UEPOPS430B
Control Permit To Work Operations

Trainee "On Job" Activity Workbook

Version 1

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Table of Contents

1. USING THIS LEARNER RESOURCE

This Student "On Job Activity Workbook" maps to the following unit of competence:

UEPOPS430B Control permit to work operations

1.1. *Essential Knowledge and Associated Skills (EKAS)*

This learning module contains information directly related to and addressing the following EK&S:

Unit Code	**Essential Knowledge and Skills**
UEPOPS430B	**KS01-PO430B Permit to work operations**
	T1 Evidence shall show that knowledge has been acquired for safe working practices of: • Relevant environmental, occupational health and safety legislation and regulations • Enterprise procedures • Plant drawings and manufacturers manuals • Introduction to and typical arrangements of power production plant • Relevant plant and equipment, its location • Enterprise recording procedures • Mechanical equipment isolation techniques • Electrical equipment isolation techniques • Mechanical isolation equipment types and characteristics • Electrical isolation equipment types and characteristics
	T2 Specific skills needed to achieve the Performance Criteria: • Interpret plant drawings and manufacturers manuals • Locate relevant plant and equipment • Identify plant status • Plan and prioritise work • Apply planning principles and techniques • Communicate effectively

1.2. LEARNING OUTCOMES

Before a person can approach within the applicable safe approach distances or work upon High Voltage cables, conductors, circuit breakers, transformers and other HV plant and equipment, it needs to be taken out of service, physically and electrically isolated from potential sources of electricity supply, earthed, and the person specifically permitted to work upon the equipment.

This is achieved through a combination of performing high voltage switching and issuing and/or receiving an approved Permit To Work/Access Permit/Access Authority .

Although it sounds like a simple task, because of the high voltages, currents and complexities of a electricity distribution network, HV switching and coordination of Permit To Work/Access Permit/Access Authority procedures must be performed in exactly the correct sequence with permission from the System Controller.

As HV switching is generally performed so that other works can be done, the task also involves the preparation and completion of permit documentation, including setting up safe work perimeters around the equipment to be worked upon.

At the completion of this learning module it is expected that you will be able to:

- Identify and use enterprise procedures and documentation for the purpose of preparing access permits (work clearances).
- Establish safe working perimeter taped areas.
- Brief other work teams about the isolation activities, the extent of the safe work area as defined by the access permit/Permit To Work/Access Permit/Access Authority and remaining and associated electrical hazards.

1.3. ASSESSMENT

Demonstration of competence can occur through a variety of ways. Usually a combination of assessment techniques are used to determine that you are fully competent.

Assessment is conducted by a qualified workplace assessor, or a subject-matter expert working in partnership with a qualified workplace assessor.

Typically you will be assessed by:

- Answering a series of written questions.
- Demonstrating practical skills in a simulated or actual work environment.
- Responding to verbal questioning and hypothetical scenerios.
- Through completion and submission of a logbook, signed off by a supervisor, indicating that you have successfully completed a range of tasks associated with power and instrument transformers in a substation environment.

Your workplace assessor is required to fully brief you on the method of assessment sometime well before assessment is to occur. If you are unsure or unclear about how you will be assessed you have the right to ask for clarification from either your trainer or workplace assessor.

1.4. RECOGNITION OF PRIOR LEARNING/CURRENT COMPETENCE

You may have worked for a considerable length of time in the electrical supply industry and want to be recognised for your skills and knowledge. If so, you can ask to be assessed and credited for the Unit of Competence that you already know and have experience in.

This is referred to as Recognition of Prior Learning (RPL) or Recognition of Current Competence (RCC). To receive recognition for past equivalent training you will be asked to provide evidence of this training, typically in the form of certificates issued by an organisation such as TAFE. Experience gained on-the-job will require you to put together a portfolio of evidence – references from supervisors, diary records of when you have performed the tasks, and certificates from training programs that may be applicable.

However, sometimes your knowledge and experience may be out-of-date or not now regarded as best practice, and an assessor may not deem you to be competent. When this happens you can then go back and study the learning module to pick up on those identified areas that you need to develop and improve.

2. INTRODUCTION

The electrical risks and consequences of an electrical incident involving HV are significantly greater than for low voltage.

Under fault conditions the higher voltages and fault current levels release massive quantities of energy.

The inherent hazards associated with HV systems are well recognised throughout the industry sector and consequently safety protocols and practices to effectively manage the risks are well defined.

Despite these precautions accidents still do occur. This clearly indicates that working with High Voltage is dangerous and demonstrates the need for a Safe System of Work.

Development of safe systems of work in relation to operation and maintenance of HV electrical systems should incorporate:

- identify potential to risk and hazards associated with the operation and maintenance of HV electrical systems, eg analyse potential impact associated with operation and maintenance of HV electrical systems and any any proposed changes to equipment or operating conditions;
- identify training requirements for persons reqired to operate and or maintain HV electrical systems, and implement any training required to address associated competency needs;
- ensure relevant documentation/instructions/procedures regarding technical practices associated with operation and maintenance of HV electrical systems are implemented and are current.

Most if not all organisations which have operational activities and/or maintenanace activities associated with HV electrical systems and apparatus ensure that operation and maintenance activities pertaining to High Voltage Systems are governed by Safe Systems of Work (SSOW), and ensuring that strict adherence to the organisations safety precautions and engineering practices are exercised at all times.

Safe Systems of Work (SSOW) for operation and maintenance of HV electrical systems generally consist of consists of a set of safety rules and procedures, the purpose of which is to reduce risk and inhibit the exposure of personnel to dangerous situations as far as practicable.

The key elements underpinning the Safe Systems of Work (SSOW) are:

- A person is appointed as having the overall responsibility for the conduct of HV operations and activities including maintenance and repair.
- All work/operations on the High Voltage System shall be controlled by a permit system (ie documented isolation and access procedures), and that this system specifies:
    - the specific equipment that requires access
    - Requirements for isolation, signage and earthing requirements; defines the safe work area, conditions and hazards where appropriate
    - Only authorises specific personnel to undertake the task (eg Work can only be undertaken by trained Competent Persons (or persons under supervision).
    - Permits for work can only be issued by Authorised Persons in Control.

- That safe working practices shall be followed at all times, and that work is to be carried out in accordance with a safe work method statement.
- That Prior to conducting any work a risk assessment is to be undertaken.
- Equipment is to be inspected prior to any work and is to be proven to be dead; and that Earths and/or short circuits shall be applied before commencing any work.
- That no work is to be undertaken on energised circuits or equipment at any time except for the purpose of switching and testing the equipment in accordance with an approved Permit to Test.
- That safe approach distances are to be maintained at all times by all persons working on or near HV electrical apparatus

In order to meet these objectives for Safe Systems of Work (SSOW) for operation and maintenance of HV electrical systems,

High Voltage switching operations may be required for a number of purposes. These include:

- Taking a high voltage electrical feeder or bus out of service.
- Performing maintenance or replacement of equipment such as transformers.
- Isolation of other high voltage electrical equipment including generators, circuit breakers, busbars, capacitor banks and singular items of HV apparatus such as isolators, earth switches, cable potheads, surge arrestors and portable substations.

The most common switching activity is associated with isolating or high voltage generators, feeders, bus systems, transformers and cables and other HV equipment for the performance of construction or maintenance tasks.

In any high voltage industry where electrical maintenance and isolation is carried out, it is possible the department responsible for the construction and/or maintenance tasks on HV equipment will be different from the department responsible for switching.

High voltage switching involves the operation of circuit operation devices associated with HV energy reticulation systems/networks. All work must be conducted according to established procedures and ensure the safety of all concerned.

It is therefore necessary to have some safeguards to ensure no switching to re-energise the electricity works can take place until all members of the work party are clear of the job, and know the electricity works are to be re-energised.

To achieve this, a document known as an Access Permit, Access Authority is utilised within a safe systems of work “permit to work process”.

3. HIGH VOLTAGE SWITCHING OPERATIONS

HV switching persons must be familiar with their enterprise's Electrical Safety Rules and H.V. Isolation and Access Procedures.

These procedures set out the minimum requirements that are necessary to ensure safe working on, or near electrical apparatus. It is important that you have a thorough understanding of all the rules and procedures, and that you always adhere to them. They have been prepared for the sole purpose of safeguarding you and others from electric shock.

Firstly, observe the rules and procedures yourself, and when working with others, ensure that they observe them too. Remember that even if you are observing the rules and procedures, but others aren't, it may be you who suffers an electric shock. If in doubt about any rules or procedures, ask!

Your priorities when carrying out HV operating work are to:

- ensure the safety of personnel who are required to work on, or in the vicinity of electrical apparatus and to safeguard the Public from electric shock;
- safeguard your enterprise's feeders and apparatus;
- reduce interruption of electricity supply to an absolute minimum.

Note: HV switching can only be carried out by an authorised person.

3.1. OPERATING WORK

A person, authorised by their enterprise to carry out HV operating work is called an operator.

Operating work involves:

- operating switches
- opening and closing links or other connections intended for ready removal, including live line clamps
- removing and replacing fuses
- securing all isolation points
- proving that mains and apparatus are de-energised
- earthing and short circuiting mains and apparatus
- identifying safe work areas
- issuing Access Authorities

3.2. Operating equipment

Operating equipment consists of the following items.

Testers	Used to prove whether a HV conductor is de-energised
Earthing equipment	For shorting and earthing lines and apparatus. Only approved operating equipment is permitted to be used, as makeshift earths may not be capable of carrying a fault current.
Clothing	Appropriate Personal Protective Clothing, safety helmets, insulated gloves etc. that are supplied by your enterprise must be used as, and where necessary
Communication equipment	Communication equipment can be a radio and/or telephone, and are used to coordinate the switching sequence or program

3.3. System diagrams

A System Diagram is a single line electrical circuit diagram used for planning of HV switching operations.

The System Diagram indicates the normal condition of the System. However during abnormal conditions coloured marker pins are used to indicate those switches that are in a position other than their normal operating position.

The diagram is not to scale, and includes all the information that is necessary for the operation of the HV system.

Diagram symbols.

Although all symbols meet Australian Standards, each enterprise will have their own standard drawing symbols which they use on all Cable Diagrams. You must be familiar with these symbols.

Minimum safe working distances

Whenever any type of work requires workers to go within the minimum safe working distances for maintenance, repairs or additions, on or near High Voltage (HV) installations, procedures must be in place to ensure that the work can proceed safely and also not affect other in-service parts of the network.

The work could include such things as cleaning, painting, weeding, construction work or general maintenance, not just electrical work.

The person responsible for arranging the work must ensure that if it is necessary for members of the work group to come within the minimum safe working distances as listed within the organisations Electrical Safety Rules/Safe Work Procedures.

The basic safety principle for HV states that “all high voltage conductors must be treated as alive until isolated, proved de-energised, earthed and short-circuited and an Access Permit issued”.

SECTION 3 - WORKPLACE LEARNING ACTIVITIES:

REFER TO ABR 5255 Volume 2, Revision 5

CHAPTER 55 High Voltage Safety Rules - and complete the activities listed below

1. Explain the role and responsibilities of an authorised HV switching person.

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2. Identify each item of safety equipment/clothing that your enterprise supplies for work in relation to HV switching and explain when it must be used/worn.

Safety equipment/clothing	**Use**
Safety helmets	
Protective clothing	
Insulating Gloves	
Communication devices	
Insulated tools and equipment	
Testing devices	
Operating equipment	

3. Ask your supervisor/mentor for a HV System Diagram for your enterprise. After you have studied the System Diagram:

Describe as many of the main features of the electrical supply system from the diagram provided.

