SUBSTATION ACCIDENT
BARRY GASS
HIGH VOLTAGE TRAINING
An Authorised Person received an electric shock and was badly burned, when testing for voltage at the back of an isolated 11kV circuit breaker in a substation.
Introduction

High Voltage Training
Introduction

• The Authorised Person died three days later in hospital from the injuries he sustained in the accident.
• His assistant survived the incident, escaping with burns to his hands, face and upper body.
Sequence of Events

• The Authorised Person had to isolate an 11kV cable, in order to cut in a new mini substation, between a substation and a mini substation.
• He had already Switched, Isolated, Tested and Earthed the cable on both sides correctly.
Cut in a new mini substation
Sequence of Events

A risk assessment had been conducted and a work permit issued, in accordance with the company’s rules and regulations.
Risk Assessment
**HAZARD IDENTIFICATION AND RISK ASSESSMENT**

**035806**

<table>
<thead>
<tr>
<th>RESPONSIBLE PERSON:</th>
<th>SIGNATURE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>Time:</td>
</tr>
</tbody>
</table>

**DEPARTMENT:**  | **SECTION:** |
|------------------|--------------|

**OPERATION:**

**TASK TO BE PERFORMED:**

<table>
<thead>
<tr>
<th>New hazard identified</th>
<th>YES</th>
<th>NO</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Does Risk Assessment already exist?</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment Name &amp; No.</th>
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</thead>
</table>

**HAZARDS**

<table>
<thead>
<tr>
<th>ELECTRICITY</th>
<th>NOISE</th>
<th>PEOPLE ABOVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRE / HEAT</td>
<td>DUST</td>
<td>PEOPLE BELOW</td>
</tr>
<tr>
<td>MACHINERY</td>
<td>HEIGHTS</td>
<td>VICINITY</td>
</tr>
<tr>
<td>SLIP AND FALL</td>
<td>WEATHER</td>
<td></td>
</tr>
</tbody>
</table>

**OTHERS:**

**WHAT ACTION DID YOU TAKE TO ELIMINATE / CONTROL THE HAZARDS IDENTIFIED?**

( Elimination / Substitution / Isolation / Engineering / Administration / PPE )

1:  
2:  
3:  
4:  

**COMPLETE THE FOLLOWING QUESTIONS**

(For more detailed info check cover page)

P = Which PPE do you need for this specific task?

A = Did you inspect your work area? List your concerns.

R = Are you using the correct tools for this task? List the tools.

T = Did you lock out? (Are you sure its safe / who were involved?)

S = Did you discuss the risk assessment / do you have to revise / compile a new risk assessment? What should be added?

**Name(s):**

**Signature:**

**Constable 11437**
Work Permit

Written authorisation for work to be carried out on electrical mains or apparatus.

High Voltage Training
Sequence of Events

The circuit breaker had integral earthing and had been tested and placed in the earth position, locked off and a danger tag applied.
Integral Earthing
Integral Earthing
Integral Earthing
Integral Earthing
Sequence of Events

During the course of the work, the Authorised Person had to remove the back cover of the panel (cable end box), in order to disconnect the 11kV cable.
Sequence of Events
Sequence of Events

• The Authorised Person chose to identify the correct back cover to be removed, by counting the number of breakers in from the LEFT hand side.
Counted the number of breakers in from the **LEFT** hand side at the front.
Sequence of Events

He walked around the back of the panel, from the right hand side and counted the breakers from the **RIGHT**, instead of the left.
Counted the number of breakers in from the **RIGHT** hand side at the back.
The Authorised Person also checked the label on the back of the panel to confirm that he was at the correct breaker.
Sequence of Events

Unfortunately, this cover was a removable cover and had been incorrectly replaced, on the wrong panel, from a previous job that had been done.
As the cable was earthed at the MSS
and the circuit breaker at the front of the panel by integral earthing,
the Authorised Person decided that it was not necessary to wear a flash suit when removing the back cover and testing.
Sequence of Events

• He removed the back cover and decided, as an extra safety precaution, to safety test the conductors, before removing the tape.
• He decided to use a live tester to penetrate the insulation before removing the tape for safety.
Sequence of Events
Sequence of Events

• However, instead of using an approved Medium/High Voltage live tester, as required in terms of the company’s regulations,
High Voltage Live Tester
he picked up a low voltage multimeter to test for the presence of voltage.
Sequence of Events

• He also enlisted the help of his assistant to hold the multimeter, whilst he tested the conductors.
• The assistant was not wearing any special Personal Protective Equipment (flash suit).
On penetrating the tape, there was an explosion, causing third degree burns to 80% of his body and his assistant sustained burns to his hands, face and upper body.

