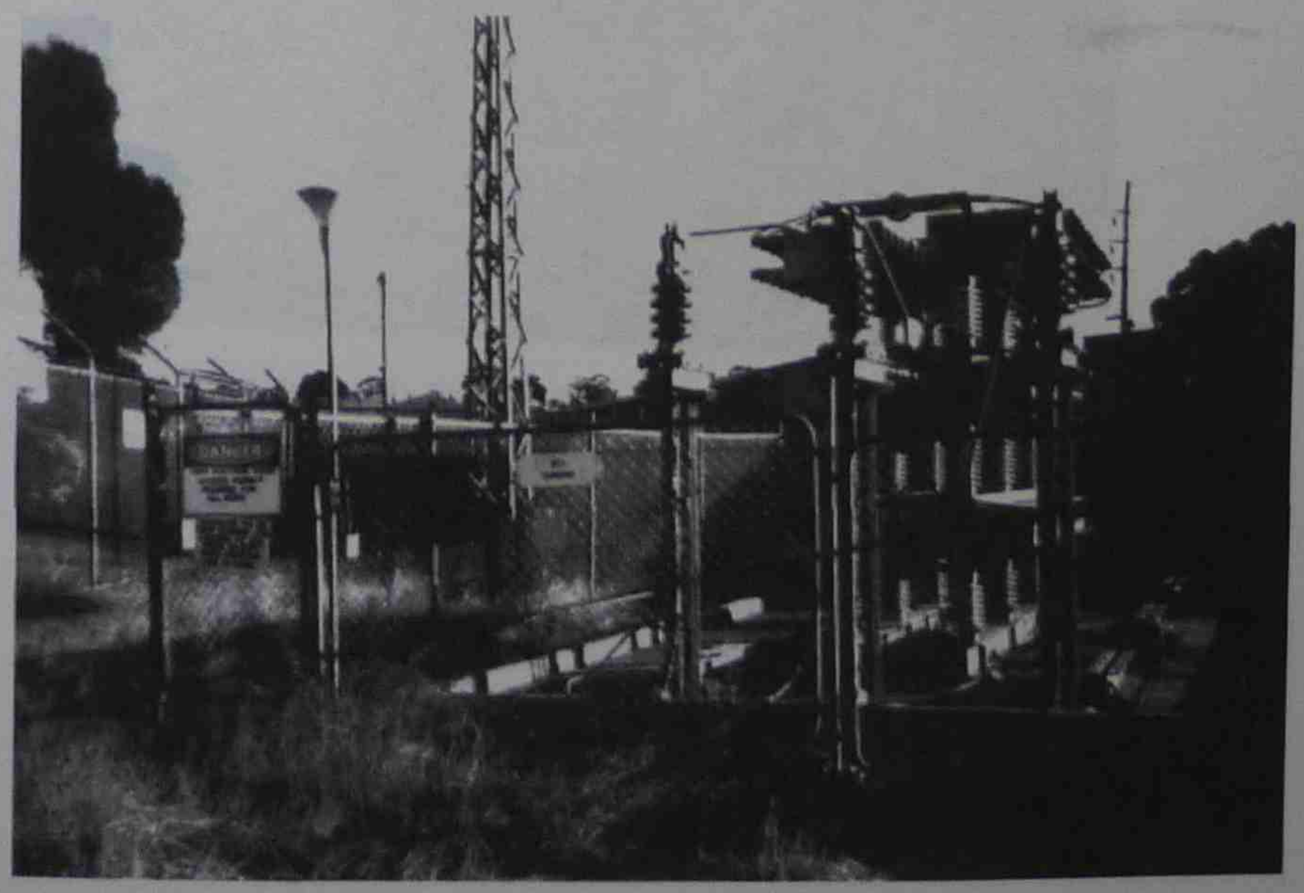
- authorised staff
- the holder of a current access permit for that area.

Ensure that entrances to these cages are adequately secured against unauthorised entry.

Examples of cages

Complete room

Indoor cage



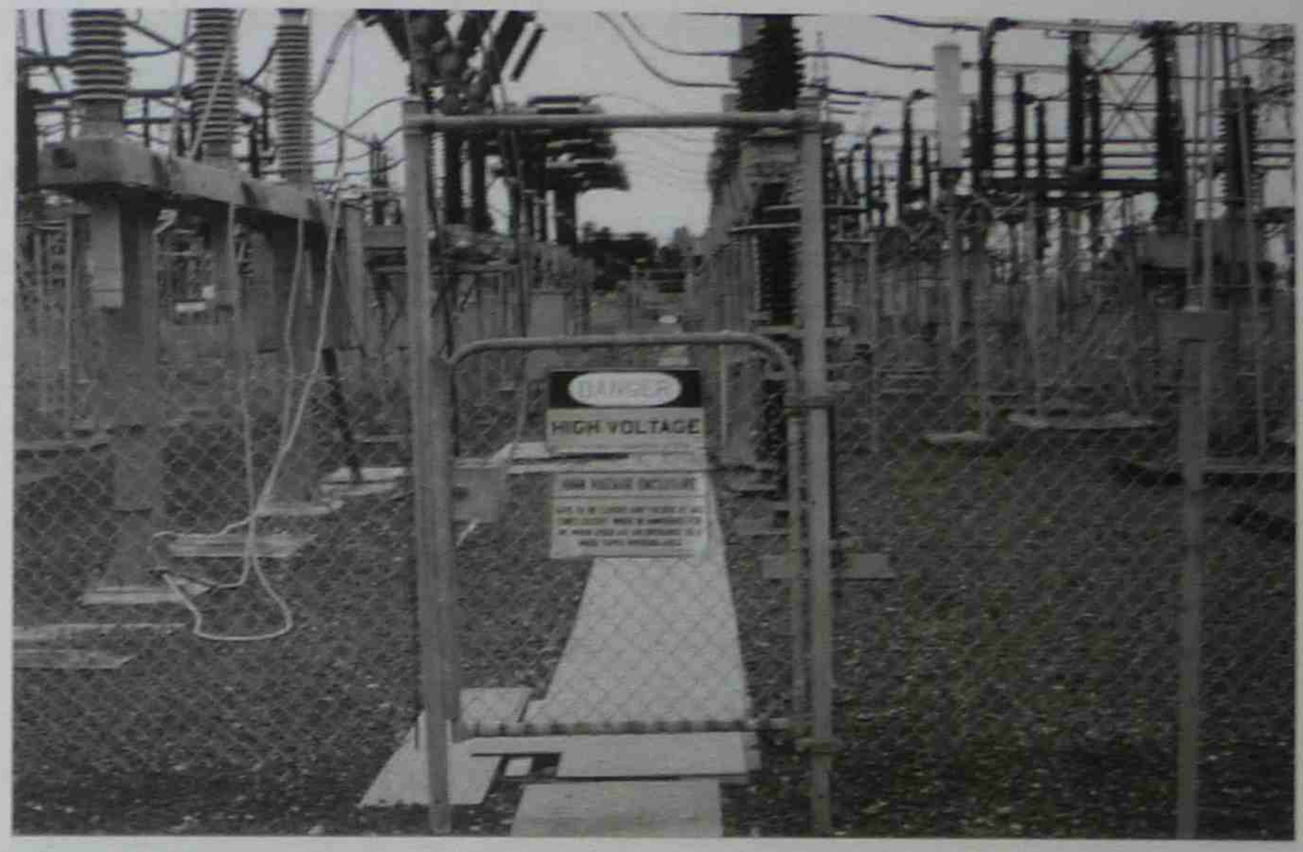
Outdoor cage

14.2 Enclosures

ESR No	2.1

An enclosure is an area surrounded by a chain wire or mesh barrier of at least 1.2 metres in height containing exposed high voltage mains and apparatus. The barrier is to remind people that the need to be cautious when approaching exposed high voltage mains and apparatus inside a switchyard or substation.

It is possible to enter an enclosure and maintain minimum safe working distances.



Note: The height bar is to remind you to lower equipment below shoulder height before entering enclosure.