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List, identify and interpret the symbols from the diagram provided.

Symbol	Interpretation

4. Describe what minimum approach distances/safe approach distances are and the responsibilities of workers with respect to these distances.

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5. Complete the table below by inserting the correct Safe Approach Distances.

Safe Approach Distance to exposed conductor (MAD) *	**Authorised Persons** **APC, PIC, CP, Safety Observer**	**HV aware (instructed) persons**
Nominal phase to phase voltage	**Safe Approach Distance (mm)**	**Safe Approach Distance (mm)**
LV, below 1 kV ac		
LV, below 1 kV dc		
HV, up to 11kV ac		
Safe Approach Distance to insulated conductor		
LV , below 1 kV ac and dc		
HV, up to 11kV ac		
Safe Approach Distance to enclosed conductor (HV and LV)	Arc Flash Protection Boundary	Arc Flash Protection Boundary

4 HIGH VOLTAGE SWITCHING

HV switching is the process of isolating HV electrical apparatus and can be used to initiate the following:

- the disconnection of electrical apparatus from the system for maintenance, repair or testing.
- the disconnection of electrical apparatus from the system for any other type of maintenance, or repair work that is not electrical but will involve working closer than the safe working distances from live exposed electrical equipment.
- the disconnection of electrical apparatus for work involving alterations to the system.
- re-arranging system configuration.

HV switching, or more accurately the opening and closing of high voltage apparatus is a means of transferring circuits and loads from one supply point to another or isolating electrical apparatus from supply.

This can be achieved by:

- paralleling two circuits together to form a ring main
- paralleling large transformers to form a master/follower arrangement
- or simply opening a switch to isolate a section of electrical apparatus.

Switching of any nature is a detailed and planned operation - it involves coordination between all parties concerned.

This includes:

- the person requesting a particular section of apparatus out of service
- the person preparing the switching instruction
- the individual involved in carrying out the switching instructions
- the recipient/holder of the Access Authority or the work party actually carrying out the requested work.

The supervisor is usually the person requesting a particular section of electrical apparatus to be de-energised and isolated so that maintenance crews can gain access to carry out maintenance or repair.

The supervisor must ensure that the requested apparatus is safe and adequate for the intended work, i.e. clearances from adjoining live electrical apparatus, busbar, or overhead electrical apparatus is in accordance with the minimum safe working distance specified in the relevant organisational policies procedures and/or safe work requirements.

Programmed work will have to be cancelled if:

- wrong points are isolated
- there is a failure to notice other electrical hazards
- switching request is not submitted to the appropriate person.

Failure to coordinate can result in additional expense, increased switching and unnecessary plant outages.

Each enterprise will have set guidelines for carrying out HV switching. However, they generally consist of:

HV Switching Procedures	procedures applying within an electricity supply enterprise relating to HV Switching including HV Switching Requests and HV Switching Instructions
HV Switching Requests	a request for a particular HV Switching operation
HV Switching Instructions	instructions detailing the switching procedures for a particular HV Switching Request

4.1 HV switching procedures

HV switching procedures are used within an enterprise to take electrical apparatus out of service for:

- repairs
- maintenance
- construction
- painting
- cleaning.

Switching procedures are the basic steps that, when completed, ensure HV apparatus is safe to work on, or near, and are generally the same irrespective of the individual enterprise.

Switching procedures must be completed prior to commencement of any work.

Switching procedures stipulate that before working on or near HV apparatus, the apparatus ***must be:***

1. **OFF LOADED** from the circuit **/** apparatus **DE-ENERGISED**
2. **ISOLATED** from all possible sources of supply and where possible, mechanically locked open and the **ISOLATION SECURED** to prevent unauthorised operation by attaching Danger Tags on or adjacent to all devices and controls that could be used to energise the electrical apparatus
3. **PROVED DE-ENERGISED** immediately after isolation
4. **EARTHED AND SHORT-CIRCUITED**
5. **CLEARLY IDENTIFIED WITHIN A SAFE WORK AREA** by erecting suitable barriers, tapes etc.
6. **ISSUE AN ACCESS AUTHORITY** to the responsible person in charge of the work/test and duly signed by the recipient and the work group.

The ***method and sequence*** of making the equipment safe ***must be adhered to*** at all times and ***no short cuts will be taken***.

The use of safe work practices is critical to ensure the safety of the workers and the prevention of damage to the equipment.

To carry out HV switching procedures the following must be completed:

- requirements for taking electrical apparatus out of service;
- switching requests;
- switching instructions.

4.2 Switching Requests

Prior to a request for switching, a number of items/issues need to be considered including:

- the length of time any maintenance/repairs will take
- the length of time the equipment stays out of service
- whether alternative supply, generators or equipment are available/required
- whether isolation and/or earthing is required from the main incoming supplies from another Supply Enterprise
- whether all interested parties have been advised of possible interruption
- whether the electrical system diagrams have been checked to ensure the correct switching sequence will take place and that all points of isolation have been identified.

These are just a few examples of items that should be checked prior to taking any electrical apparatus out of service. Once these points have been considered a request for switching can be made listing these items and other points of importance.

No high voltage switch or fuse is to be operated without authorization from the Controller or owner, except for the purpose of saving life or property. In the case of emergency operation, the network Controller or owner will be notified as soon as possible.

Therefore, in order for a particular section of electrical apparatus to be de-energised and isolated for work to be undertaken, a switching request will have to be made.

The employer develops the specific procedures applying within an enterprise. The information listed here is a guide.

- If more that one Access Authority is required, a separate switching request may be required. Specific procedures are developed in each enterprise for this situation.
- Isolation areas covered by different Access Authorities shall not overlap. In these circumstances, the isolation area will normally be expected to cover both work groups.

- Where work areas adjoin at a common isolation point two individual danger tags will be used on a common isolation point, between the two different work groups.
- Switching Requests may only be made out by an authorised person.
- Switching Requests may only be approved by the Network Controller or an authorised person.

SECTION 4 - WORKPLACE LEARNING ACTIVITIES:

REFER TO ABR 5255 Volume 2, Revision 5

CHAPTER 55 High Voltage Safety Rules - and complete the activities listed below

1. Complete the table below in relation to relevant factors/issues that you need to consider at your enterprise prior to organising a Switching Request including the information required and where/how to access it. Discuss your answers with your supervisor/mentor.

Issue/factor	Information

2. List the main points for preparing a HV switching request at your enterprise.

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3. Prepare a switching request using your enterprise's procedures.

5 SWITCHING INSTRUCTIONS

Upon receipt of an approved Switching Request, a switching instruction is made out by the Controller.

HV switching instructions take into consideration how a piece of high voltage equipment will be taken out of service and made safe for persons to work on or near.

Switching instructions are the detailed and itemised steps, which explain in a regimented manner, the overall process of isolating the requested electrical apparatus or mains.

Switching instructions follow the same steps as the switching procedure but contain detailed instructions **for a specific switching request** including how to:

1. de-energising	the piece of equipment (in other words turning it off)
2. isolation	of HV electricity works from all possible sources of supply and where possible, mechanically locked open
3. securing of the isolation	to prevent unathorised operation or interference. Danger Tags shall be displayed on or adjacent to all devices and controls that could be used to energise the electricity works
4. proving de-energisation	of the exposed conductors
5. earthing	and short circuiting the conductors
6. clear identification of the Safe Area for Work	by erecting suitable barriers, tapes etc. where necessary
7. issuing an access permit	to the responsible person in charge of the work/test and duly signed by recipient and the work party

5.1 FUNCTION OF SWITCHING INSTRUCTIONS

The function of the Switching Instructions is to ensure that all operations are carried out in the correct order, no steps are omitted and that all necessary safety precautions have been included.

Switching Instructions should always be prepared by referring to the HV System Operating Diagrams and any other necessary Operating Diagrams, to determine the switching items necessary, for the work to be carried out. The items laid down in the Switching Instructions must follow a logical sequence and must not be deviated from.

All items of plant which are to be operated must be described by their full designated name (and number when applicable) as specified on the System Operating Diagram. Those items which do not have specific names must be described in an unambiguous manner.

Where switching of protection and control Circuitry is to be included in the Switching Instructions, it will be necessary to consult Operating Diagrams or other such diagrams which show more detail of Protection Circuitry and Auxiliary Supplies etc.

Switching Instructions may involve the transfer of load, the interruption of load and the making of load (possibly all in the same Instruction). Therefore it is necessary for the person writing the instructions to know the capabilities of the relevant electrical apparatus.

Switching instructions should follow the principles outlined below:

- Written/printed by a responsible person with a thorough knowledge of the network, safety, switching, and loading procedures
- Each step follows in a logical sequence to the next and should be numbered
- Steps or numbers on the switching instructions shall be followed in correct sequence
- Switching instructions are taken off accurate diagrams of the overall network
- All information pertaining to the work should be included e.g. description of work, date, time and persons responsible for carrying out the switching and holding the access permit.

Information/Details contained within Switching Instructions

- *Dedicated unique number for each Switching Instruction. Also the reference numbers of other associated documents such as Special Circuitry Isolation Sheets, Protection Permits, Alteration sketches etc. are to be included.*
- *The Area responsible for the execution of the Switching Instructions*
- *The date, time and duration of the work with a brief outline of the work to be carried out.*
- *The effect of the outage on system security and any special provisions made to enhance security.*
- *A distribution list of all interested personnel.*
- *A schedule of time for the issue and surrender of Access Permits and/or Test permits.*

Switching Instructions should contain all the switching items necessary to isolate and restore the equipment and provide space to record the following steps:

Time	Used by Switching Officer, area Supervisor and Controller to record the actual times of execution of each step.
Operation Step No.	Lists a sequence of consecutive numbers given to each step of switching and **the sequence must be carried out in the order shown** and not deviated from.
Location	Entry identifies the place at which a switching step is performed.
Apparatus -	Must provide full description of the apparatus that is to be operated. The description must be as per System Diagram or standard unambiguous terminology.
Operation	Defines the action that is to be performed on the apparatus. Where such action is providing an **Isolation Point** or **Earthing Point** that is necessary for the issue of an **ACCESS AUTHORITY** or **TEST PERMIT**, then each such step must be designated with a letter, e.g. (A) (B) etc.

Where the switching steps can be grouped into a sequence with a single intent, e.g. the isolation of an particular piece of electrical apparatus, then each sequence may be headed with a short title as a means of segregating the different sections of switching steps, e.g. titles such as ISOLATION, EARTHING etc. This is particularly beneficial in a long and complicated set of Switching Instructions.

Points to remember:

Standard switching instructions for each job can be compiled and re-used if the electrical apparatus lends itself to straight forward isolation, and the operator checks to see that the format is appropriate for the standard instruction.

The Switching Instruction will be checked by a second Controller for any errors.

A duplicated copy of the Switching Instruction is then issued to the authorised person performing the switching. The original copy is to be retained by the Controller to permit supervision and confirmation of all phases of the Switching Instruction. The original copy is to be treated as the master record of all operations performed.

The authorised person performing the switching is to keep the Controller informed as to the state of the electrical system by regularly calling in key operations. The Controller is to record the times at which these operations are performed and sign off the master copy on completion of switching. Filed assemblies of Switching Instructions, Access Permits, etc. are to contain the master copy on top of all paperwork connected with the switching.