Sequence of Events

High Voltage Training
Cause of the Incident and Injury

- The cover on the back of the panel had been replaced on the wrong panel the last time that work had been carried out.
- The Authorised Person counted from the wrong side when he went around the back of the switchgear.
Counted from the LEFT at the front
and from the **RIGHT** at the back
Cause of the Incident and Injury

• The Authorised Person used the wrong tester to test that the cable was dead.
• He was not wearing a flash suit whilst testing that the cable was dead.
Cause of the Incident and Injury

• The Authorised Person allowed his assistant to work too close to the cable without wearing adequate personal protective equipment (flash suit).
Root Cause

• The wrong cover plate was removed exposing the workers to live 11kV conductors.
• He counted from the wrong side and used a low voltage multimeter to test the live 11kV cable.
Contributing Factors

• The Authorised Person had not taken all the risks into account when conducting the risk assessment.
• Nor had he explained the dangers and hazards of the task to his assistant.
• He did not follow the correct safety rules and operating regulations.
Contributing Factors

• The Authorised Person was not fully concentrating on the job in hand.
• He was late in performing the planned switching operations.
• He was pressurised by other staff waiting for him to finish so that they could work on the cable.
In the ensuing investigation, it was found that the Authorised Person’s mind was not on the job, as he had had an argument with his wife, before leaving for work that morning and was late isolating the cable.
Conclusions

He was pressurised by staff waiting to work on the cable and did not follow the correct procedure in order to get the work done.
Conclusions

• He rushed the job and picked up the wrong tester (low voltage multimeter) to test the 11kV cable.
• He failed to wear a flash suit and did not make sure that his assistant was safe by allowing him to work too close to the back of the panel without the required PPE.
Remedial Action

All existing circuit breaker panels, in all substations, to be checked, to make sure that they are labelled correctly and in the correct manner, in terms of the company’s regulations.

• i.e. panels should be labelled on the front, back and top of the panel and where possible, on non-removable covers.
Remedial Action

• A Standard Operating Procedure needs to be compiled, stating the correct safe procedure to remove the back cover and test the cable before removing the tape.
• Training needs to be provided on the above Standard Operating Procedure to all staff required to remove such covers.
Remedial Action

• It was decided that an insulated rod or pole should be held on the front of the panel, that would be visible from the rear of the panel, as well as the other identifying method used in this incident.
Remedial Action

• If it were required to test 11kV conductors in a similar situation, before the tape is removed, they shall be tested using a proximity tester.
Remedial Action

- The tester should be fixed onto an approved insulating rod of the correct voltage rating, maintaining safety clearance.
Remedial Action

and an approved flash suit shall be worn.
Remedial Action

• All conductors to be discharged, using an approved single pole discharge device, before attempting to remove the tape, after confirming they are dead.
Remedial Action

Panels are to be painted different colours to indicate their function i.e. Red for a Ring, Blue for an Incomer, (this can also assist with identification).
Remedial Action

• In order to maintain safety it is essential that a risk assessment exists for each task.
• A risk assessment must be carried out at all work sites, over and above the existing general risk assessment, as the risk changes at each work site, although the task remains the same.
Remedial Action

• Risk assessments to be reviewed to ensure they cover all areas.

• Training to be conducted.

• Include the Heirachy of Control.
Remedial Action

• It is a misconception that PPE is the first line of defence, when in fact it is the last!
• Therefore, staff to be trained on the Hierarchy of Control, to ensure safety of personnel.
# Hierarchy of Control

<table>
<thead>
<tr>
<th>Most effective means of control</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Substitution</td>
</tr>
<tr>
<td></td>
<td>Separation</td>
</tr>
<tr>
<td>Administrative Control</td>
<td></td>
</tr>
<tr>
<td>Least effective means of control</td>
<td>Personal Protective Equipment (PPE)</td>
</tr>
</tbody>
</table>
# Hierarchy of Control

<table>
<thead>
<tr>
<th>Control Type</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elimination</strong></td>
<td>Whenever possible, eliminate the hazard. Eliminating the hazard eliminates the risk.</td>
</tr>
<tr>
<td><strong>Substitution</strong></td>
<td>Substitute with a less hazardous alternative. For example, you can install remote S/G operation instead of operating in front of the S/G with a Flash suit.</td>
</tr>
<tr>
<td><strong>Separation</strong></td>
<td>Isolate the hazard with mechanisms, such as isolation and lockout, machine guards, barricades or interlocks.</td>
</tr>
<tr>
<td><strong>Administrative Control</strong></td>
<td>Develop controls such as Safe Operating Procedures and improving skills (training).</td>
</tr>
<tr>
<td><strong>Personal Protective Equipment</strong></td>
<td>This is the least effective risk control. The use of PPE alone is not adequate and must be supported by one of the controls above.</td>
</tr>
</tbody>
</table>
Remedial Action

• All safety rules and operating procedures to be reviewed, updated and monitored regularly.
• Enforce discipline at the work site.
• Ensure compliance with rules and regulations.
It is essential to comply with the OHS Act and to follow company safety rules and operating procedures.
Remedial Action

• This is not only a legal requirement, but can also prevent damage to equipment, prevent injury to personnel and save lives.
Remedial Action

• Full flash suits must be worn when testing for zero potential.
• Flash suits to be worn during all MV/HV switching operations.
• Other staff to stand away, in such a position that they could not be injured by an explosion.
Remedial Action

- Training on MV/HV operating must be conducted and reviewed every two years (refresher courses conducted).
• You should always consider what can go wrong and what will be the consequences.
• In this situation what voltage am I testing?
• What safety precautions do I need to take?
General

• Always adopt a reasonable man approach.
• Always ask yourself would I let my 16 year old son or daughter do the job?
• If the answer is no, then why should I do it, or ask anyone else to do it!
• Remember, for every action there is a reaction.
NO OPERATING CONDITION OR URGENCY OF SERVICE CAN EVER JUSTIFY ENDANGERING THE LIFE OF ANYONE
General

Remember:

Safety before production!

NOT Production before Safety!
THERE IS NO SUBSTITUTE FOR SAFETY
HIGH VOLTAGE TRAINING

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