15. Work Near Exposed Mains and Apparatus (Including Overhead Conductors)

15.1 Minimum Safe Working Distances

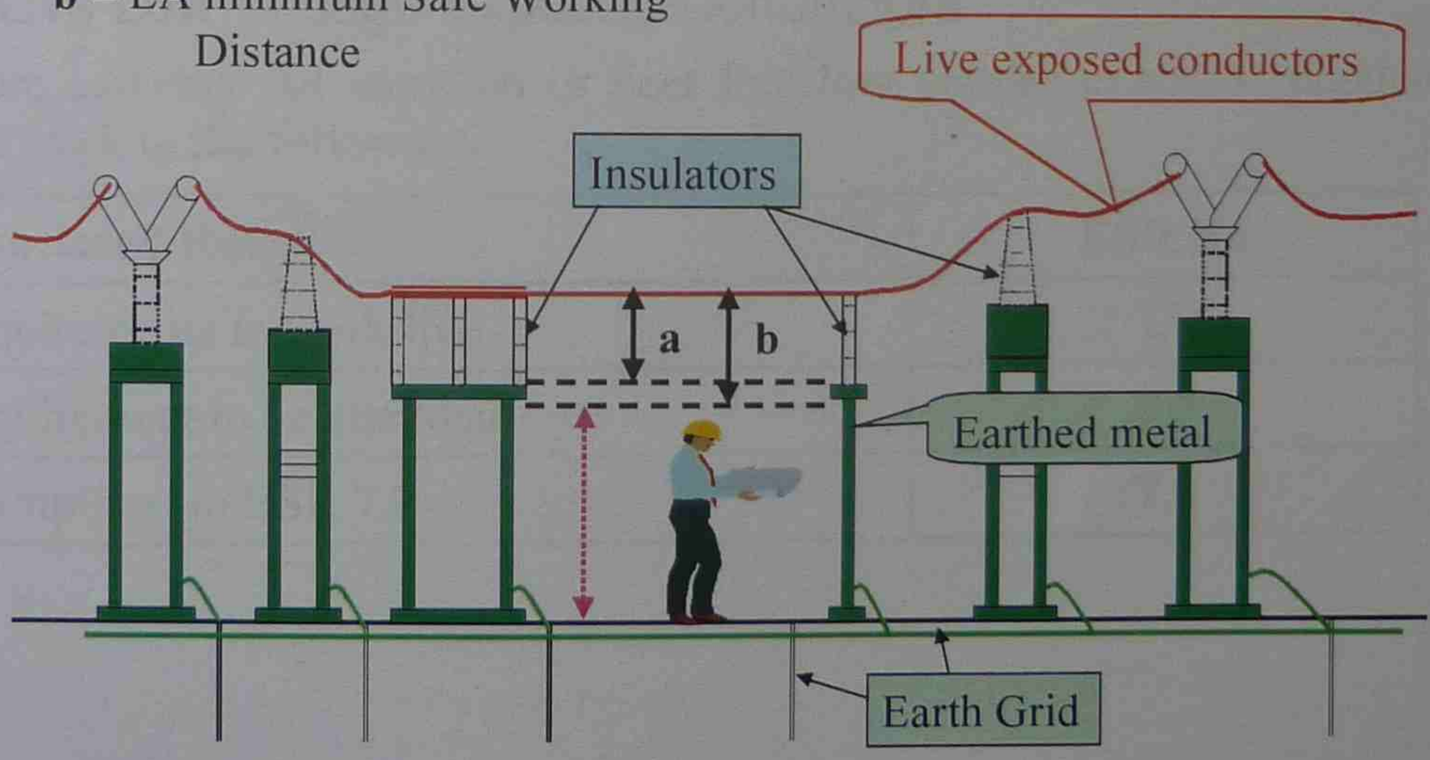
When you are working near live exposed conductors, you or anything you are holding must not come within the minimum safe working distance for the nominal network voltage involved. Always refer to the current Electrical Safety Rules for the clearances.

Associated Rules	**ESR No**
Full Rule	5.1
Actual Distances	Table 5.1
Reduced Distances	5.2

Safety Clearances in Substations

a = Non flash over distance

b = EA minimum Safe Working Distance



Persons must not under any circumstances bring any part of their body, or any tools or objects they are working with, within minimum safe working distances.

Where work is being carried out by persons in or on plant or equipment the minimum clearance will be as shown in the Electrical Safety Rules with the specific requirements, precautions and the minimum approach distances for those working to ISSC26 listed in the ISSC26 document. It should be noted that if you are moving equipment or using plant within restricted areas then you must conform again to the Electricity Safety Rules.

Associated Rules	ESR No
Clearances for Plant and Equipment	5.5
Actual Clearances	Table 5.4
Clearances for ISSC26 Work	ISSC26 Table A
Moving Plant and Equipment	17.3

Where the location of exposed live mains and apparatus or overhead conductors is such that minimum safe working distances cannot be maintained, the Project Manager must be advised to arrange for Access Permits to be issued or screens and barriers to be erected.

It may also be necessary to erect a suitable temporary screen or barrier to ensure minimum safe working distances are maintained from live mains and apparatus during the work. An Access Permit may be necessary to ensure safe fitting or removal of the screen or barrier. Competent and authorised staff to meet Network requirements shall carry out screening and barrier construction.

Contractors must temporarily erect warning signs where there is a danger that persons may accidentally come closer than the minimum safe working distance from exposed high voltage mains and apparatus. The Project Manager will supply the necessary signs when requested by the contractor.

15.2 Working on Live Low Voltage Exposed Conductors

Before carrying out work on or near live low voltage exposed conductors, you must work to the following:

Associated Rules	ESR No
Requirements to work live	7.3
Requirement to be attended	7.7
Exemptions to ESR 7.7	7.8

16. Screens and Barriers

16.1 Low Voltage Screens

Whenever you are working where accidental contact with *live low voltage* apparatus could occur, you must be protected by effective screens. Screening must be erected when there is a possibility of your person or something that you're holding coming into contact with the live low voltage exposed conductors.

Only personnel who are authorised can erect screens, or work on live low voltage apparatus without screens. To be authorised you must complete course SS 1000 *'Live Low Voltage Work in Substations'* and have the appropriate stamps in your network passbook

When erecting screens, you must take into account the possibility of unauthorised personnel being in other parts of the substation. Work by an unauthorised person must always be supervised by an authorised person.

The screening must be constructed in such a manner that there are no gaps for your equipment or person to enter, which includes the top and undersides of the screened board.

The materials used to screen are varied but must be robust enough to with stand knocks and relatively sharp objects. If this is not the case then your personal safety can be put at risk, and in this case you must request that the screening be done to a suitable standard. Screens must be securely fixed or supported.

16.1.1 Precautions

- Do not interfere with erected screens.
- Do not stack material or goods against screens.
- Do not allow wires, rods, conduits or similar sized objects to penetrate between the screens or into a screened zone.
- Do not obstruct passageways or emergency exit routes. Erect screens so that staff and materials can pass safely.
- When used near *high voltage mains and apparatus*, the screen must not come into contact with the *high voltage mains and apparatus*.

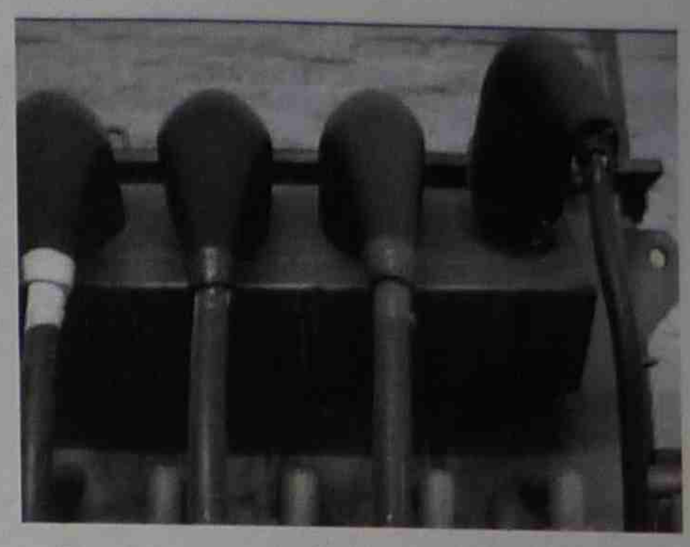
ESR No	4.1.9

16.1.2 Materials used for Screening

- Polycarbonate Sheeting to AS 4256.5 (eg 'Lexan' 3.0mm)
- PVC Lined Plywood (PVC Sheeting - 'Darvic' 1.5mm)
- PVC Matting ('Lineworker's Mats' and 'Clear Flexible PVC)
- PVC Pipes (Such as 'Torapoli Pipe')
- Rubber Matting (Such as rubber insulating floor matting)
- Nylon Cable ties, Insulation tape and Polypropylene twine (such as 'Marlin') are suitable for securing screening.

Polycarbonate sheeting

PVC piping



Transformer boots

PVC matting – lineworker's mat and clear flexible PVC

Rubber matting

Plywood and Darvic sample Darvic – electrical insulation plywood – mechanical protection

16.1.3 Substation Screening Identification Tags

Must be affixed to the screening in a prominent location. When leaving screening unattended for a reasonable duration or when screening is installed for a third party.

This tag will be black print on a yellow background. Information includes name of person who screened, their contact details and reasons for the screening.