Only under emergency situations may a Controller vary the above procedures, either to repair electrical apparatus that has failed in service, or to safeguard people or property from potential sources of danger.

In such instances, the Controller shall record all switching steps provided to the authorised switching personnel who, in turn, shall repeat the instruction received from the Controller for confirmation both before and after the execution of the instruction. The Controller shall record that the instructions provided have been correctly executed. A copy of the switching performed in an emergency shall be filed for record purposes.

5.2 Communication devices

When you are speaking via radio or telephone you must:

- identify yourself;
- identify your location;
- identify your reason for calling.

When you receive a sequence of instructions on operating work, you must write down the instructions and then repeat the details of the instructions back. This is to ensure that you have received the correct instructions and that you have understood them.

Mobile Phones

Greater coverage and improved reception has increased the reliability of mobile phones and enabled them to be used as an alternative to radios for communication during switching procedures.

Radios

The Department of Communication licenses all radio transmitter/receivers and the licences are issued for particular frequencies. It is illegal to operate a transmitter/receiver without a licence for that particular frequency.

Transmitter/receiver may also be known as two-way radios.

Networks

There are two common types of communication networks:

- controlled
- uncontrolled.

A controlled network consists of a base station and a number of mobiles. In a controlled network, the majority of communication is between base and one or more mobiles. Communication directly between mobiles (called 'flank' communication) is only allowed after each station has received permission from base.

The uncontrolled network consists of hand-held portable transmitter/receivers operated without the control of a base; that is any unit may call any other unit. The uncontrolled network is essential for field communications, as it is to cater for short-range transmission and enables informal communication between any number of sets.

Correct communication procedures are required regardless of the communication network used. Failure to use the correct procedures will not only leave the operator in a difficult position, but also may jeopardise the safety of persons in an emergency.

It is important to remember that the transmitting and receiving sections of the unit are interconnected so they cannot both operate at the same time. This is done by means of a change over switch on the microphone. When the microphone switch is pressed, the receiver is automatically disconnected.

Microphone

The microphone is a sensitive piece of equipment that converts sound waves into an electrical signal.

Speak across the microphone, not directly into it. Speaking directly into the microphone may cause distortion.

Keep the microphone a constant distance form the mouth and supply a constant volume of tone.

Remember that the transmitter is activated whenever the microphone switch is pushed. Only press the button when transmitting because the signal will 'jam' the network and prevent others form transmitting.

Use of the radio communication

Because transmitting and receiving stations cannot operate at the same time there is a protocol for speaking over the radio. Your enterprise will have a set procedure for this. The following hints are normal procedure.

- Always listen before starting your call – don't interrupt others
- Always call the other user's call sign before starting your own
- Be concise and to the point
- Always give priority to emergency calls
- Radios are expensive – look after yours

When making a call the following are normal terms:

Term	Use…
'Come in…..'	When making with another user to get their response
'Receiving…'	When making first response to a call from another user
'Over'	When you've finished speaking and require a response
'Out'	When you've finished the conversation and cleared the airwaves
'PRIORITY Come in…'	At the end of the initial call to convey an emergency

5.3 Summary of common sense switching procedures and practices

Before commencing any operating, always consider the procedures in an orderly sequence and carry them out in that order. ***Do not attempt any short cuts*** when operating but retain the methods as advised. These methods are based on procedures practiced by experienced Operators and are designed to avoid errors.

Should you have the slightest doubts about the instructions, your ability, or consider the equipment defective, contact your Supervisor and request assistance.

One of the key points in any switching operation is ***"If you don't know how to do it, don't do it!"***

Summary of Common Sense Switching Practices

- Switch on lighting when entering an electrical control room irrespective of lighting requirements and ensure you also have a torch. This acts as a monitor of local system conditions. For example, if there were auxiliary supplies that should have been changed over, then on opening the circuit breaker all the lights may go out, or if you close onto an earth that had been forgotten to be removed during re-energising you would see a dip in the lights, or they might go out.
- Check that any circuit breaker trip coil D.C. supplies are okay. If the D.C. supply is not okay then under fault situations the circuit breakers will not be able to trip and major equipment failure could occur resulting in injuries to persons in the switchroom.
- Check that all exit doors are capable of being opened and passageways are clear.
- Use only the approved HV equipment, which has been made available for your use.
- Before operating any HV switchgear, ensure that the equipment appears to be in good condition and is not in need of maintenance. Note any oil spills, which could indicate a reduced level of oil in the switchgear. Where there are insulating medium indicators such as oil gauges, gas (SF_6) pressure gauges/indicators, check that the level is satisfactory.
- It is important to remember that electrical apparatus may become energised even though it is isolated, through the following means:
  - ☑ Induced static charges.
  - ☑ Accidental contact with other equipment in close proximity.
  - ☑ Being inadvertently energised from outside the Work Area.
- ***Never assume*** that all three phases are de-energised because one phase has proved de-energised.
- ***Never assume*** that conductors that have been proved de-energised will remain so. Regard them as alive and maintain minimum safe working distances, until earthing and short-circuiting equipment has been connected and Access Authority has been issued.
- When carrying out an isolation, ***lock and Danger Tag*** switches you have operated, so that no other person can operate the switch. Where a switch is withdrawable, ***lock closed*** all shutters, over live orifices and attach ***Danger Tags***.

An operating sequence procedure ***MUST*** be adopted and adhered to, ensuring a routine can be established, thus assisting in general safe work practices and avoidance of errors.

A recommended sequence would be:

1. Check for an alternative supply (where necessary).
2. Off-load and de-energise the equipment.
3. Check that the changeover to alternate supply has been effective.
4. Isolate from all sources of supply and attach Danger Tags.
5. Prove de-energised (prove testing equipment before and after the test).
6. Apply Earths.
7. Establish a safe Work Area where necessary by the use of approved tapes/barriers, warning signs etc.
8. Issue an Access Authority

This type of sequential operating can be adapted for most isolating requirements.

Switching can be a very technical and demanding task. However, if persons required to carry out switching operations follow these few simple rules before each operation, errors will be few and far between.

When following switching instructions, ask yourself these questions:

- **STOP.** What has to be done?
- Are you ***at the correct item*** on the switching instructions? Operations must be done in the sequence of the switching program (Check).
- Are you ***at the correct location***? (Check the panel or equipment number or designation).
- Are you ***at the correct switch***? (Check the switch label).
- ***What operation*** has to be carried out? (Open or close).
- **STOP.** Now check existing conditions.
- Is the switch ***in the correct*** position? (Check). For example, if you have to turn the switch on, is it off?
- Are there meters/instrumentation available ***to indicate*** circuit conditions? (If not a tong ammeter or other indicating devices may be required.)
- Are there ***any tests*** that have to be made before operations, for example, proving de-energised before applying earths etc?
- Are any ***other checks*** to be made before operation, for example, permit status, earths removed, circuit breaker status, phase rotation/Phasing required?

SECTION 5 - WORKPLACE LEARNING ACTIVITIES:

REFER TO ABR 5255 Volume 2, Revision 5

CHAPTER 55 High Voltage Safety Rules - and complete the activities listed below

1. **When are Switching Instructions used in your enterprise?**

2. **Who writes the Switching Instructions in your enterprise?**

3. **Who checks the Switching Instructions in your enterprise?**

4. **Explain the procedures and requirements for writing and checking Switching Instructions in your enterprise?**

5. **List factors that need to be considered when writing Switching Instructions.**

6. Obtain a copy a Switching Instruction used by your enterprise.

   Identify where the required information is located on your enterprise's Switching Instruction form. Discuss any questions you have with your supervisor/mentor.

7. Discuss with your supervisor/mentor the communications equipment used in your enterprise and the procedure for use. Practice using the equipment following the required procedures. When you feel confident ask your supervisor/mentor to observe you using the equipment.

6 Deenergising and Isolating Electrical Apparatus

De-energising is about removing the source of electrical energy, using appropriate switching devices.

Before operating any switching device, the following checks and actions should be performed in order to achieve safe operation of the device:

Checklist for switching

check the identification number/name of the device;

ensure the device is in good operating order including:

- level of insulating medium checked where possible
- visual check of condition
- operating handles connected to earth grid (touch potential)
- no unusual sounds or smells

know the load breaking/making limitations of the device and the expected load to be broken

wear the correct personal protective equipment

only use operating equipment designed for the purpose:

- use manufacturers handles
- operating sticks tested and in good order.

Once the above conditions have been satisfied the following needs to be adhered to while carrying out the operating work:

operating work must be carried out by **authorised persons only**, using operating equipment approved by the employer and rated for the voltages and service conditions applicable within that station;

before any remotely controlled electrical apparatus such as circuit breakers, isolators, tap changing equipment, air compressors, etc. **are operated locally** any remote control features must first be rendered inoperative;

electrical apparatus which is to worked on and, which is capable of storing some form of energy, such as circuit breaker operating mechanisms, should be **fully discharged** or otherwise rendered **inoperative** prior to work commencing unless otherwise requested by the work group.

Switchgear used to de-energise electrical apparatus must be capable of breaking normal load current without damage to equipment or injury to personnel.

The table below shows a selection of switches that can be found on various HV electrical systems. As you can see, only Circuit Breakers and Fuse Switches are capable of breaking full load current with Air Break Switches, Underslung Links and Drop Out Fuses having limited load-breaking capacity.

Switchgear Type	Carry Full Load Current	Make & Break Full Load Current	Close-On to a Fault Current	Break Fault Currrent
Circuit Breaker	✓	✓	✓	✓
Fuse Switch	✓	✓	✓	✓
Isolator	✓			
Links	✓			

6.1 SWITCHGEAR FOR DE-ENERGISING ELECTRICAL APPARATUS

Circuit breakers

Circuit breakers are designed to perform two duties. Firstly as a switch to open and close normal loads and secondly, to open under fault conditions when the current will be much greater than normal load current. Under both these conditions arcs are formed across the contacts as the switch operates.

The problem for the circuit breaker designer is to design suitable processes to extinguish this arc. Conditions favourable to arc extinction are:

- a long arc path (wide separation of contacts).
- a fast rate of making the path long (rapid contact separation).
- cooling of the arc stream and contacts (reduce the amount of ionised or conducting gas which forms the arc).
- Points 1 and 2 are purely mechanical and there are definite limits to speed and length of break.
- Point 3 is the main field in which developments have occurred in high voltage circuit breakers.

With AC systems an additional problem is to prevent the arc re-striking as the current wave alternates. As the current passes through zero further ionization ceases momentarily, and it is during this brief pause that interruption may take place if sufficient insulating medium can be imposed between the separating contacts. This may take a number of cycles to achieve.

Circuit breakers are classified according to the medium used to quench the arc. The most common are:

- oil
- SF_6
- air blast
- vacuum.

