

PSLWM	2.1
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OPERATION OF LV SYSTEM

FOREWORD

Power Systems Management Safety Procedure (PSMSP) 5.1 lays down the procedure for the **Authorisation** of **Persons** in connection with the ScottishPower **System**. In accordance with these procedures **LV System Switching** may only be carried out unsupervised by a suitably authorised **Authorised Person**. Prior to authorisation the **Person** shall have undergone and satisfactorily completed training in accordance with PSLWM 1.4.

1 SCOPE

This Section of the Power Systems Live Working Manual lays down guidelines for **Persons** to carry out competently **Switching** on the **LV** distribution **System**.

2 DEFINITIONS

Terms printed in bold type are as defined in the ScottishPower Safety Rules (Electrical and Mechanical) 4th Edition.

3 DANGERS

The main dangers to persons carrying out **Switching** on the **LV** distribution **System** are electric shock or burns arising from:-

3.1 The use of uninsulated tools, or the use of tools with damaged insulation, or insulation not **Approved**.

3.2 The careless insertion or removal of fuses or links resulting in metalwork making contact between phases or from phase to earth.

3.3 Damaged rubber gloves.

3.4 The insertion of fuses or links without establishing the voltage conditions and where, for example, due to a **System** fault, phase to phase voltage (415V) exists across the contacts.

3.5 Phase barriers being missing in a pillar, cabinet, board or underground link disconnection box and fuses or links making contact across phases.

- 3.6 Metallic or other conducting objects being dropped into an underground disconnection box.
- 3.7 The presence of gas in an underground link disconnection box.
- 3.8 Failure to correctly use appropriate PPE.

4 LV SYSTEM

LV System operations consist of a series of actions which must be taken to avoid **Danger** and where appropriate keep customers informed of possible loss of supply.

LV Switching may be considered as:

- (i) the action of insertion of fuses or links
- (ii) the action of withdrawal of fuses or links
- (iii) the action of closing a circuit breaker
- (iv) the action of opening a circuit breaker
- (v) any other method of making an electrical circuit
- (vi) any other method of breaking an electrical circuit

Details of the actions required in **LV Switching** are given in Part 6 of this Section but can be summarised as follows:-

- Action A *Instruction/Notification* before **Switching**.
- Action B *Identification* of apparatus and/or circuit to be operated.
- Action C *Examination* of the immediate area where **Switching** is to take place.
- Action D *Inspection* of the **Apparatus** to ensure that it is not distressed or otherwise deficient.
- Action E *Assembly* of the correct tools and equipment, ensuring their safe condition.
- Action F *Verification* of the voltage conditions before and during **Switching**.
- Action G *Insertion and Withdrawal* of fuses or links.
- Action H *Verification* of voltage conditions after withdrawal of fuses/links.
- Action I *Securing Apparatus* to maintain safety.
- Action J *Reporting* that **Switching** has been completed.

5 GENERAL GUIDELINES ON LV SYSTEM SWITCHING PRACTICE

- Step 1 *Carry out all operations in accordance with ScottishPower Safety Rules (Electrical and Mechanical) - 4th Edition, Power Systems Safety Instructions and associated policies and practices.*
- Step 2 Before starting an operation:
- (a) *Make sure* that lighting is sufficient to allow operations to be carried out safely.
 - (b) *Inspect* cabinet, pillar, etc. for any signs of distress, damage or overheating which could affect the operation.
 - (c) *Ensure* a clear path exists away from the **Apparatus**
 - (d) *Ensure* a good foot-hold and a firm and steady stance so that if a tool, fuse or link should slip balance is not lost.
 - (e) *Ensure* phase barriers and screens are fitted in pillars, cabinets, distribution boards or underground network boxes and are in a sound condition before carrying out any operation.
- Step 3
- (a) Use **Approved** insulated tools for inserting and withdrawing fuses/links and for tightening and loosening bolts or wedges in fuses/links.
 - (b) Wear **Approved** rubber gloves if you have to use special tools provided by manufacturers to insert or withdraw fuses/links because they may not be fully insulated to ScottishPower standards.
 - (c) *Inspect* before and after use all **Approved** insulated tools and special tools, including link poles.
- Do not use an insulated tool or link pole if the insulation has been cut away from the head of the tool or pole.
- Step 4 *Consider*, before operating any tool, what could happen if it slipped in use.
- Step 5 *Consider*, before loosening any part, what could happen once it can move freely.
- Step 6 Use **Approved** voltage indicators to check voltage conditions before inserting fuse or link which will make a parallel or energise a section.
- Step 7 Use only voltage indicators (test lamps or standard voltmeters) which have fused leads.
- Step 9 *Seek* assistance if difficulties arise during **Switching**.