Substation Screening Identification Tag
Substation Copy

Screened by: _____

Contact Number: _____

Date: _____

Reason: _____

_____

_____

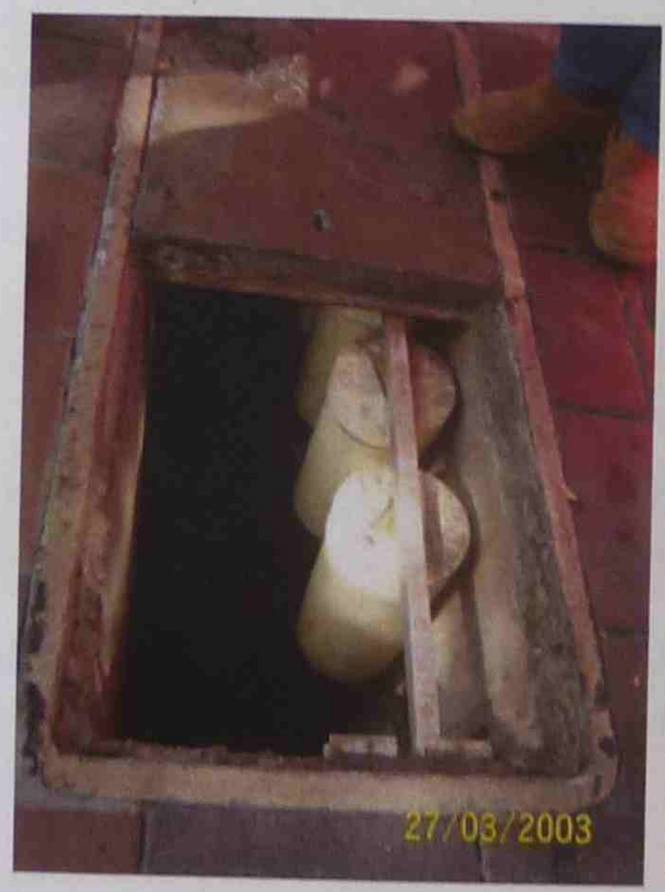
(See Reverse for Details)

Persons relying on this screening for safe working should satisfy themselves as to its integrity and contact the *authorised person* overleaf should any doubt exist.
This screening and / or temporary insulation has been installed by an *authorised person* and can only be altered or removed by an *authorised person*. If required please contact the *authorised person* overleaf for any alterations, repairs and when the screening and / or temporary insulation is no longer required.

See Clause 4.1.9 in the Electrical Safety Rules
'Screens and Temporary Insulation'

16.1.4 Practical Screening

The job on the left is to screen off all live parts to connect a new distributor, which is de-energised. In this case, there is no need to screen earthed metal. The job on the right is the same kiosk screened to work live on the middle distributor.



Any live work in this type of pit (photo left) must be done in accordance with appropriate procedure and staff must be trained in this procedure. This includes operating links if fitted.

Conduit caps over connections must be removed only one at a time in order to work on this type of pit live. When work on one phase is complete, the cap must be replaced before the next cap is removed.

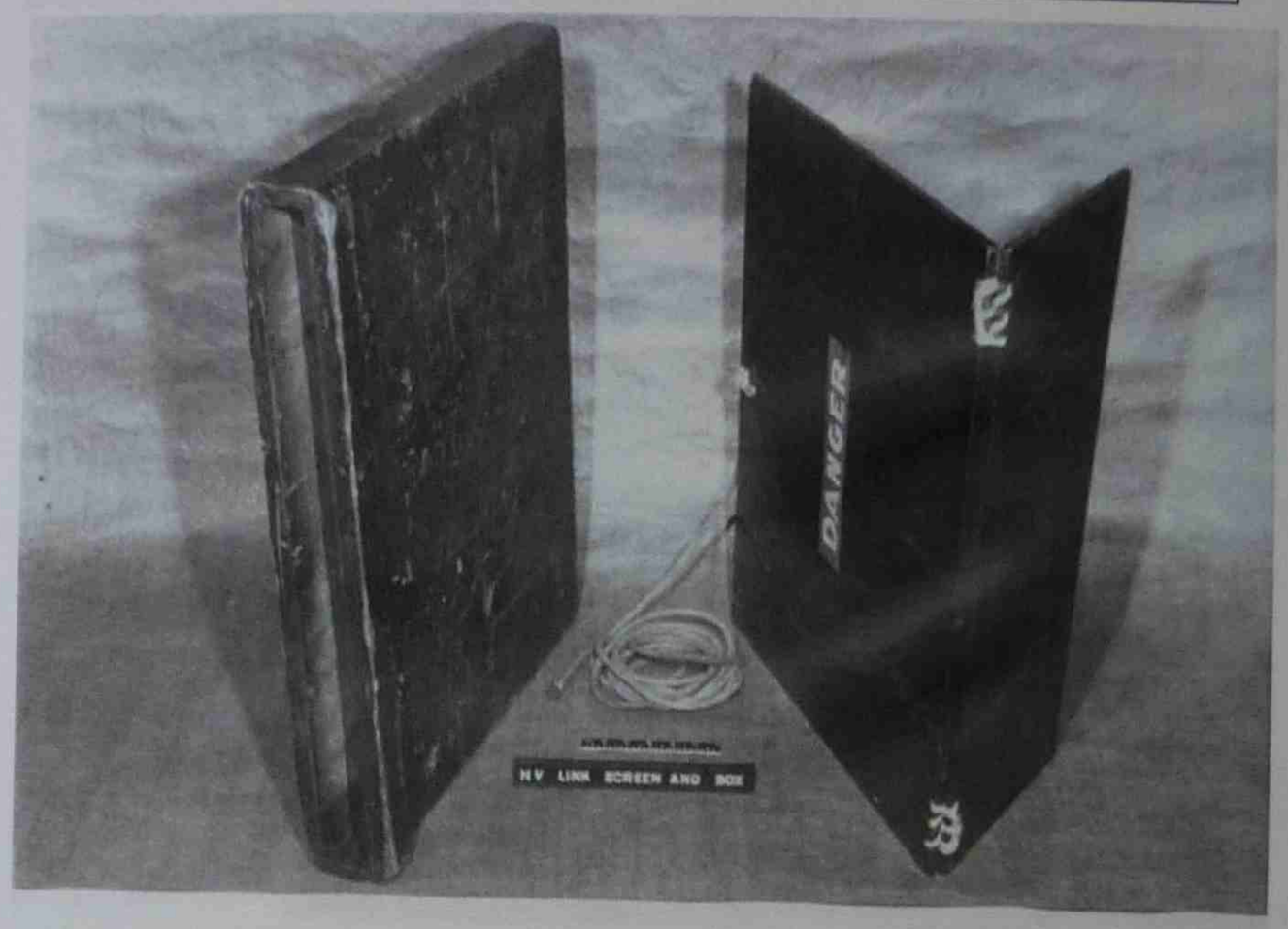
Apply screening to the inside and edges of the cast iron (photo right) surround within 500mm of live terminal to be worked on. Cover adjacent links with large polycarbonate covers.

16.2 High Voltage Link Screens

For high voltage cubicle switchgear, busbars and live link contacts must be guarded by specially designed high voltage link screens.

High voltage link screens are constructed of thick, high quality insulating material and erected only by Operators. These screens must be tested annually by Testing and Certification Australia, and stored in their special containers when not in use.

ESR No	4.1.9



16.3 Torapoli/Tiger Tails

Insulating covers, mats and insulating pipes (Torapoli, more commonly known as 'Tiger Tails') provide insulation to protect authorised personnel working aloft from:

- phase to phase contact
- phase to neutral contact
- phase to earth contact.

Generally they are used to protect:

- authorised workers and plant from inadvertent or brush contact with uninsulated LV mains and apparatus
- mains from mechanical damage from plant.

In addition they provide visual enhancement of the mains for benefit of plant operators who must maintain clearances of ESR 5.5 table 5.4.

Installers of insulating covers, mats and pipes must use sufficient ties, buttons or other means to ensure that the insulating covers, mats or pipes will not move, open or otherwise allow unintentional contact to be made with uninsulated live or earthed mains or apparatus.

Should any inadvertent contact an authorised worker must immediately check that the insulating cover, mat or pipe has not been dislodged and that no electrical contact has been made or is possible due to the exposure of an uninsulated piece of live LV mains or apparatus. (ie –an unauthorised worker must arrange for an authorised worker to check the situation)

16.4 Barriers for High Voltage Equipment

Coming into contact with high voltage may cause death or very serious injury; therefore all means available must be used to stop this occurring.

When working outside of the minimum safe working distance but where there is a possibility of contact with the live High Voltage then robust barriers must be erected.

Screening and barriers are to be erected by qualified personnel because it requires live high voltage working skills.

For example: plywood, Bakelite or fencing which is erected between you and the live equipment. Preventing you or any extension of your body coming within the Minimum Safe Working Distance.

ESR No	8.8

16.4.1 Hazemeyer or Magnafix Type Switches used in Kiosk Type Substations

These types of switches are not exposed but have had problems with dust and moisture leading to tracking. While there is not a written procedure stating that they must be treated with caution, it is suggested that they be treated as live low voltage. This means that when the likely hood of contact with these switches when in service may occur then screens should be erected.

Screening and barriers are to be erected by qualified personnel because it requires live high voltage working skills.

17. Protection

All parts of the system require protection systems to protect the mains and apparatus, general public and the workers from electrical hazards when things go wrong.

The following will give you a basic idea of what protection you may encounter.

17.1 Fuses

– 240/415V and 11kV Systems are sometimes protected by High Rupturing Capacity fuses (HRC) which burn out to isolate the affected section.