Oil Circuit Breakers

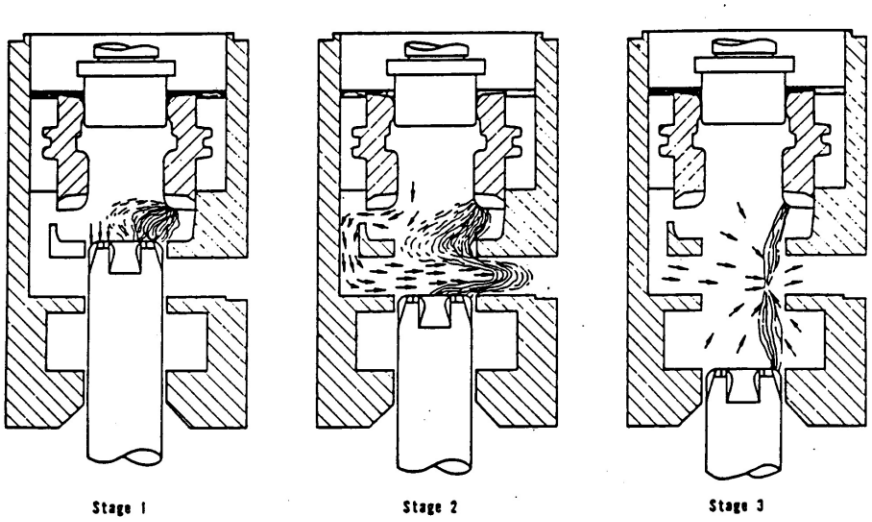
The use of oil as an insulator in circuit breakers has the following advantages -

- absorption of arc energy by decomposition of oil.
- good cooling properties of the gas formed, which has a high percentage of Hydrogen.
- the large cooling surface presented by the surrounding oil in close proximity to the arc.
- the ability of cool oil of high dielectric strength to flow into the arc space after the current zero.
- reduced clearances.

The disadvantages are -

- inflammability;
- maintenance required to keep the oil in good condition and the level correct;
- the large size because of the volume of oil needed.

The following diagram shows the stages of arc extinction in a minimum oil circuit breaker on opening of the contacts.



THE THREE STAGES OF OPERATION OF 'MINIMARC' INTERRUPTER AS FITTED TO TYPE J-18 CIRCUIT BREAKER

Stage 1 - the arc is being established

Stage 2 - oil flow is forced across the path of the arc to extinguish it

Stage 3 - the extinguishment of the arc.

SF_6 (Sulphur Hexafluoride) Circuit Breakers

SF_6 gas is non-toxic, non-flammable and odourless having a density of 5 times that of air.

It is an exceptional insulation medium, with a dielectric strength 2 to 3 times that of air at atmospheric pressure. This ratio increases with increasing gas pressure.

Common operating pressure for 132kV switchgear is 28OkPa, at which the dielectric strength is equivalent to that of transformer oil.

Because of the good insulation properties these circuit breakers are extremely efficient and are currently being used across the full range of voltages for both indoor and outdoor circuit breakers.

The circuit breaker usually consists of each phase contained in separate insulated chambers and operated by a common drive mechanism.

A great advantage of this type of circuit breaker is the compactness of the breaker, requiring a smaller area for installation. The maintenance of this type of breaker is also reduced.

NOTE:	**Gas masks offer no protection against lack of Oxygen.** **Decomposed SF_6 has a pungent smell and is toxic.**

Air Blast Circuit Breakers

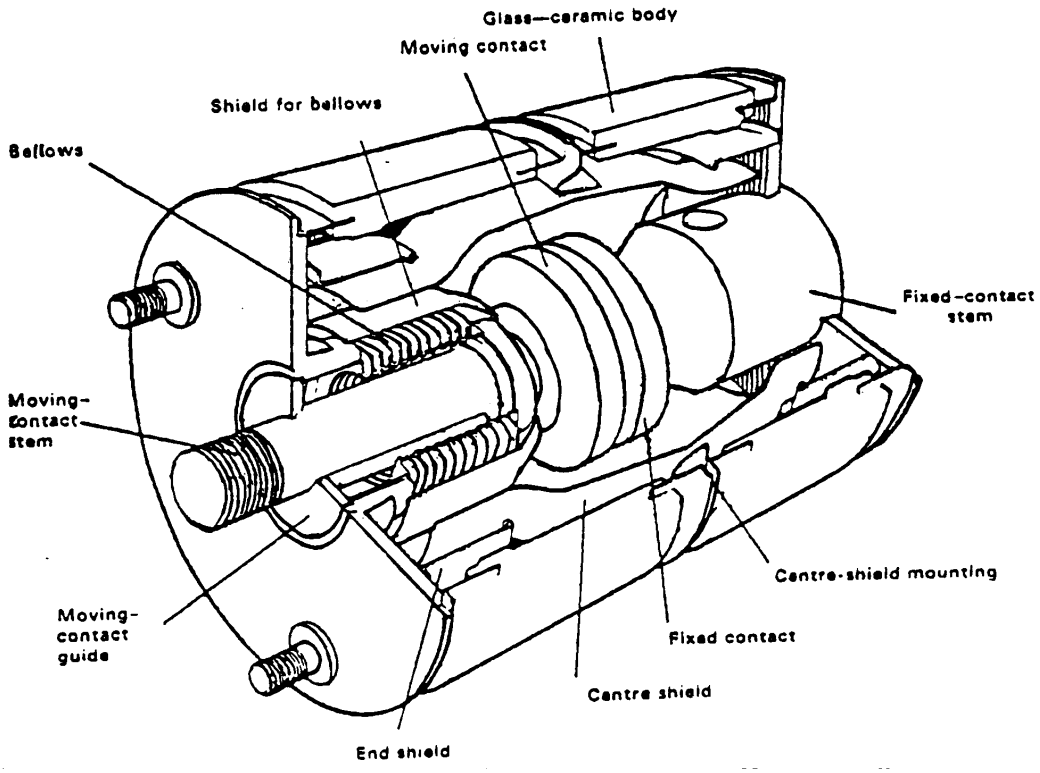
Air blast circuit breakers rely on a ***'blast'*** of compressed air across the contacts to extinguish the arc. This compressed air can be supplied via external air compressors and storage cylinders or can be an integral part of the design of the circuit breaker.

Vacuum circuit breakers (vacuum interrupters)

The advantages of vacuum circuit breakers are:

- minimum maintenance
- quiet operation
- oil free, no fire hazard operation
- no exhaust gases for flameproof operation
- re-strike free operation and low current values
- short travel and low energy requirement of contacts
- compact size and low weight.

Theory and construction of vacuum circuit breakers



As can be seen in the above diagram, the vacuum circuit breaker comprises a sealed vessel with insulating side walls and metal ends containing a fixed and a moving contact, the material and geometry of which dictate the performance or the circuit breaker.

The moving contact has a guide and is permitted to move in the vacuum enclosure by means of a metal bellows. Shields surround the contacts to prevent the metal vapour released during operation from condensing on the insulating walls of the chamber.

The short travel and low energy requirements of vacuum circuit breakers ensure a maintenance free mechanical life or at least 50,000 operations.

The life of the equipment is governed by the operational conditions at a particular installation.

Control of circuit breakers

Circuit breakers can be operated manually or automatically.

Manual operation is performed by operating the open or close switch on the circuit breaker, or preferably remotely, this is the usual means of operating the circuit breaker.

Automatic operation occurs when the ***protective devices*** associated with the circuit breaker ***detect a fault*** causing it to ***'trip'***.

Both of these methods rely on some form of control system that tells the circuit breaker to open or close.

HV circuit breakers use a **DC** supply for the control systems because of its reliability. The DC supply is obtained from a bank of batteries situated in the switchroom and these are connected to a battery charger that maintains the voltage level of the batteries.

This battery charger maintains a ***'trickle'*** charge on the batteries. Some battery chargers have automatic charging systems so that if the battery voltage level falls below a set level the battery charger will change over to ***'Boost'*** charge.

If the DC supply is faulty and a fault occurs on the HV System, or HV equipment, controlled by circuit breakers, then the circuit breakers will not operate to clear the fault as they need the DC supply for their control circuits.

This may result in major equipment damage as well as personal injury to anyone in the switchroom.

It is therefore most important when entering a switchroom to ensure the DC supply is *'healthy'*.

Protection Schemes (Automatic Operation)

All circuit breakers are designed to act as fault clearing devices similar to a household fuse, however, they operate much quicker and can interrupt fault currents in excess of 20,000 Amps.

Before the circuit breaker can clear these faults it needs to be told that a fault has occurred, this is accomplished by protection relays designed to detect different types of faults.

The most common types of fault that occur are phase to phase faults, i.e. short circuit between phases, and earth faults, i.e. where one or more phases come into contact with earth or something at earth potential.

Phase to phase faults are detected by overcurrent relays of which there are different types.

Earth faults are detected by earth fault relays and again there are different types of these relays. The relays have ***'flags'*** that drop to indicate relay operation and identifies which phase(s) have been affected.

Earth fault schemes rely on current transformers (CTs) to detect the fault current. The CT's transform the fault current to a manageable level for the relays to operate within their limitations.

The newer types of relays are electronic operation and have indicating LED's (light emitting diodes) instead of flags. These LED's light up under fault conditions. The exception being the ***'Power Supply'*** LED which should be on at all times.

Before closing any Circuit Breakers these relays should be checked and if any flags/LED's are indicating, the cause of the relay operation should be investigated prior to closing the circuit breaker.

Circuit Breaker Operations

Persons (Operators) carrying out switching procedures on an high voltage system will need to operate circuit breakers as part of that work.

The operation of circuit breakers can be part of normal system control work or part of the de-energising, isolating, proving de-energised and the application of earthing equipment to make safe electrical apparatus for the issue of an Access Authority.

The Access Authority will be issued for work on an item of electrical apparatus within the isolated area.

When operating circuit breakers, the person carrying out that switching process must understand what will happen when the circuit breaker is opened or closed.

Circuit breaker controls can be either:

- A three position switch, the three positions being **Open**, **Close** and an in between position called the **Discrepancy** position.

  The control switch for each circuit breaker will normally be in the Open or Close position.

  If circuit breaker is **closed** then the indicating lamp within the control switch is **on**, if the circuit breaker is **open** then the indicating lamp within the control switch is **off**.

  If the control switch is selected to discrepancy before final operation then the lamp within the control switch will **flash** as a warning check before final operation.

  The lamp **will also flash** if the circuit breaker has for some other reason operated automatically and is then in a position **other than that indicated** by the control switch.

  This can happen as a result of a protection operation causing the circuit breaker to trip.

  Coupled with the flashing lamp will be an audible bell or alarm to help highlight the abnormal operation of a circuit breaker.

OR

- A three position auxiliary switch, the three positions being **Supervisory**, **Local** and **Maintenance**.

  In the **Supervisory** position, the circuit breaker operation (ie. open-close) is controlled through the SCADA system from either a remote control room or from the substation terminal unit (STU) in the substation.

  In the **Local** position, the circuit breaker operation is control from the substation control panel.

  In the **Maintenance** position, the circuit breaker operation is control from the circuit breaker open close switch only.

OR

- The circuit breaker controls could simply be **Open** and **Close** pushbuttons with associated Open and Close indicating lamps on the control panel above each pushbutton.

  The corresponding pushbutton lamp will be illuminated to indicate which position the circuit breaker is in.

Persons carrying out high voltage switching work must also have a good knowledge of the operating aids available to determine whether the actual opening or closing of the circuit breaker was successfully accomplished.

Operating aids consist of:

- instrumentation such as voltmeters, ammeters, load indicators,
- control panel indicating lamps for circuit breaker control,
- relay operations,
- alarm indications,
- auxiliary supplies, and
- control room lights.

Listed in the steps below are the processes involved in the opening and closing of circuit breakers.

Matters to Consider When Opening a Circuit Breaker

Whenever an Operator is required to open a circuit breaker then the following considerations must be made by the Operator -

1. Check if there is any abnormality within the substation, or any other apparent reason that suggests the circuit breaker should not be opened. If there is then the matter should be referred to the Controller or Area Supervisor,
2. Check what instruments are available on the control panel as operating aids, consider their expected behaviour, and check that such behaviour does occur during or directly after the actual operation.
3. If the circuit is carrying load, check that an alternative parallel supply is available to pick up the load or whether that load is to be interrupted. If a local check cannot be made, the Operator must receive advice from the Area Supervisor.
1. If the ammeter reading is near zero, press the fine scale button (where provided) and watch for pointer movement.
4. Where auto-close (auto-standby) facilities are provided, the Operator should make it non-auto if isolation is to follow.
5. The Operator must warn any staff, who may be in the vicinity of the circuit breaker of its pending operation,

6. The Operator selects the circuit breaker control switch to the discrepancy position (lamp flashes), then checks the correct circuit breaker has been selected.
7. Operates the control switch in the indicated direction (**O** or **Open**), the lamp will go out. If it is just pushbutton control then the Operator must ensure the correct circuit breaker is selected before pressing pushbutton, the lamps will change over from Close to Open.
8. Immediately after opening the circuit breaker the Operator should check load pick up has occurred on alternative circuits,
9. Check that the circuit breaker indicator shows open and that the circuit breaker is in a satisfactory condition,
10. For those circuit breakers where the close operation is performed mechanically by a spring, check that the spring is charged.

Matters to Consider When Closing a Circuit Breaker

When an Operator is required to close a circuit breaker then the following considerations must be made by the Operator :

1. Check that all Access Authorities have been cancelled (surrendered) and indicate the equipment as being fit to return to service,
2. Check that all Earth Switches, Working Earths and Operator Earths have been removed from the circuit, that is to be energized by the closure of the circuit breaker,
3. Check that all associated protection devices are auto and that no multi-trip relays, flags or LED's (light emitting diodes) have operated. Any abnormality should be reported to the Area Supervisor before relays, flags or LED's are reset,
4. Check what instruments are on the control panel as operating aids, consider their expected behaviour including transfer of load, and check that such behaviour does occur during or directly after the actual operation of the circuit breaker,
5. Check that the substation and / or System conditions are suitable for any resulting parallel conditions. In particular before paralleling check whether any phase-outs are required,
6. Check that the line auto-reclose (A/R) facility, if provided, is in the non-auto position.
7. The Operator selects the circuit breaker control switch to the discrepancy position, this causes the control switch lamp to flash, then checks the correct circuit breaker has been selected.
8. Operates the control switch in the indicated direction (**I** or **Close**). This action causes the flashing lamp on the control switch to remain on and not flashing. If it is just pushbutton control then ensure the correct circuit breaker is selected before pressing pushbutton, the lamp will change over from Open to Close.

9. During the close operation, observe the behaviour of ammeters, voltmeters and control room lighting. Should the circuit breaker trip on an attempted closure these indications are invaluable aids in diagnosing whether there has been an high voltage fault, or some malfunction of protection, or non-latching of the circuit breaker.
10. After the circuit breaker has closed check that -
    i. Circuit breaker control is restored to the normal remote / supervisory position, and
    ii. A/R, or Auto-Standby is made auto, unless instructed otherwise.
11. Check that the circuit breaker indication is showing closed and that the circuit breaker is in a satisfactory condition.
12. For those circuit breakers where the close operation is performed mechanically by spring, check that the spring has been recharged after closing of the circuit breaker.

6.2 SCADA SYSTEMS

SCADA systems (Supervisory Control and Data Acquisition) are widely used for the overall operation of circuit breakers. This system incorporates alarms, trip and close operations, current and voltage levels as well as ancillary equipment associated with the breaker closing.
SCADA and DFA (Distribution Feeder Automation) schemes oversee the overall electrical network. They allow:

- system loading to be constantly monitored
- flexibility within the distribution area
- historic logging of events
- restoration of supply quickly
- auto/non auto function of various features
- voltage control.

6.3 ISOLATION

Once the electrical apparatus has been de-energised the next step is to **"*Isolate*"** it. The definition of isolated is ***"....disconnection from all possible sources of electrical energy by the opening of switches, withdrawal of circuit breakers, removal of fuses, links, connections and the like, and secure the isolation by the use of locks, where possible and applying Danger Tags to all points of isolation."***.

Isolation of HV electrical apparatus must be effected by making a break in the electrical circuit with insulation appropriate to the voltage, at:

- a switch or isolator; or
- removed or separated connections.

The breaking, or physical separation of contacts can be achieved by:

- by the opening of air break, gas, oil, vacuum type switches
- by the breaking of jumpers in sections of lines
- by the opening and racking out of oil circuit breakers or air insulated circuit breakers
- by the operating of H.V. fuses or links.

Switches at points of isolation must be locked open, where possible, or removable connections secured to prevent someone else closing or replacing them while work is being carried out on the line.

Where the electrical apparatus is isolated by opening jumpers or bonds, all loose ends must be secured to prevent any movement, which could cause the line to become alive.

In all cases and irrespective of the type of switchgear, if the contacts are not visible, the switch used for isolation purposes shall be closed in the earth position, before it can be used as such.

6.4 Danger Tags

Danger tags are boards, plates or tags on which the word "Danger" is boldly marked.

Every point of isolation will have a Danger Tag attached by the Access Authority Issuer, and are a warning against inadvertent and unauthorised operation of switches and other controlling devices.

They shall be attached to isolating valves, drives, control levers, or switches etc., or if this is impracticable, they are to be attached in such a position as to warn any person about to operate the circuit opening and closing device, or other controlling device.

Danger Tags shall not be interfered with and may only be removed by the Access Authority Issuer, this generally being done when restoring the equipment back to service.

Devices used for securing isolation

Devices commonly used to secure isolation points are usually conventional padlocks of varying sizes depending on the equipment.

Access to keys to operate locks is usually restricted to personnel authorised by the employer to operate and issue Access Authorities.

Other types of locking devices may be used but, as always, the security of the device shall be maintained by only allowing suitably authorised personnel access to the lock operating device.

6.5 Isolation of Voltage Transformers (VT's)

Voltage Transformers (VT's), as well as distribution transformers (located either within the station or remotely), are possible sources of HV supply due to backfeeds from the LV system.

Care should be taken when a HV isolation is being carried out, prior to the issue of an Access Authority, to ensure that both the primary (except for direct connected transformers) and secondary connections are isolated from all electrical supply and Danger Tagged.

Before working on VT's, other than draw-out type transformers, isolation, earthing and short-circuiting of the HV windings and isolation of all secondary windings of the VT's must be carried out.

If the HV electrical apparatus to which the VT's are connected is isolated, earthed and short-circuited the VT's may remain connected to the HV electrical apparatus. The LV windings ***must be isolated and Danger Tagged***.

For work on Capacitive Voltage Transformers (CVT's) or similar equipment both the primary and secondary connection must be earthed. Do not apply earths immediately after isolation, allow a minimum period of five (5) minutes for the capacitors to discharge before applying any earths.

6.6 Apparatus used to provide isolation

High Voltage Switches/Circuit Breakers

The most common form of isolation for HV is where the HV circuit breaker is racked out/down, placed in the out of service position and locked, and Danger Tagged, or completely withdrawn from the housing, and the associated shutters locked closed, and Danger Tagged.

Some systems have a set of isolating links in series with a circuit breaker that cannot be locked open. This is mostly on low voltage equipment. Once the circuit breaker is tripped the isolating links are opened and a Danger Tag applied to them.

Isolation of electrical apparatus that has been effected by the operation of a switch (including an isolator), is satisfactory for work if the following precautions have been taken -

i) A switch that is withdrawable must be withdrawn from live spouts, and shutters over the live spouts ***locked and Danger Tagged*** to prevent access to live parts;

ii) A switch that is non-withdrawable, and in which the contacts are not visible, must be placed in the open position, the earthing switch closed and the switch operating shaft(s) mechanically ***locked in position and Danger Tagged***. (See Note 1);

iii) A switch that is non-withdrawable, and in which the contacts are visible (including those relying on gas pressure for insulation), must be mechanically ***locked open and Danger Tagged***, where possible. (See Note 1).

If a switch cannot be mechanically locked open, a Danger Tag must be placed so as to attract the attention of a person standing in a position to operate the switch.

Note 1: Where the switch operating shaft cannot be locked, covers preventing access to the operating shaft must be locked and Danger Tagged, and any remote switch control circuits disabled by the removal of fuses or opening of links and Danger Tags are to be applied.
Note 2: Unless specifically requested otherwise, where switches are spring, hydraulically or pneumatically operated, the stored energy must be discharged so that the switches cannot be closed inadvertently.

With some enclosed or metal-clad switchgear, it is not always possible to check closed contacts or verify if there is a visual break in the circuit. Where this situation applies, the isolated section of high voltage can be tested whether internally or externally (secondary of supply transformer).

Note: Where the isolation is by opening HV fuses, the fuse carriers must be completely removed.

6.7 Isolation of Other Energy Sources

Before any work can be carried out on HV equipment all other possible sources of stored energy ***must be isolated*** as part of the overall isolation procedure.

Isolation of other energy sources, such as the discharge of stored ***mechanical energy*** (charged springs), valves controlling ***hydraulic pressure*** (pressurised water, fuel or oil lines) or ***pneumatic pressure*** (compressed air lines) or ***gas pressure*** must be carried out, unless otherwise requested by the work group.

This can be done by discharging pressures or closing valves, and ***Danger Tags*** attached to the isolating valves, drives, control levers, or switches etc.

The isolation, of these mechanical types of energy sources, ***is extremely important*** and often can be forgotten with dire results.

Summary of isolation procedures

To isolate HV electrical apparatus prior to proving de-energised and applying earths the following p[points should be considered:

Summary of Isolation Procedures

i) the **equipment is isolated** from all sources of supply **by** the provision of a **visible break** between each source of supply and the work site;

ii) if a visible break **cannot be provided** then the equipment being used as the point of isolation must be rendered **inoperable by** isolating the control circuitry or disconnection of conductors;

iii) **each point** of isolation is **locked or secured** to prevent operation and a **Danger Tag is attached**;

iv) **check there is no possibility of a back-feed** from standby generators, solar systems or any other possible source of supply, if there is isolate and attach a **Danger Tag**;

v) **check isolation of other energy sources** has been carried out, unless otherwise requested by the work group, such as the discharge of stored **mechanical energy** (charged springs), valves controlling **hydraulic pressure** (water, fuel or pressurised oil lines), or **pneumatic pressure** (compressed air lines) or **gas pressure**. This can be done by discharging pressures or closing vavles, and attaching **Danger Tags** to the isolating valves, drives, control levers or switches etc. The isolation of these mechanical types of energy sources is **extremely important** and often can be forgotten with dire results. They should always be isolated **before work commences**.

Carrying out the above procedures will ensure that the **work site is isolated from all sources of electrical supply, or other energy sources and every point of isolation has a Danger Tag attached**.

SECTION 6 - WORKPLACE LEARNING ACTIVITIES:

REFER TO ABR 5255 Volume 2, Revision 5

CHAPTER 55 High Voltage Safety Rules - and complete the activities listed below

A. Explain the basic arc extinction principles and arc quenching devices used in HV switchgear.

B. Discuss with your supervisor/mentor the functions of "System Control and Data Acquisition' (SCADA) system and its main components. What is the function of SCADA?