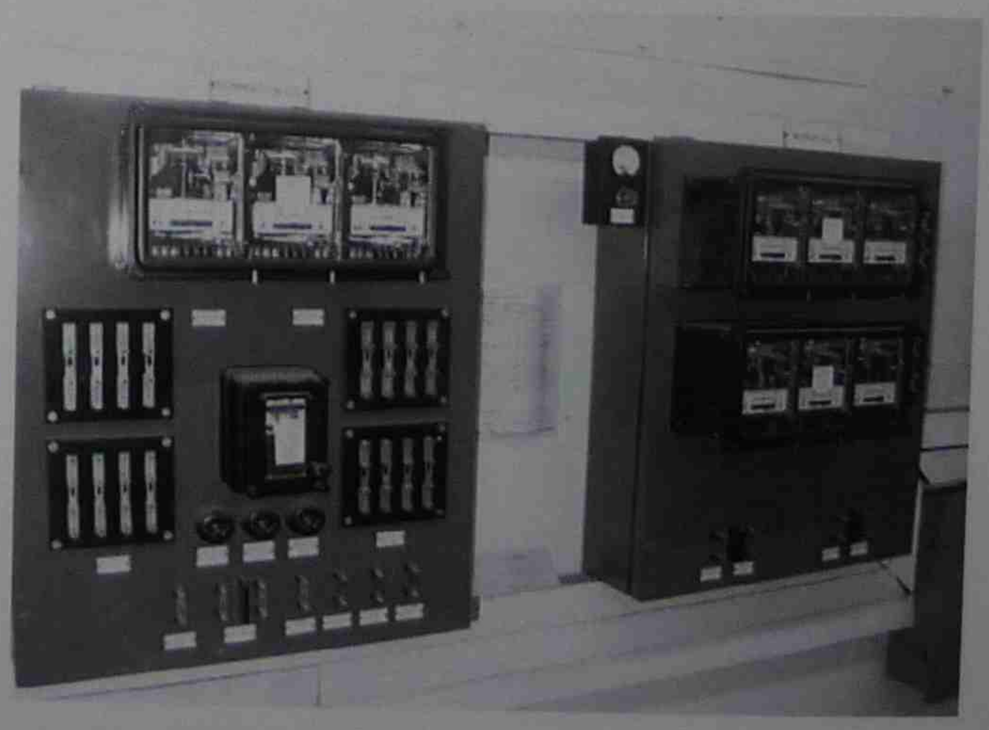
17.2 Circuit Breakers

– On all voltage levels. Designed to open under fault conditions to clear the affected section from supply. Unlike the household circuit breaker they do not sense and operate independently, this is done via a protection system which then send a trip to the circuit breaker.

17.3 Protection Systems (Relays)

Include:

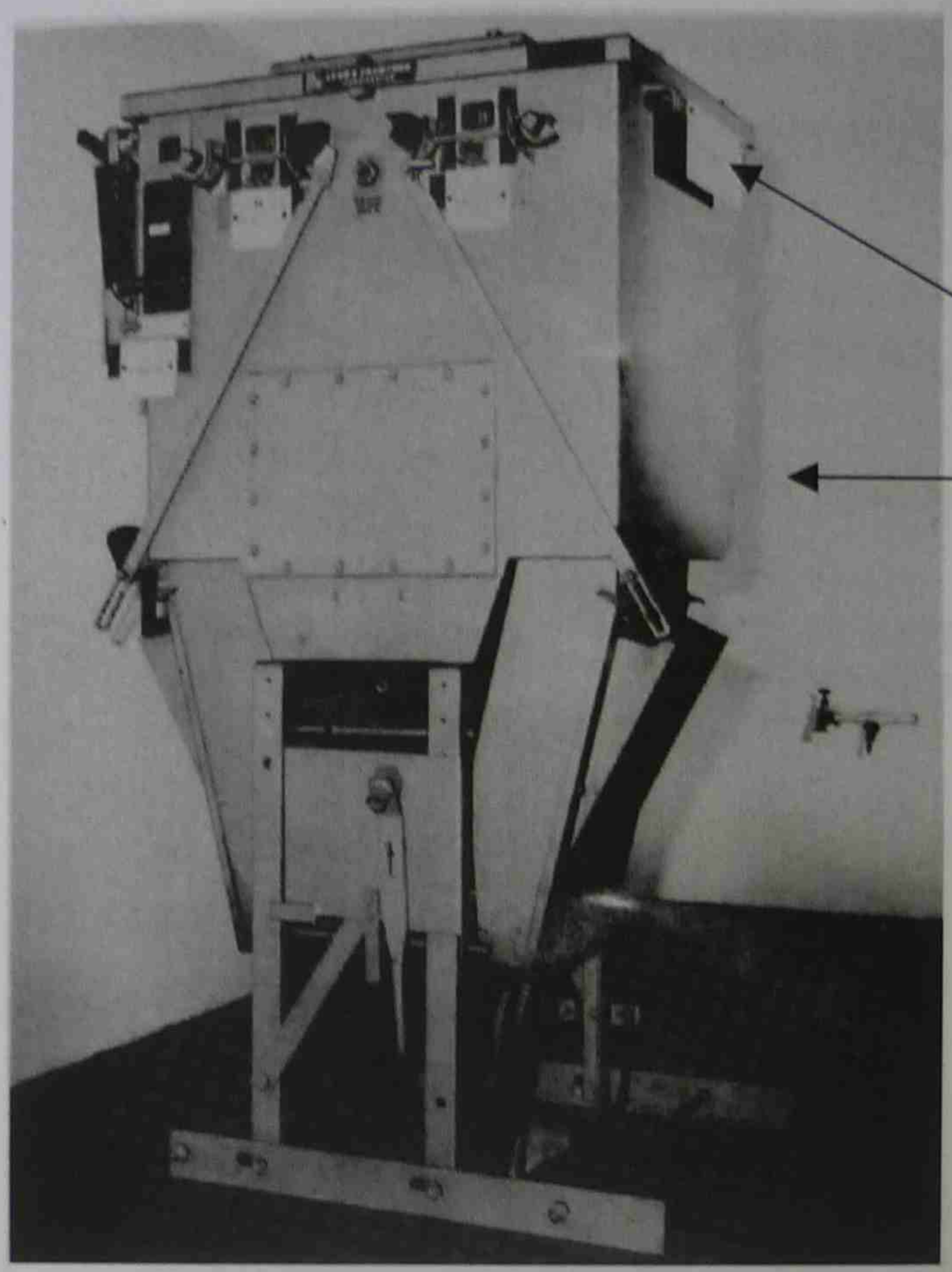
- Overcurrent – Detects excess current
- Earth Fault/Frame Leakage – Detects excess leakage current to earth
- Differential – Transformer Protection compares input to output and detects any imbalance
- Translay/Balanced Voltage/Pilot Wire – Cable Protection compares both ends and detects any imbalance
- Over Voltage/Under Voltage – as name suggests
- Distance – Complicated relay that compares voltage and current and decides if system is faulty or not.
- Buchholz/Oil Surge – Detects gases and fast oil movement in transformer, indicates burning or explosions inside transformer.



Protection panels will be of various sizes and shapes but all will contain exposed links which are safe to work around but workers should not touch as these links can have dangerous voltages and currents

17.4 Interlocks

ESR No	6.16



People's lives depend on interlocks remaining intact any damage must be reported straight away so repairs can be completed.

18. Confined Spaces/Substation Atmosphere

When working in places such as pits and vaults, ensure there is adequate ventilation to maintain a breathable and non-explosive atmosphere.

Sufficient ventilation may not be available in the following circumstances:

- after faults or explosions
- where there is a long entry, eg a tunnel
- when using LPG or other bottled gases, eg welding, soldering, de-compounding
- when opening chambers or equipment containing heavier-than-air insulating gases, eg SF6 equipment
- where exhaust fumes could enter, eg vehicles or stationary engines operating near the entrances or ventilation openings.

If at any time, you suffer from:

- eyes, nose or throat irritations
- difficulty in breathing
- a ringing sensation in the ears

leave the area immediately and do not return until the area has been checked with a gas detector and adequate ventilation has been re-established.

ESR No	6.14

Confined Spaces include:

- underground substations
- joint holes
- pits and vaults
- tunnels
- transformer tanks
- open hole more 1.5m
- open hole less 1.5m no ventilation work with head and shoulders below ground

You must comply with the requirements of NUS 151 *'Work in Confined Spaces'* and the various Network and Technical Standards which contains procedures for operating gas detectors.

18.1 Training

EnergyAustralia recognises a variety of confined space courses and requires all personnel show proof of such training every 12 months. This training should be stamped in your Network Passport. Confined Space, Training courses are available from EnergyAustralia.

EnergyAustralia Training Contact	Phone

18.2 Underground and Basement Substations or Chambers

Underground or basement installations require extra precautions.

ESR No	6.7.1

Under certain conditions, parts or chambers of substations or switching stations may be subject to atmospheric contamination (or oxygen deficiency). They then become classified as 'confined spaces' under the *Occupational Health and Safety (Confined Spaces) Regulation* 1990. When this happens, you must comply with the requirements of NUS 151 *'Work In Confined Spaces'*.

Underground Substations are always a confined space.

Since the vent is directly in the road there is a real risk of atmospheric contamination.

Basement Substations have vents, which connect to the building ventilation so are dependent on position of ventilation outlets.

If there is no risk of air intake contamination, no work processes used that will create atmospheric contamination or oxygen deficiency and at least one transformer on load then the substation is not a confined space. However, you must always comply with the following minimum precautions:

- Before entry, use a gas detector to test the atmosphere in the entrance chamber, to ensure it is safe. **Do not enter** to do this, but lower the gas detector or sensor head into the chamber first.
- While you are inside, operate the gas detector continuously to monitor the atmosphere. Place the detector as close to you, and as low, as possible.
- If the gas detector alarm sounds, **get out of the substation immediately**.
- If the gas detector readings vary from fresh air readings, investigate the cause before continuing work.