C. Explain the various circuit breaker control switch positions available:

D. Name five (5) operating aids to assist observations when operating circuit breakers:

E. Name three (3) conditions to check after opening a circuit breaker:

F. How would you identify a point of isolation?

G. If a switch cannot be locked open where can the Danger Tag be placed?

7 WORK AREAS and ACCESS AUTHORITY

7.1 Safe work areas

The Safe Work Area is the area in which it is safe to perform work. It is essential that:

- the Safe Work Area is clearly identified and defined by a barrier method approved by the employer
- the boundary(ies) of the Safe Work Area clearly indicates the dividing line between live electrical apparatus and the electrical apparatus on which it is safe to perform work;
- there is only one access point to the Safe Work Area and that it is clearly defined
- the Safe Work Area is accessible without interfering with the method used to define the Safe Work Area (tapes/barriers/man proof fences)
- the Safe Work Area can be accessed without stepping over or under the barrier method in use
- only the Access Authority issurer may move or re-arrange the tapes/barriers, provided that the meaning and intent of the Access Authority is at all times maintained
- only the Access Authority issurer may move or temporarily re-arrange the tape/barrier to allow for the movement of plant or materials in the safe working area where the entrance is unsuitable or of inadequate size.

NOTE: Although no person may pass over or under the erected tapes/ barriers, it is permissible for a brief period of ground level inspection only, when it is not possible to go around the tapes/barriers, provided that the Access Authority Recipient (authorised holder of the Access Authority) is first advised.

The method of identification of the Safe Work Area may be accomplished using:

- Yellow tape or an alternative;
- Approved physical barriers (eg barricades locking devices);
- Fencing, signage, delineation.

The tape/barrier separates live apparatus from apparatus that it is safe to work on.

The safe work area is defined differently for:

- work inside the switchroom of an electrical station
- work out in the switchyard of an electrical station
- HV overhead conductors
- HV underground cables.

7.2 Tape/barrier considerations

Safe work areas will:

- only be marked out and established after isolation and earthing has been completed;
- be clearly defined. Tapes/barriers will be erected and anchored such that persons working within the safe work area will no exactly where he/she can and can not go;
- have only one entrance to the safe work area. Any other gates or entrances forming part of a boundary to the safe work area shall be tapped, as a warning against their use;
- have an entrance passageway extending outward for a least 2metre so that it is plainly visible to persons approaching. The entrance passageway ***will not*** be considered part of the safe work area;
- be established taking into account the work to be done. There will be adequate room for the work to be completed within the safe work area without the need for staff to be tempted to rearrange the tape;
- be closed when the work area is empty (e.g. lunch) to prevent unauthorised persons from attempting to enter;
- tapes/barriers that are securely tied and anchored;

7.3 Access Authorities

An access Authority is a pre-printed from which, when used in accordance with a switching procedures adopted by the employer, gives the recipient of the Authority permission to work on or near the designated electricity works.

In any high voltage industry where electrical maintenance and isolation is carried out, it is possible the department responsible for line work, substation maintenance and construction will be different form the department responsible for switching. It is therefore necessary to have some safeguards to ensure no switching to re-energise the electricity works can take place until all members of the work party are clear of the job, and know the electricity works are to be re-energised. To achieve this, a document known as an Access Authority is utilised. When the officer in charge of switching for the designated section of the electricity works to be worked on is satisfied that:

☑ the designated section is isolated from all possible sources of supply;

☑ the isolation is secured;

☑ the designated section is proved de-energised, earthed and short circuited and;

☑ where necessary a safe area for work has been identified;

an Access Authority for Work or Test is issued to the officer in charge of the work party (the Access Authority recipient).

7.4 Authorisations

There are three (3) Authorisations that you should be aware of for persons issuing and/or receiving Access Authorities. They are -

☑ **Authority to Perform Operating Work**

Only an authorised person (normally the Access Authority Issuer) may perform operating work.

☑ **Authority to Issue Access Authorities**

Only an authorised person (Access Authority Issuer) may issue Access Authorities.

☑ **Authority to Receive Access Authorities**

Only a suitably authorised person (Access Authority Recipient) may receive an Access Authority.

Note:	**The first two authorisations normally apply to the Access Authority Issuer, who generally carries out the operating work to de-energise, isolate, prove de-energised, apply earths, set up the Work Area and issues the Access Authority. All authorisations must be in writing and carried all times in the Work Area.**

7.5 Access Authority documentation

An Access Authority is a legal document that authorises specific work to be carried out on de-energised HV electricity works.

It usually comprises a double sided A4 size document with the heading "Access Authority for Work/Test" printed on it. It is not valid until all sections are completed, checked, and the document signed by all relevant people.

The front page records **ALL** relevant information pertaining to the work that will be carried out (See Appendix "A"). This information is usually completed by the ***Access Authority Issuer*** (authorised person to issue Authorities) and consists of:

i) a description of the electricity works on which the work/test will be carried out;

ii) the voltage concerned;

iii) a ***description of the work*** to be carried out,

iv) the ***time and date*** of issue;

v) the ***points of isolation*** where Danger Tags have been attached;

vi) the ***locations*** where electrical apparatus has been ***earthed*** and short-circuited;

vii) ***warnings of*** adjacent live exposed conductors or electrical apparatus;

viii) any ***restrictions or special*** precautions which may apply (dangers present on the worksite, endorsements for specific earth removal etc.);

ix) any ***screens, tapes / barriers*** that are erected;

x) statements signed by the Access Authority issuer regarding the action taken to ensure the work/test area remains isolated and earthed;

xi) statements signed by the recipient confirming that the conditions of the Access Authority are understood and accepted.

Note:	**Items vii), viii) and ix) should be pointed out to the Access Authority Recipient (Holder) and members of the Work Group, as well as being recorded on the Access Authority.**

The back page records signatures of the members of the working party, as well as the recipient's signature on cancellation of the Access Authority (See Appendix "A"). The information recorded on this page of the Access Authority consists of:

i) statements to be signed by members of the working party, prior to the commencing work, that they understand the contents and accept the conditions of the Access Authority;

ii) signatures of the members of the working party on completion of the work;

iii) statements to be singed by the Access Authority recipient upon cancellation of the Authority;

iv) confirmation that the electricity works can or can not be returned to service.

The original copy of the Access Authority is held at the job site by the Access Authority recipient who is usually in charge of the work group and a carbon copy remains in the book held by the Access Authority Issuer.

The Access Authority Issuer has no authority to proceed with the reversal of switching or any other switching which would affect the electricity works under access. This can only be carried out when the **cancelled** original copy of the access Authority has been returned to the Access Authority issuer.

7.5.1 Entries on Access Authorities and related documents

All entries made on Access Authorities and related documents must be in ink and care must be taken to make the writing clear and legible.

When more than one Access Authority is to be issued for work at different work locations, a procedure is required to record the number of Access Authorities issued. Procedures such as cross-referencing the Access Authorities, details of Access Authorities issued recorded by the Controller/Supervisor, or use of an Access Authority Folder, are appropriate. It is important that each Access Authority has its ***own unique number*** to avoid any mistakes or confusion.

7.5.2 Issue and cancellation of Access Authorities

An Access Authority is a ***legal document*** that is to be signed before commencing work by the ***Access Authority Recipient*** receiving the Access Authority, and then signed by every other person in the Work Group who are

working on the electrical apparatus covered by the Access Authority, stating the following:

- that each person ***understands the conditions*** of the Access Authority
- that each person ***understands the appropriate requirements*** applied to the Access Authority
- the ***time and date*** of receiving the Access Authority.

On issuing the Access Authority, the Access Authority Issuer ***must advise*** the Access Authority Recipient and preferably ***all persons*** working on equipment or job for which the Authority is being issued of the following:

- a ***confirmation of the description*** of the work to be carried out;
- the ***time and date*** of issue;
- the ***points of isolation*** where ***Danger Tags*** have been attached;
- the ***locations*** where electrical apparatus has been ***earthed*** and
- short-circuited;
- the ***warnings of adjacent live*** exposed conductors or electrical apparatus (if applicable);
- any ***screens, tapes / barriers*** that are erected to define the ***Work Area***;
- any ***restrictions or special precautions*** which may apply.

On completion of the work the Access Authority is to be signed ***OFF*** by all persons in the Work Group, who had signed ***ON*** the Access Authority, ***and*** then finally signed ***OFF*** by the ***Access Authority Recipient*** (authorised person) who received the Access Authority, stating:

- that they ***are clear*** of the electrical apparatus
- that they understand that the *electrical apparatus* is to be treated *as* ***alive***
- that the Access Authority is cancelled, indicating that ***no work*** is to be ***carried out*** on or near the electrical apparatus ***from that time on***
- the ***time and date*** of cancelling the Access Authority.

The Access Authority recipient is responsible for ensuring that all members of the work group have signed off the Authority and that they will now remain clear of and regard the electrical apparatus as live.

The original copy of the Access Authority is held at the job site by the Access Authority recipient who is usually in charge of the work group and a carbon copy remains in the book held by the Access Authority Issuer.

An Access Authority form should also have provision for -

- the transfer of the Access Authority from the original ***Access Authority Recipient*** (transferor) to another ***Access Authority Recipient*** (transferee) for cases where the original Recipient is unable to continue work or must leave the Work Area.

- If the intended transferee Recipient has already signed on the Access Authority under ***"Issue"*** that person must sign under ***"Cancellation"*** before becoming the new ***Access Authority Recipient***.
- the temporary cancellation of an Access Authority for work, to enable the issue of an Access Authority (Testing Access Authority) endorsed for the application of high test voltages. In this case all persons who have signed under ***"Issue"*** must sign under ***"Cancellation"*** before the Access Authority can be temporarily cancelled.

7.5.3 Leaving and returning to a worksite under Access Authorities

All persons covered by an Access Authority, who leave the site of the work shall, on return to the site, and before commencing work, identify the electricity works on which they were working and verify that the Access Authority covering the electrical apparatus is still valid.

7.5.4 Common isolations

Occasionally work is carried out on two independent job sites where part of the isolation becomes a common point between the two parties and work completion times vary. De-energisation of the first section is also usually required. In these isolated cases, two separate Access Authorities are issued, with double danger tagging applied to the common isolator. When the first Access Authority is cancelled, one danger tag only, pertaining to the respective area to be re-energised, is removed.

The isolated section to be re-energised shall only be energised after all staff working on the other isolated section have been instructed to stand down during the energisation process.

After energisation the remaining isolated section shall be re-tested to ensure the integrity of the common isolation point, prior to giving permission for work to re-commence.

7.5.5 When an Access Authority is required

An *Access Authority* must be issued whenever *any type of work* requires the Work Group to go *within the minimum approach distances* of HV electrical equipment. This is a requirement for any work *not just electrical work*, it could be cleaning, painting, weeding, construction work or general maintenance.

The purpose of an Access Authority is to allow work or testing to be carried out *on or near* HV exposed conductors, or on HV electrical apparatus.

All persons requires to work on or near, or test high voltage electricity works shall be the recipient of or be in possession of an Access Authority covering the electricity works to be worked on or tested, or have entered their signature under "issue" on the Access Authority.

An Access Authority shall be issued and accepted before any work or test is carried out on high voltage electricity works.

7.5.6 When an Access Authority is not required

An Access Authority is not required in the following circumstances:

- In an emergency, when there is immediate risk to human life or property, provided that the work is carried out under the sole charge of the authorised person, who shall ensure that isolation, proving de-energised, earthing and short circuiting of the electricity works has been carried out in accordance with the applicable safe working procedure guide.
- When authorised live line working procedures have been adopted.
- When work is carried out on electricity works that cannot be energised by operating work, because of the absence of electrical connections to any possible source of electricity supply. Where no person, and no material or equipment not insulated for the voltage concerned, can come within the relevant minimum safe working distance specified, of any exposed conductor which is live, or can be energised by operating work.

7.5.7 Responsibilities of Persons Issuing Access Authorities (Access Authority Issuer)

The authorised ***Access Authority Issuer*** must at all times in the Work Area carry their written authorisation, which must be current to show they are trained and competent to carry out the work. When issuing the Access Authority, the ***Access Authority Issuer*** must -

☑ ***Ensure that***, before issuing an Access Authority to allow work, or testing to be carried out ***on or near*** electrical apparatus, ***all necessary safety precautions*** have been taken.

☑ ***Check that all details*** of the isolation, earthing and short-circuiting and any other precautions have been ***clearly documented*** in ink on the Access Authority in a clear and legible handwriting.

☑ ***Have the right***, in the interests of safety, ***to refuse to*** -

a) Issue an Access Authority to a person who is not trained and authorised to accept Access Authorities as an ***Access Authority Recipient***,

b) Issue an Access Authority when there is concern that the details of the isolation specified in the Disconnection and Reconnection Request are considered inappropriate to the stated task, or

c) Hand an Access Authority to an ***Access Authority Recipient*** who is considered incompetent, insufficiently interested or inattentive when the authorised person is describing live exposed conductors or electrical apparatus adjacent to electrical apparatus on which work or test is being carried out.

Where isolation of hazardous low voltage (e.g. fan supply, motor control) or mechanical apparatus (e.g. air supply to air blast circuit breaker) has not been carried out, this shall also be noted on the Access Authority.

The Access Authority Issuer shall advise the recipient and the working group of the conditions for the Access Authority as well as any hazards present at or adjacent to the work site.

Should circumstances change after an Access Authority has been issued, e.g. further isolation require, then the authorised switching employee shall ensure that:

- all the working group are clear of HV electricity works and are signed off the Access Authority;
- the Access Authority is cancelled.

When the additional switching is completed, then:

- the isolated are is re-tested
- earthing and short circuiting is applied
- a new Access Authority is issued.

No changes are allowed to be made to the Access Authority on issue. Should it be necessary to make changes, the Access Authority shall be cancelled and a new one recording the changes issued.

7.5.8 Responsibilities of Persons Receiving Access Authorities (Access Authority Recipient)

The authorised ***Access Authority Recipient*** (Holder), when receiving Access Authorities must:

☑ ***Ensure that*** they carry their written authorisation at all times while at the Work Area. The authorisation must be current, to show they are trained and competent to accept Access Authorities.

☑ ***If*** the Access Authority Recipient ***is authorised to apply Working Earths***, then it should be indicated on the written authorisation.

☑ ***Ensure that*** the Access Authority clearly ***defines the safe Work Area*** for the work that is to be done and fully understand which electrical apparatus is still to be regarded as alive.

☑ ***Ensure that*** weather conditions have not made the work dangerous.

☑ ***Ensure that*** they have physically demonstrated to, and instructed, the work group in the safety requirements of the Access Authority

☑ ***Ensure that all persons*** in the Work Group required to carry out associated work sign ***ON*** the Access Authority under ***"Issue"*** before they ***commence work*** and that they are aware of their responsibility upon returning to the Work Area following an absence. (See Note).

☑ ***Be responsible for safeguarding the Access Authority*** until its cancellation, and not leave the Work Area. Should there be a need for the Access Authority Recipient ***to temporarily leave*** the Work Area, instructions must be ***given to ensure*** that the ***persons remaining*** observe the safety requirements. (See Note).

☑ ***Ensure that***, when the Access Authority is to be cancelled ***all persons*** who signed ***ON*** the Access Authority and worked on the job, sign ***OFF*** the Access Authority under ***"Cancellation"***.

☑ ***Ensure that*** all persons working at the Work Area covered by the Access Authority observe the relevant safety provisions.

☑ ***Ensure that*** on completion of the work ***all Working Earths*** for which that person is responsible have been ***removed*** before signing off and cancelling the Access Authority.

☑ ***Have the right*** to refuse to work on or test electrical apparatus specified on the Access Authority ***when the requirements*** with respect to the issue of the Access Authority have ***not been met***.

> **Note: All persons covered by an Access Authority who leave the Work Area must, on return to the Work Area, and before commencing work, identify the electrical apparatus on which they were working and verify that the Access Authority covering the electrical apparatus is still valid.**

It is the responsibility of the Access Authority recipient to firstly have a clear understanding of the job to be undertaken. He/she should be fully aware of the extent of the work area, what electricity work is alive, what is de-energised, where earthing is applied and any back feeding that might have been carried out.

When the recipient signs onto the Access Authority, he/she is stating that:

- he/she understands his/her duties;
- he/she is acquainted with the nature and position of all electricity works both in and outside the work area;
- any persons under his/her control will have no difficulty in keeping clear on live electricity works.

If, during the course of the work, visitors arrive to check on the progress of the job, the Access Authority recipient shall request that they in turn sign onto the Access Authority before entering the work area. Before leaving, they also sign off the Access Authority.

The recipient of the Access Authority, who intends to test HV electricity works, shall ensure that the area(s) under test is clearly defined, is adequately taped.

If it is felt the taped areas should have a better location for the entrance, or there is not enough isolation to safely carry out the test, then the authorised employee who carried out the isolation should be consulted to review the re-arrangement of the barriers.

In addition, the Access Authority recipient shall ensure that all persons are kept clear whilst the test voltages are applied and that signs are erected indicating, **"DANGER, HIGH VOLTAGE TESTING IN PROGRESS"**.

A person shall be posted to warn others not to approach the test area(s).

At the conclusion of the tests, the Access Authority recipient shall ensure that electricity works that may have become charged during the course of the

testing work, are fully discharged and that any earths removed during the course of the test are immediately re-applied.

He/she shall converse with the working group and fully explain to them all the dangers and limitations as outlined on the Test Access Authority.

They in turn shall acknowledge what has been told to them, then read and sign onto the "issue" section of the Test Access Authority. Each person is responsible for his/her safety foremost, and also that of his/her fellow workers.

7.5.9 Responsibilities of the working group

Members in the working group have the following responsibilities:

- ☑ each individual shall understand the conditions of the Access Authority, and if they don't they shall seek clarification from the Access Authority recipient;
- ☑ all work shall be carried out in accordance with the employer's safety rules and those outlined in the relevant Guides;
- ☑ upon returning to the work site under access, they shall check that conditions have hot changed at the work site and check that the Access Authority is still current before commencing work;
- ☑ ensure that all tools and equipment are removed from the electricity works on completion of the work;
- ☑ wear the correct protective clothing and use the correct protective equipment at all times.

7.6 ADMINISTRATION OF DOCUMENTATION

7.6.1 Missing Access Authorities

Lost by recipient during course of work

- If an Access Authority is lost by the recipient during the period of the job (e.g. wind blows it away, or it is accidentally misplaced), the recipient shall notify the Controller, and he/she will arrange for the issue of a replacement Authority, marked accordingly. The recipient is responsible for ensuring all people who signed on the lost Access Authority sign on the new Access Authority.

Lost after all work was completed

- When an operator reports that an Access Authority is missing from a work site, after the completion of work, it shall be the Controller's personal responsibility to:
  - ➢ direct the operator to check over all sections of isolated HV electricity works;
  - ➢ Notify the person who was in charge of the work or his immediate supervisor and request that he take whatever steps necessary to locate the Access Authority and/or the personnel involved on the Access Authority;
  - ➢ Co-operate with the investigation to try to recover the Access Authority.

If the Access Authority can not be located, then the clearance to restore the electricity works to service shall only be given after it is established that all personnel are clear of the electricity works and that the understand that the electricity works shall be regarded as live.

7.6.2 Right to Examine Access Authorities

Persons authorised by the employer and inspectors of regulatory bodies may examine any Access Authority on issue to determine whether all safety requirements have been carried out and are being observed.

7.6.3 Right to Withdraw Access Authorities

An authorised Access Authority Issuer may ***withdraw an Access Authority*** on issue if it is considered that ***all safety requirements*** are not being complied with.

The authorised Access Authority Issuer ***must advise*** the ***Access Authority Recipient*** and ***all persons*** who have signed on the Access Authority as members of the work party.

7.6.4 Place of Issue of Access Authorities

The Access Authority may be ***delivered personally*** to the Access Authority Recipient ***or*** it may be ***left at a secure location*** which is accessible to both the ***Access Authority Recipient*** and the authorised ***Access Authority Issuer***.

At the completion of the work, the ***Access Authority Recipient*** may either hand the cancelled Access Authority to the authorised ***Access Authority Issuer***, leave it at the place of issue or leave it at a secure location accessible to the authorised ***Access Authority Issuer***.

7.6.5 Responsibilities of Persons Recovering Access Authorities

The authorised ***Access Authority Issuer*** recovering the cancelled Access Authorities must ensure that electrical apparatus is not placed in service until ***all*** relevant ***Access Authorities have been cancelled***. On completion of the work or test, the authorised ***Access Authority Issuer*** is to forward all operating papers relating to the task, to the

Controller / Supervisor.

7.6.6 Issue of Duplicate Access Authorities

Where an original Access Authority has become lost or is destroyed, the original ***Access Authority Recipient*** or the Supervisor on being satisfied that such is the case, may request the issue of a replacement Access Authority which should be marked **"DUPLICATE"**.

7.6.7 Alterations to Access Authorities on Issue Not Permissible

The ***precautions listed*** on the Access Authority ***must not be altered***. If it becomes necessary to alter the precautions as stated on the Access Authority on issue, the Access Authority must be cancelled. A new Access Authority must be issued setting out the new precautions, which then apply.

7.7 Test Access Authorities

Procedures approved by the employer are required to allow Access Authority earths to b removed to conduct electrical tests or to allow dangerous test voltages to be applied to electricity works in the work area. The usual procedure to achieve this is by the use of Test Access Authorities.

Test voltages greater than 1000V or tests where large capacitances (long lengths of cable or capacitor banks) are usually considered hazardous do required a Test Access Authority.

Test Access Authorities can be a different colour to the work Authority, but they will usually have similar wording to the work related Authority, with the **exception** to the title at the top of the document.

These Authorities shall only be used by people engaged in the testing of high voltage switchgear and associated protective relays.

The major difference with a Test Access Authority is that:

- It allows the recipient to remove earthing equipment form isolated high voltage switchgear for the purpose of injecting test voltages and currents etc.
- Work is still confined to within the taped area, and all earthing shall be restored immediately the testing is completed.
- Persons not involved in the test cannot sign onto the Test Access Authority, due to the danger of receiving an electric shock from test voltages induced into the isolated area.

Access Authorities for work that are issued on the electricity works that will be subjected to test voltages shall be withdrawn or cancelled prior to the issue of the Test Access Authority.

For high test voltages the adequacy of the isolation points shall be considered. If the test voltage is out of phase with the system voltage on the other side of an isolation point, the voltage across the isolation point may be the sum of the two.

For this reason it may be necessary to ensure (via the Switchgear instruction) that there is a section of earthed conductor between the apparatus under test and the system.

This is not normally required when the test voltage is within 10% of the nominal system voltage or less than 3000V. The employer's procedures should take into account the voltage withstand rating of installed switchgear.