18.3 Use of Fall Arrest Systems for Underground and Basement Distribution Substation Entry

AS 1657 *Fixed platforms, walkways, stairways and ladders – Design, construction and installation* sets down requirements relevant to safe access to and safe working at places normally used by operating, inspection, maintenance, and servicing personnel.

There are three categories of Basement and Underground Substation access.

1. Entries from building basements and carparks
2. Entries from building facades, with a ladder ascending/descending from an entry chamber
3. Entries from footpath hatchways

In general, walkways, stairways and step type ladders with a pitch of 60-70° comply with AS 1657. Note that normal ladder climbing ie:

- ensuring that the rung of the ladder is under the instep of your foot
- using the 'three points of contact' principle

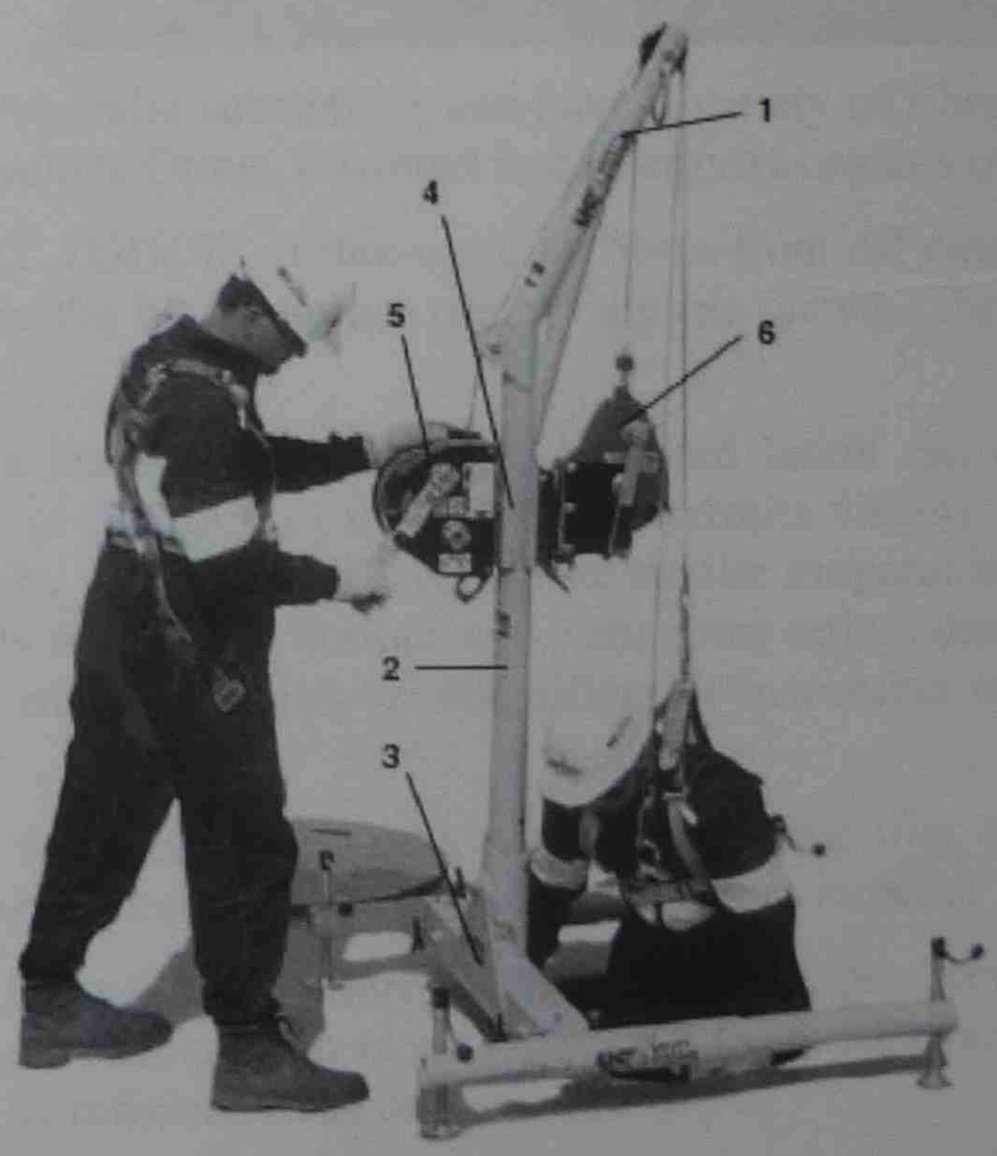
- lowering equipment down the access hatchway rather than carrying it down.

Ladders with a pitch of greater than 70°, 'vertical' ladders and wall-mounted rung ladders also generally comply with AS 1657. However, some form of fall arrest must be used in these cases, and the above ladder climbing precautions must still be used.

In general, if a substation has one access complying with AS 1657, then this should be used as the 'normal' personnel entry and exit point, and the non-compliant access should be used for emergencies only.

In cases where both substation accesses do not comply with AS 1657, a fall arrest system should be installed or positioned at the most convenient access point. This point should then be used as the 'normal' personnel entry and exit point, and the other access should be used for emergencies only.

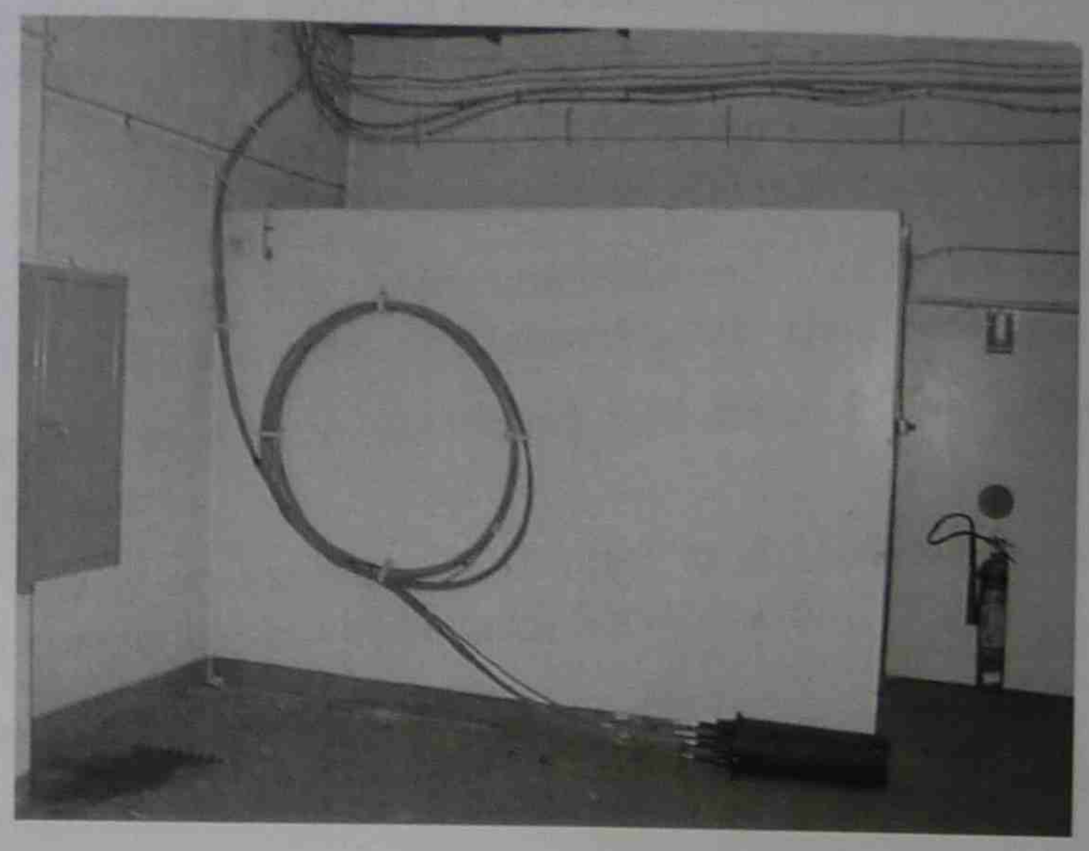
Under emergency conditions, regardless of which access is used, it is not necessary to use a fall arrest system. It is considered that risks arising from delays outweigh those from ladder fall for substation installations. (DG37)



1. Davit Arm
2. Stem
3. Level
4. Rescue winch mount
5. Rescue winch
6. Fall arrest/control descent device

19. Dangers and Contaminants

19.1 Fibre Optic Cables



EnergyAustralia substations can have a variety of fibre optic systems present. These include Optus, Powertel and EnergyAustralia's own signal system.

DO NOT TOUCH - Fibre-optic as fibres from off cuts can penetrate the skin and enter the blood stream where they can damage the heart and possibly kill you.

Invisible Danger: WARNING - Infra-red lasers can damage the retina (the 'screen' at the back of the eye which permits vision). As well, infra-red light emitted by infra-red LEDs can cause similar irreparable damage when the light source is magnified. Serious and permanent retinal damage may be caused by the use of microscopes or magnifiers or inspection scopes on active optical fibres.

Ensure that before use of a microscope, magnifier or inspection scope, all necessary precautions have been taken. These include:

(a) identifying the fibre to ensure the fibre, patchcord or connector that you are looking into is not connected to an infra-red light source (Not even an infra-red LED or test source).

(b) ensure that either:

- an infra-red filter is fitted to the microscope or magnifier or inspection scope and that it is in good condition (ie not broken, cracked, chipped or scratched), or
- you are wearing infra-red filtering glasses or goggles (which must be in good condition), or
- you use a camera and monitor- type inspection scope.

Note: Precaution (b) does not need to apply to patchcords disconnected from the optical network and completely isolated from infra-red light sources.

19.2 Polychlorinated Biphenyl's

Polychlorinated Biphenyls (PCB) are highly stable, non-flammable insulating liquids which were once used in the electrical industry.

They do not readily break down in the environment and residue accumulates in living tissue contaminating the food chain.

The effects of Polychlorinated Biphenyls (PCB) on humans depends on the form of contact and dosage. Dangers are cumulative and may cause cancer.

Whatever affected area has been contaminated, wash thoroughly to avoid ingestion. Full first aid measures on Material Safety Data Sheet.

Substitute liquids have been developed and most PCB products have been removed and replaced.

If you need details on handling PCB refer to *EG100 Oil Handling and Spill Response* and contact the Environmental Services Unit.

PCB Contamination Definitions

PCB Free Material	Material with PCB contamination≤2mg/kg.
PCB Material	
Non Scheduled PCB Material	Material with PCB contamination 2mg/kg-50mg/kg.
Scheduled PCB Material	Material with PCB contamination≥50mg/kg.
Concentrated PCB Material	Material with PCB contamination≥100,000mg/kg.

Note: For the purposes of this document, Milligrams per kilogram (mg/kg) can be considered the same as parts per million (ppm).

19.3 Asbestos

Asbestos dust contains tiny indestructible fibres, which can cause damage when they are breathed into the lungs. The most dangerous fibres are the smallest ones, which may be invisible to the naked eye, but which can penetrate the lungs most deeply. The amount of asbestos dust in the air people breath is the important factor in determining the level of risk. Almost all healthy adults have a few asbestos fibres in their lungs, which in most cases do them no harm.

If products containing asbestos are in good condition, they present no significant health risk. However, safety precautions must be taken when maintaining, repairing or removing equipment that has asbestos materials or when disturbing any product containing asbestos in a way likely to generate dust.

Safety at work is a high priority for EnergyAustralia and we have been pro-active in providing appropriate safe working procedure to protect staff from any hazards related to asbestos in the workplace.

A range of asbestos issues has been identified and agreed safe work methods have been developed and implemented. Where appropriate a number of removal programs have been initiated and are progressing.

Materials that contain asbestos have been used throughout EnergyAustralia. Some areas/products that have been identified include but are not limited to the following:

- NC compound/putty (when dried considered friable)
- Switchboards and panels (Lebah, Zelemite, Ausbestos)
- Arc chutes and barriers
- Bandaged cable (considered friable)
- Vinyl floor tiling
- Roof sheeting
- Internal insulation of fire doors
- Asbestos cement sheeting
- Moulded cement materials such as conduits, pipes, ducts and troughing.

Note: Friable asbestos is asbestos material that is easily crumbled or reduced to a powder.

Site audits of all substations have and are been undertaken and audit reports reviewed. At the completion of the review period, results are then added to the asbestos location register.

19.3.1 Asbestos Location and Product Register

The Asbestos Location and Product Register contains information on all EnergyAustralia's assets (including network, office and depot buildings) across our supply area that may contain asbestos.

(a) Location Register: provides specific information for each location including non-network buildings, and all substation and control point locations as listed in the Technical Information System (TIS).

(b) Location Catalogue: lists every type of EnergyAustralia building and network asset and the typical asbestos products that may be found at each.

(c) Products Catalogue: lists and describes the asbestos products known to exist in our premises.

The Register is located on Lotus Notes and is designed for use on a PC or laptop. Contractors can find location information from their contract administrator.

High risk asbestos items such as the asbestos bandaged cable will be removed as a first priority.

Low risk asbestos (bonded asbestos, in stable condition and left undisturbed) is not required to be removed and will be regularly inspected under the requirements of the asbestos management plan.

19.3.2 Work Procedures

Work procedures have been developed for working on or adjacent to materials that contain asbestos and must be followed when carrying out this work. The PPE requirements are clearly outlined for each specific work procedure. The level of PPE required will depend on whether the asbestos is in a bonded or friable form.

19.3.3 Training

Asbestos Awareness Training and/or Asbestos Removal Training is required to carry out the work with asbestos. This includes care and use of PPE (personal protective equipment) relating to asbestos procedures.

19.4 Dieldrin

Dieldrin is the common name of a compound that was once used as an insecticide. Dieldrin, in our case Arsenic Dieldrin is an Organo-Chlorine Pesticide (OCP) which was used as a treatment for termites in areas around our poles and cables. The chemical is made in a laboratory and does not occur naturally in the environment. Pure Dieldrin are white powders, while technical-grade Dieldrin are tan powders.

The US Department of Agriculture cancelled all uses of dieldrin in 1970. In 1972, however, EPA approved Dieldrin for killing termites. Use of Dieldrin to control termites continued until 1987. In 1987, the manufacturer voluntarily cancelled the registration for use in controlling termites. Dieldrin is still present in the environment from these past uses.

Dieldrin in soil or water breaks down (degrades) very slowly. Dieldrin sticks to soil and may stay there unchanged for many years. Water does not easily wash dieldrin off soil. Dieldrin does not dissolve in water very well and is therefore not found in water at high concentrations. Most Dieldrin in the environment attaches to soil and to sediments at the bottoms of lakes, ponds, and streams. Dieldrin can travel large distances by attaching to dust particles, which can then be transported great distances by the wind. Plants can take up Dieldrin from the soil and store it in their leaves and roots. Fish or animals that eat Dieldrin-contaminated materials store a large amount of the Dieldrin in their fat. Animals or fish that eat other animals have levels of Dieldrin in their fat many times higher than animals or fish that eat plants.

19.4.1 Health Effects

Symptoms of Dieldrin poisoning have been seen in people who were exposed to very large amounts of these pesticides during their manufacture. Symptoms of poisoning have also been seen in people who intentionally or accidentally ate or drank large amounts of dieldrin. Most of these people experienced convulsions or other nervous system effects, and some had kidney damage. Some people who intentionally ate or drank large amounts of Dieldrin died. Health effects in people exposed to smaller amounts of Dieldrin occur because levels of the chemicals build up in the body over time. Exposure to moderate levels of dieldrin for a long time causes headaches, dizziness, irritability, vomiting, or uncontrollable muscle movements. Some sensitive people seem to develop a condition in which dieldrin causes the body to destroy its own blood cells.

Studies show that high levels of Dieldrin cause effects on the nervous system and on the kidneys. Results also show additional effects after exposure to lower levels for longer periods including changes in the liver and reduced ability to fight infections. Studies in animals give conflicting information but show dieldrin may cause birth defects, make it more difficult for male animals to reproduce and may damage sperm.

Listed as Possible Carcinogen and a Possible Mutagen.

19.4.2 Contamination and Precautions

Exposure to Dieldrin occurs when you drink water, breath air, or come into contact with contaminated soil at hazardous sites (Can be absorbed through the skin). Dieldrin remains in the environment for a long time and is usually detected in soil, sediment, and animal fat. Decomposition of Dieldrin gives off toxic fumes including carbon monoxide, carbon dioxide and hydrogen chloride gas. Levels of dieldrin have decreased over the years since they are no longer produced or used. The levels of Dieldrin in air and water are typically very low. If the proposed excavation work involves contaminated soils in the vicinity of underground sub-transmission cables, special protective gear must be worn and special handling procedures must be followed these will be provided by an EnergyAustralia's representative when requested.

Some basic precautions include:

- **Personal Protective Equipment** -Wear appropriate NIOSH/MSHA approved respirator, chemical resistant gloves, safety goggles, other protective clothing.
- **Hygiene Measures** - Safety shower and eye bath, Do not breath in, get in eyes or on skin or clothing, avoid prolonged or repeated exposure and wash thoroughly after handling.
- **Sediment Controls** –To stop spread of contaminated soils control measures must be put in place.

19.5 Creosote

Creosote is a complex mixture of many chemicals. EnergyAustralia has used two types of creosote, Low temperature creosote and high temperature creosote. Low temperature creosote was used for many years as a pole preservative later they changed to high temperature creosote for a few years before ceasing use entirely.

It was a brown to black oily liquid with a characteristic sharp smoky or tarry odour. Creosote was used to preserve power poles and many wood products.

Creosote does not occur naturally in the environment but it can be released to water and soil through its use as a wood preservative.

19.5.1 Health Effects

Reports describing creosote poisoning in workers through accidental or intentional ingestion of creosote indicate that brief exposures to large amounts of creosote can cause harmful effects on your skin, eyes, nervous system, and kidneys and can result in death. Longer-term exposure to lower levels of creosote can also result in damage to your skin, such as reddening, blistering, peeling and increased sensitivity to sunlight.

Long-term exposure to low levels of creosote, especially direct contact with the skin has resulted in skin cancer and cancer of the scrotum. An increased risk for cancer has been demonstrated in animals exposed to creosote. Birth defects have been seen in livestock exposed to coal tar creosote treated wood. Since these effects were seen in animals, it is also possible that they could occur in humans. The International Agency for Research on Cancer has determined that creosote is probably carcinogenic to humans.