7.7.1 Issue of Access Authorities Involving Test Voltages

Testing Access Authorities are required in the following situations -

- the application of test voltages / currents, which produce ***high voltage / currents*** on electrical apparatus;
- the use of insulation testing devices rated at ***higher than 1,000V*** on electrical apparatus;
- the use of electronic insulation testing devices on cables and capacitors which can create a voltage ***greater than 1,000V***.

Notes:

1. **Care must be taken when applying insulation testing devices rated at less than 1,000V to cables and capacitors. When momentarily discharged to earth, voltage recovery is possible.**
2. ***Direct current resistance measurements or transformer windings can also generate high momentary voltages when the circuit is interrupted.***

An Access Authority endorsed ***"Testing"*** for the application of high test voltages or high current tests, must not be issued on electrical apparatus until all Access Authorities for work covering the electrical apparatus to be tested, have been withdrawn.

However, if any section of the electrical apparatus can be disconnected and removed a safe distance from the test area, an Access Authority may be issued for that section, provided that the Access Authority for work draws attention to the test area. This would require suitable cross-referencing on both Authorities.

7.7.2 Persons Assisting Testing Personnel During Tests

The Access Authority Recipient of a Testing Access Authority must ensure that all persons assisting the testing personnel during tests sign under *"Issue"* on the Access Authority. Such persons are under the control of the *Access Authority Recipient* until they have signed under *"Cancellation"* on the Authority.

7.7.3 Application of Testing Voltages (Electrical apparatus under Access Authority or being installed)

High test voltages *must not be applied* to electrical apparatus that is being installed, *unless* the person in charge of the test has warned *all persons* working on the electrical apparatus of the proposed test, and has received from them an assurance that they will *stand clear* until the test has concluded and the electrical apparatus has been discharged to earth.

7.7.4 High Test Voltages

An employee must not apply test voltages, to electrical apparatus under Access Authority, unless an Access Authority endorsed ***"Testing"*** for the application of high test voltages has been issued.

7.7.5 High Voltage isolation of apparatus for work on remote low or medium voltage switch boards.

When it is required to work on a remote low voltage distribution panel for which there is No suitable low voltage isolation, and it is not within safe working clearances of live high voltage electricity works, then the high voltage supply to the shall be isolated.

It is may not be necessary to apply earths to the isolated high voltage switchgear or transformer. However, in all cases where these procedures are carried out, the switchgear that provides the high voltage isolation shall be locked (where possible) and danger tagged in an approved manner.

An Access Authority is NOT required as the work is on low voltage. The operator gives verbal clearance to the work group, after having proved the low voltage to be worked on is de-energised.

7.7.6 Insulation Testing Devices Rated at 1,000 Volts or Less, or Low Voltage for Test Purposes

An employee ***must not apply*** insulation testing devices or low voltage for test purposes to any electrical apparatus being installed or ***during the currency*** of an Access Authority for work ***unless all persons*** working on the electrical apparatus have been warned of the proposed application of test voltages, and has received from them an assurance that they will ***stand clear***.

Note: Where any part of the electrical apparatus, which will become alive is exposed, such as by the removal of covers, the employee in charge of the test must arrange for staff to standby at these points during the tests or otherwise take precautions such as the affixing of notices to prevent persons from coming in contact with the live conductors.

7.7.7 Work on Electrical Apparatus Continuing from Day to Day

When work is ongoing from one day to the next, on completion of the work each day the Access Authority must be placed at the specified place of issue, or in a secure location.

All persons covered by the Access Authority who leave the site of the work during the progress of the work must, on return to the Work Area, and before commencing work, identify the electrical apparatus on which they were working and verify that the Access Authority covering the electrical apparatus is still valid.

SECTION 7 - WORKPLACE LEARNING ACTIVITIES:

REFER TO ABR 5255 Volume 2, Revision 5

CHAPTER 55 High Voltage Safety Rules - and complete the activities listed below

1. **Explain how safe work areas are defined at your enterprise in:**
   - **i) Switchrooms.**
   - **ii) HV panels, enclosures or on HV apparatus**

i)_____

_____

ii)_____

_____

_____

2. **List the different types and colours of barriers and tapes used at your enterprise and their applications.**

Barrier/Tapes	Colour	Applications

3. **Identify the information required to be contained on an Access Authority and identify the person who's responsible for supplying/completing the information.**

Information	Person responsible

4. Explain when an Access Authority required.

_____

_____

_____

5. Explain who can:

i) issue an Access Authority

ii) be the recipient of an Access Authority?

_____

_____

_____

6. Complete the table below by listing the responsibilities.

	RESPONSIBILITIES
ACCESS AUTHORITY ISSUER	
ACCESS AUTHORITY RECIPIENT	

7. Describe the circumstances under which the access Authority recipient can refuse to accept an Access Authority.

_____

_____

_____

8. Identify the requirements that must be fulfilled by persons signing onto an Access Authority before they start work.

_____

_____

_____

9. Explain the responsibilities associated with signing onto an Access Authority.

_____

_____

_____

10. Explain your responsibilities if you leave and return to a worksite under an Access Authority

_____

_____

_____

11. Tick the correct statements in relation to an access Authority for test.

An Access Authority for test is required for test voltages above 1kV. ☐

An Access Authority for test may be required for test voltages below 1kV. ☐

An Access Authority for test and an Access Authority for Work may be issued at the same time on the same equipment provided the earths are left applied. ☐

8 WORKPLACE ASSESSMENT ACTIVITIES:

The workplace assessment activities within this section are to be undertaken by the trainee "on the job" under the supervision of an employee or personnel which holds an organizational authorization for Controlling Permit To Work Operations.

Each activity is to be performed by the student, with the assessment task being completed to the satisfaction of the authorized person and in compliance with organizational policies, procedures and/or safe working requirements.

Workplace Assessment Task 1

In the spaces provided below, explain the processes required to prepare for switching work on or near HV equipment/apparatus according to your organisational requirements.

Provide references to your organisations policies, procedures and safe working requirements for preparation for switching work on or near HV equipment/apparatus according to your organisational requirements.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

The trainee (name)_____ has completed the above activity related to preparation for switching tasks at _____to the company standards.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____

Workplace Assessment Task 2

In the spaces provided below explain the purpose of a switching request within your organisation.

Provide references to your organisations policies, procedures and safe working requirements explaining the purpose of switching requests.

The trainee (name) _____ has completed the above activity related to switching requests at _____ to the company standards.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____

Workplace Assessment Task 3

In the spaces provided below, explain the steps required to prepare switching instructions within your organisation

Provide references to your organisations policies, procedures and safe working requirements for the preparation of switching instructions.

The trainee (name)_____ has completed the above activity related to switching requests at _____to the company standards.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____

Workplace Assessment Task 4

In the spaces provided below, explain the persons within your organisation who are authorised to issue Permits To Work, Permits To Test and Permits For Accesss.

Provide references to your organisations policies, procedures and safe working requirements which identify those personnel f authorised to issue Permits To Work, Permits To Test and Permits For Accesss.

The trainee (name) _____ has completed the above activity related to switching requests at _____ to the company standards.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____

Workplace Assessment Task 5

Using your organisational **High Voltage Permit To Work Form**, the trainee is to complete a Permit For Work under the supervision of an authorised person for a task associated with maintenance of HV Electrical equipment which requires:

A. *Electrical Isolation of HV Apparatus*
B. *Mechanical isolation of associated apparatus (if/where required)*
C. *Release of stored energy within associated apparatus (if/where required)*
D. *Testing and proving HV apparatus de-energised*
E. *Fitting of earthing as required by organisational policies, procedures and safe work requirements*
F. *Delineation of the safe work area and its boundaries*
G. *Ensuring that all members of the work team participate within an explanation of the requirements of the Permit For Work*
H. *Ensuring all members of the work team "sign on" from the Permit For Work*
I. *Upon completion of the work, ensuring all members of the work team "sign off" from the Permit For Work*

The trainee (name)_____ has completed the above activity related to Permit For Work at _____to the company standards, and a completed example of the permit is attached.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____

Workplace Assessment Task 6

Using your organisational **High Voltage Permit To TEST Form**, the trainee is to complete a Permit For Testing under the supervision of an authorised person for a task associated with maintenance and testing of HV Electrical equipment which requires:

A. *Electrical Isolation of HV Apparatus*
B. *Mechanical isolation of associated apparatus (if/where required)*
C. *Release of stored energy within associated apparatus (if/where required)*
D. *Testing and proving HV apparatus de-energised*
E. *Delineation of the safe work area and its boundaries*
F. *Ensuring that all members of the work team participate within an explanation of the requirements of the Permit For Test*
G. *Fitting and/or removal of earthing as required by organisational policies, procedures and safe work requirements for testing*
H. *Ensuring all members of the work team "sign on" from the Permit For TEST*
I. *Upon completion of the work, ensuring all members of the work team "sign off" from the Permit For TEST*

The trainee (name)_____ has completed the above activity related to Permit For Test at _____to the company standards, and a completed example of the permit is attached.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____

Workplace Assessment Task 7

Using your organisational **High Voltage Permit To Access**, the trainee is to complete a Permit For Access under the supervision of an authorised person for a task associated with maintenance of HV Electrical equipment which requires:

A. *Electrical Isolation of HV Apparatus*
B. *Mechanical isolation of associated apparatus (if/where required)*
C. *Release of stored energy within associated apparatus (if/where required)*
D. *Testing and proving HV apparatus de-energised*
E. *Fitting of earthing as required by organisational policies, procedures and safe work requirements*
F. *Delineation of the safe work area and its boundaries*
G. *Ensuring that all members of the work team participate within an explanation of the requirements of the Permit For Access*
H. *Ensuring all members of the work team "sign on" from the Permit For Access*
I. *Upon completion of the work, ensuring all members of the work team "sign off" from the Permit For Access*

The trainee (name)_____ has completed the above activity related to Permit For Access at _____to the company standards, and a completed example of the permit is attached.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____

Workplace Assessment Task 8

Using your organisational **High Voltage Safe Work Method Statement and Risk Assessment Form**, the trainee is to complete a SWMS and Risk Assessment under the supervision of an authorised person for a task associated with maintenance of HV Electrical equipment which requires:

A. *Electrical Isolation of HV Apparatus*
B. *Mechanical isolation of associated apparatus (if/where required)*
C. *Release of stored energy within associated apparatus (if/where required)*
D. *Testing and proving HV apparatus de-energised*
E. *Fitting of earthing as required by organisational policies, procedures and safe work requirements*
F. *Delineation of the safe work area and its boundaries*
G. *Ensuring that all members of the work team participate within an explanation of the requirements of the Permit For Access*
H. *Ensuring all members of the work team "sign on" from the Permit For Access*
I. *Upon completion of the work, ensuring all members of the work team "sign off" from the Permit For Access*

The trainee (name) _____ has completed the above activity related to HV SWMS and Risk Assessment at _____ to the company standards, and a completed example of the permit is attached.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____

Workplace Assessment Task 9

Using your organisational **High Voltage Authorised Persons Assessment Sheet,** the trainee is to be assessed against organisational requirements for competence related to Section 4 – General Safety (Specifically subsections 4.1, 4.2 and 4.3):

The trainee (name) _____ has been assessed with respect to organisational requirements for High Voltage Authorised Persons Assessment (specifically Sections 4.1, 4.2 and 4.3) on the (date) _____at (Location) _____ to the company standards, and a a copy of the completed High Voltage Authorised Persons Assessment Sheet is attached.

Employer Assessor

Signed: _____ Name _____ Date _____

Employer Authorised Person

Signed: _____ Name _____ Date _____