19.5.2 Contamination and Precautions

Creosote can enter your body through the lungs as a contaminant of air, through the stomach and intestines after eating contaminated food or drinking contaminated water, or through the skin. Although there is no information on how fast or how much of the creosote mixture is absorbed, many of the parts of the creosote mixture are rapidly absorbed through the lungs and the stomach and the intestines.

Wear protective clothing, long sleeved shirt or overalls fastened at wrists and neck, with long legged trousers with trouser legs worn outside over boot tops, boots, socks and safety hat plus PVC gloves. Avoid wearing contaminated clothing - remove contaminated clothing before reuse.

Ensure a high level of personal hygiene is maintained when working near this product. Always wash hands before eating, drinking, smoking or using the toilet. After working with the product use warm soapy water and a well tufted wash cloth to thoroughly wash all areas of skin that have been contacted with product.

After washing, apply a broad-spectrum UV blockout cream or lotion on exposed skin areas before going into sunlight. Keep out of strong sunlight for 2 to 3 days after being affected by the product.

19.6 Arsenic Compounds

Arsenic is an element, in some ways it resembles a metal, in others a non-metal. Its close chemical relatives include nitrogen, phosphorous, antimony and bismuth. It is used in pesticides, fungicides, weed killers and wood treatment products which release arsenic to the environment. These releases are to the ground, air and water. The burning of treated wood is of particular concern, as the smoke may contain dangerous amounts of arsenic compounds and other chemicals used to treat the wood. Various preparations with inorganic arsenic compounds are registered in NSW as timber preservatives. Inorganic compounds such as arsenic trioxide and copper chrome arsenate has been used around our system. These inorganic arsenic compounds are classified by the National Health and Medical Research Council (NHMRC) as Schedule 7 poisons (Schedule 9 are considered the most toxic).

Arsenic Trioxide is used to treat active termite infestations by applying small amounts to termite galleries. A high level of skill by the pest control technician, and knowledge of the behaviour of termites, increases the probability of arsenic trioxide successfully destroying the infestation.

Copper Chrome Arsenate is found where you see green or blue green coloured dressed and natural timber poles, which are vacuum/pressure impregnated with CCA liquid treatment.

19.6.1 Toxicology

Arsenic is an element that is not essential for human nutrition, but is normally found in trace amounts in human tissues. It is acutely and chronically toxic to man, but the biological effects vary with differences in chemical form, solubility, dose, rate of exposure and route of intake. Arsenic compounds are cumulative, potent, protoplasmic poisons that block cell and tissue respiration, can paralyse smooth muscle and cause many small haemorrhages.

The commonest cases of persons being poisoned by arsenic are those in which arsenic is taken in a mixture or powder, but poisoning can also result from inhaling arsenical fumes or dust, and also by continual contact with the skin, especially when accompanied by perspiration. Most arsenic salts are soluble to some extent and are rapidly absorbed through the gastrointestinal tract or skin. Vapours are absorbed through the lungs.

Acute arsenic poisoning has been caused by ingestion of as little as 100mg of arsenic trioxide, while 130mg has been reported as a fatal dose. Furthermore, arsenic accumulates in the body, so that, small doses may become fatal in time. A single dose may require 10 days for complete disappearance and this slow excretion is the basis for a cumulative toxic effect. Several instances were reported where cancers of the skin and liver were attributed to arsenic in domestic water supply.

19.6.2 What effect might Arsenic and its compounds have on my Health?

Arsenic acid and its salts are known to be carcinogenic to humans. Some arsenic compounds are also considered to be teratogens (will harm a foetus). Lower levels of exposure to arsenic or its compounds may cause nausea, vomiting, diarrhoea, abnormal heart rhythm, damage to blood vessels, decreased production of blood cells, and a feeling of 'pins and needles' in the hands and feet. Long-term oral exposure (contaminated water) has resulted in stomach disorders, anaemia, a 'pins and needles' feeling in the hands and feet, skin lesions, and liver and kidney damage.

19.6.3 Environmental Effects

Arsenic and most of its compounds are solids that do not evaporate. They exist as small particles in the atmosphere. Burnt arsenic compounds exist as a gas. These remain in the atmosphere as gases or small particles until they settle into the soil or water depending upon where the air currents carry them. Arsenic is not water-soluble, but many of its compounds are water-soluble. These can contaminate ground water. Arsenic does not break down, but does change form.

19.6.4 Handling Procedures

- Wear protective clothing when risk of exposure occurs.
- Personal Eye Protection -When using pesticides or machining treated wood which contains arsenic compounds use safety glasses with side shields. Contact lenses pose a special hazard; soft lenses absorb irritants and all lenses concentrate them.
- Hands/Feet- Wear safety footwear. Wear impervious gloves. Avoid contact with ash.
- Use in a well-ventilated area. Avoid generating and breathing dust. Effective dust extraction and good ventilation is required. Wear appropriate respiratory protection.
- When handling, DO NOT eat, drink or smoke.
- Hygiene - Always wash hands with soap and water after handling. Work clothes should be laundered separately.
- Use good occupational work practice. Observe manufacturer's storing and handling recommendations.

19.7 HFR 992

Chemical name, mixed Perfluoro-2-alkylethyl stearate, is the white powder found on 11kV indoor heatshrink terminations. This white powder is a non wetting additive that the manufacturer has added to this style of termination, to prevent surface leakage currents and other surface activity in humid indoor environments.

The white powder does not affect the long term performance of the termination and there is no need to remove it.

The product has a low order of toxicity with no known human effects of over exposure.

Although not a carcinogen or mutagen and having no recorded harmful effects EnergyAustralia still recommends caution including the following-

- Avoid inhaling dust or fumes. Using local exhaust ventilation over processing equipment.
- Observe good standard of industrial hygiene.
- Wear rubber gloves.
- Wear safety spectacles or goggles.
- Wear protective clothing and non skid boots.

First Aid Measures:

- Skin, wash off with soap and water.
- Eyes, flush with plenty of water, seek medical advice.
- Ingestion, in case of problems seek medical advice.

20. Legislation and Standards

All work must be in accordance with relevant legislation and standards, including:

- Construction Safety Act 1912
- Occupational Health and Safety Act 2000
- Occupational Health and Safety Regulations 2001
- Electricity Supply (Safety Plan) Regulation 1997
- National Electricity Network Safety Code ESAA 01-2001 as amended
- AS 2865 Safe Working in a Confined Space
- AS/NZS 3012 Electrical Installations – Construction and Demolition Sites
- AS/NZS 4576 Guidelines for Scaffolding.
- Electricity Association of NSW publications.
- EC 14 Guide to Electrical Workers' Safety Equipment
- ISSC 24 Guide to Electrical Workers' Escape and Rescue Procedures
- ISSC 26 Guide for Operating Plant and Cranes Near Overhead Power Lines (Formerly Exemption 5099).
- ESAA NENS 01-2001, National Electricity Network Safety Code
- All persons shall comply with WorkCover requirements

All work must also comply with the following EnergyAustralia documents:

- EnergyAustralia's Electrical Safety Rules
- Relevant Network Standards including-
  - NS156 Working Near or Around Underground Cables
  - NS165 – Construction Work in Substations

20.1 The Electrical Safety Rules (ESR) book

20.1.1 Purpose

Is intended to be a working guide to safe work on EnergyAustralia's Supply Network. The book was written to conform to the Electricity Supply (Safety Plans) Regulations 1997.

20.1.2 Numbering

There is a contents list at the front of the Electrical Safety Rules book and this contains a list of the sections against the page number. At the rear is an index, which is an easier way of accessing the rules. The key words are against the rule number and the page they appear on. The numbering system that is used is similar to the one used in Australian Standards. The number has three parts for example 12.3.5. The first part is the section number as in the example, Section12. The second is the rule number as in the example, Rule Number 3. And the third part in the example is Clause Number 5.

The number system is not decimal as in section 12. If there is more than 10 rules in a section then it DOES NOT increment to the next section but the rule number goes to 11, the same applies with clause numbers.

20.1.3 The principles behind the Electrical Safety Rules

The basic principles behind the ESR (Electrical Safety Rules) are:

1. The safety of personnel

This is for everyone, employees and contractors, also the general public, trespassers and vandals.

2. The continuity of supply

This can affect hospitals, traffic lights and the elderly etc

3. The safe guarding of the mains and apparatus and other property.

20.2 NS165 – Construction Work in Substations

Network Standard NS 165 is EnergyAustralia's specification and requirements for construction work, including excavation, in EnergyAustralia's major substations and switching stations.

The principal objective of this Network Standard is to specify and achieve a safe system of work, having regard to the electrical hazards in substations.

This Network Standard applies to all construction work, including excavation work, in and around EnergyAustralia's sub-transmission and zone substations, and switching stations, and other installations where specified in contract documents. It includes structural, civil and excavation works, construction work on structures for electrical equipment and work on oil containment installations. It does not cover work on the installation, removal, maintenance or repair work of electrical equipment. This standard does not apply to routine non-electrical maintenance work, such as transformer painting etc.

Note: Where the work is being carried out under contract or other form of agreement with EnergyAustralia, all documents shall be read in conjunction with the Contract Documents or agreement documents as applicable.

Appendix A - Checklists

As well as the daily Hazard Assessment Checklist the following checklists, if applicable, shall be completed daily:

A1 Daily Cable Excavation Checklist

A2 Daily Checklist for Operating Jackhammers and Saws/cutters

A3 Daily Checklist for Operating Equipment and Plant.

A1 - Daily Cable Excavation Checklist

DATE: ___/___/___

DAILY CABLE EXCAVATION CHECKLIST

AREA OF WORK: _____

	Tick appropriate box Yes	No		
1.	☐	☐	Check cable diagrams.	
2.	☐	☐	Check Surveyed Cable Location Drawings (refer Clause 5.4.3).	
3.	☐	☐	If a cable is not identified on a Surveyed Cable Location Drawing, undertake further surveys or call Enerserve Network Testing for further surveys.	
4.	☐	☐	Check cable depths.	
5.	☐	☐	If excavating around high voltage cables (ie higher than 1,000 Volts), arrange for Access Permit Recipient.	
6.	☐	☐	If excavating under busbars or other live conductors, check that the minimum safe working distances can be maintained. If the minimum safe working distances cannot be maintained, apply for an Access Permit. The minimum safe working distance for this substation is ____ metres	
7.			If excavating within a one metre radius of a cable (two metres for sub-transmission cables)	
	☐	☐	a	Has an Access Permit or permission in writing been obtained from the Project Manager to start work?.
	☐	☐	b	Has a safe work method statement been provided by the Contractor to the Project Manager for review and authorisation before any work in relation to the Safe Work Method Statement commences?
	☐	☐	c	Has the Safe Work Method Statement been reviewed and authorised by the Project Manager for use, before the work referred to in the Safe Work Method Statement has commenced.
	☐	☐	d	Are all excavations within one metre of live cables (two metres for sub-transmission cables) excavated by hand, with a shovel, using short scraping motions, pulling the shovel and earth towards the operator.
	☐	☐	e	If sub-transmission cable, notify the on-call contact officer on pager (02) 9962 4558.
8	☐	☐	Excavate in areas where cables are known to cross the path of excavations first, to enable cables to be sighted thereby allowing greater certainty when excavating elsewhere in the yard.	
9	☐	☐	Visually assess the location of yard lights, yard GPO's, services boards, control cables to equipment etc. Arrange with the Project Manager to disconnect power if practicable to these localised items if there is a possibility of cables existing in the area.	
10	☐	☐	Hand excavate to at least 1.5 metres or greater for all excavations to ensure no cables exist in the area. Assess localised areas to evaluate the likely depth of cables and hand excavate past 1.5 metres depth if necessary.	
11	☐	☐	If required to excavate under cables, speak to the Project Manager about mechanical protection and support of cables.	
12	☐	☐	Has a Safe Work Method Statement for backfilling and use of cable warning tiles been developed through consultation with the Project Manager?	
13	☐	☐	Has the Safe Work Method Statement for backfilling and use of cable warning tiles been authorised by the Project Manager?	
14	☐	☐	Is there new work or conditions on the site requiring a new hazard identification and risk evaluation?	
15	☐	☐	Have weather conditions changed requiring a re-evaluation of the risks associated with the work?	

If any box is ticked NO, do not commence with any work

A2 - Daily Checklist for Operating Jackhammers or Sawcutters

DATE: ___/___/___

DAILY CHECKLIST FOR OPERATING JACKHAMMERS OR SAWCUTTERS

AREA OF WORK: _____

	Tick appropriate box Yes	No	
1	☐	☐	Check cable diagrams.
2	☐	☐	Check Surveyed Cable Location Drawings (refer Clause 5.4.3).
3	☐	☐	If a cable is not identified on a Surveyed Cable Location Drawing, undertake further surveys or call Enerserve Network Testing for further surveys.
4	☐	☐	Check depth of cables.
5	☐	☐	If sawcutting or jackhammering within a one metre radius of a cable (or two metres from sub-transmission cable) obtain an Access Permit.
6	☐	☐	Visually assess location of yard lights, yard GPO's, services boards, control cables to equipment etc. Arrange with the Project Manager to disconnect power if practicable to these localised items if there is a possibility of cables being in the area.
7	☐	☐	a) Has a safe work method statement been provided by the Contractor to the Project Manager for review and authorisation before any work in relation to the Safe Work Method Statement commences
	☐	☐	b) Has the Safe Work Method Statement been reviewed and authorised by the Project Manager for use, before the work referred to in the Safe Work Method Statement has commenced
8	☐	☐	Connect trailing earth leads to sawcutter or jackhammer.
9	☐	☐	Set up insulating mats.
10	☐	☐	Saw cut or jackhammer to depth of slab only. Stop and call the Project Manager if additional concrete is found beneath the pavement as this could be concrete encasing cables.

If any box is ticked NO, do not commence with any work

A3 - Daily Checklist for Operating Plant and Equipment

DATE: ___/___/___

DAILY CHECKLIST FOR OPERATING PLANT AND EQUIPMENT

AREA OF WORK: _____

	Tick appropriate box Yes	No	
1	☐	☐	Review proximity to overhead conductors and busbars with respect to travel paths, final operating position and work to be undertaken.
2	☐	☐	Obtain an Access Permit if the minimum clearance for plant and equipment cannot be maintained. (Refer to Clause 8.3.)
3	☐	☐	If the plant and equipment during its normal operation of work can maintain the minimum clearance for plant and equipment but may accidentally or possibly come closer than the minimum clearance, the person in charge of the plant and equipment shall arrange for an observer to watch and direct the work.
4	☐	☐	a) Has a safe work method statement been provided by the Contractor to the Project Manager for review and authorisation before any work in relation to the Safe Work Method Statement commences?
	☐	☐	b) Has the Safe Work Method Statement been reviewed and authorised by the Project Manager for use, before the work referred to in the Safe Work Method Statement has commenced?
5	☐	☐	Install earth leads to plant and equipment.

If any box is ticked NO, do not commence with any work

Appendix B - Portable Electrical Tools, Appliances and Equipment

Extract from QES16AR4

B1 - Earth Leakage Protection

Except for specific work, as documented in an Enerserve controlled procedure such as a Inspection and Test Plan/Safe Work Method Statement (Process Control Plan), all hand held and portable electric equipment must (even when supplied via a portable motor generator) be protected by a residual current device (RCD) having a rated tripping current not exceeding 30 mA.

The RCD can be of the portable type or it can form part of the permanent installation.

Interval for testing and tagging hand held and portable electric tools, appliances and equipment

	Interval between inspection and test		
	Item type		
Type of environment in which equipment is used	**Single insulated**	**Double Insulated**	**Cord extension sets and portable socket boards**
*Construction & Demolition sites	1 month	1 month	1 month
Factories, workshops & places of manufacturing, repair, assembly, maintenance or fabrication.	3 months	3months	3 months
Laboratories, tea rooms, office kitchens, first aid rooms etc.	12 months	12 months	12 months
Offices where equipment is not subject to constant flexing	5 years	5 years	5 years
Hire equipment	Before each hire		

* This requirement applies to sites where electricity is supplied from a system of wiring installed for Construction Work (as defined in the Construction Safety Act) and is not intended to form part of the permanent wiring.

Note: Competent Person; A person who has acquired, through training, qualification, experience or a combination of these, the knowledge and skill to perform the task correctly.)

B2 - Visual Inspection/Checklist

A competent person shall examine each item presented for the following as per the schedule above:

1) External damage to enclosures

2) Condition of connectors, plugs, or socket outlets

3) Damage to sheathing on supply/extension cords (internal conductors exposed)

4) Makeshift repairs by means of tape

5) Effective cord anchorage (ie no direct force on terminals/connections)

6) Legible rating plates on appliances, tools, devices, plug boards, etc)

7) Security and alignment of control knobs etc

8) Ventilation inlets/outlets unobstructed, wheels & castors secure and working.

9) Controls, interlocks, guards, alarms working and overload/over temperature protective devices are accessible and working.

B3 - Earth Continuity Tests

A *competent person* shall use a suitable ohmmeter or Insulation Resistance Tester to check that the following earth resistance values **are not exceeded for each item:**

1) From the earth pin of the supply plug to the metallic enclosure = **1.0 Ohm**

2) From the earth pin of the supply plug to oscillating or rotating metal parts such as drill chucks = **1.0 Ohm**

3) From the earth pin of the supply plug to the earth contact of socket outlets of cord extension sets, portable socket boards and portable RCDs = **1.0 Ohm**

B4 - Insulation Resistance Tests

1) The insulation resistance between each live conductor and the earth conductor of the supply cord of single insulated equipment shall not be less than **one Megohm**

2) The insulation resistance between each live conductor and accessible metal parts on double insulated equipment shall not be less than **ten Megohms**.

B5 - Tagging

Electrical tools, appliances, leads and equipment which pass the above tests shall be fitted with durable, non re useable, non-metallic tags (coloured in accordance with the Work Cover Code as follows):

Red	Blue	Orange	Green	White	Yellow
January	February	March	April	May	June
September	July	November	August	December	October

B6 - Failure of Inspection/Test

Tools, appliances or equipment which fail the inspection/test shall be immediately withdrawn from service. Any colour-coded tag shall be removed, a label warning against further use shall be attached, and the item shall be sent to an authorised person for repair or disposal.