6 LV SYSTEM SWITCHING

ACTION A - INSTRUCTION/NOTIFICATION BEFORE SWITCHING

No **Switching** should be carried out without an instruction being received and until all appropriate **Persons** have been informed. The following steps should be carried out:-

- Step 1 *Receive* instruction to:-
- (a) *Investigate* a no supply complaint(s)
 - (b) *Make* an LV parallel
 - (c) *Make* safe **Apparatus**
- Step 2 *Warn* of any proposed disconnections of supply to appropriate **Persons**. This will include warning the Local Office before carrying out **Switching** in order that "Troublecall" systems can be kept up to date.
- Step 3 *Carry out* instruction
- Step 4 *Confirm/notify* **Switching** completed.

ACTION B - IDENTIFICATION OF THE APPARATUS AND/OR CIRCUIT TO BE OPERATED

In order to correctly identify the correct **Apparatus**/Circuit to be operated the following steps should be carried out.

- Step 1 *Study* relevant **LV** schematics, cable records, maps.
- Step 2 *Compare* the information from the schematics etc., with the information available on-site on substation name plates, pillar doors, circuit labels.
- Step 3 *Proceed*, in accordance with Power Systems Safety Instruction 12, if the information matches.

Investigate further, if the information fails to match.

Where doubt remains refer to issuer of instruction for guidance.

ACTION C - EXAMINATION OF THE IMMEDIATE AREA WHERE SWITCHING IS TO TAKE PLACE

- Step 1 *Make sure* that lighting is sufficient to allow operations to be carried out safely. If necessary, use portable lighting.
- Step 2 *Determine* whether a safe working platform in front of the **Switching** area exists. If it does not, *establish* one.
- Step 3 *Determine* whether a clear path, free from any obstructions, leading away from the **Switching** area exists. If not *establish* one.
- Step 4 *Identify* any earthed metalwork, which may come into immediate proximity of **Live** metalwork during or after **Switching**.
- Step 5 *Move back*, away from the **Switching** area any persons not directly involved with the **Switching**.

ACTION D - INSPECTION OF THE APPARATUS TO ENSURE IT IS NOT DISTRESSED OR OTHERWISE DEFICIENT

Switching should not be carried out until the operator has inspected the **Apparatus** for signs of distress or damage which may lead to **Danger** when the operation is carried out.

Step 1 *Check **Apparatus** for 'Operational Restriction' labels. If they are present they must be obeyed.*

Step 2 *Check whether all phase barriers are in place. If phase barriers are missing, in certain circumstances temporary insulating barriers, for example, **Caution Notices** may be used.*

Suspend operation if in doubt until satisfactory barriers are obtained.

Step 3 *Inspect **Apparatus** for signs of distress and damage including broken **LV** insulators, overheated contacts, leaking compound, signs of flashover.*

*Seek assistance if unsure of the condition of the **Apparatus**.*

Step 4 *Establish that neutral link is in place.*

Leave neutral link in place even when phase fuses or links are withdrawn.

Underground Link Boxes - Additional Steps before opening:-

(a) *Empty all loose items from pockets to prevent anything from falling onto **Live** contacts and possibly causing a flashover.*

(b) *Remove pavement cover*

(c) *Check for smell of gas.*

Suspend all actions if at any stage gas is detected until tests for gas can be carried out.

(d) *Check for signs of overheating from inner lid.*

Suspend all actions until excess heat has been removed.

(e) *Check for water.*

Remove any present sufficient to prevent ingress when inner lid removed.

(f) *Clean loose dirt or rust flakes from top of inner lid.*

(g) *Remove inner lid carefully ensuring it does not drop back.*

ACTION E - ASSEMBLY OF THE CORRECT TOOLS AND EQUIPMENT ENSURING THEIR SAFE CONDITION

General

Select correct link/fuses, link-poles and associated equipment. Failure to do so may result in insufficient clearance from earthed metalwork or overheating due to either insufficient contact area or inability to tighten moving contacts.

Links

Step 1 *Ensure* that link(s) to be inserted is the correct size and type for use in the particular pillar or underground link box.

Step 2 *Wear* Approved rubber gloves if link(s) to be inserted requires the use of a manufacturers' special tool which may not be insulated to ScottishPower standards.

Link Poles

Step 1 *Examine* link pole before use to ensure the pole and its insulation are in a satisfactory condition.

Step 2 *Check* link pole is the correct one for the particular pillar.

Step 3 *Ensure* link pole can be operated without making inadvertent contact with earthed metalwork.

HRC Cartridge Fuses in Insulated Carriers

Step 1 *Check* insulated porcelain carrier is the correct design for the particular pillar/link box and *ensure* the fuse/carrier are correctly assembled.

Step 2 *Ensure* fuse is the correct type/size/rating.

Step 3 *Check* carrier for cracking or missing porcelain and insulated thumb-screws for damage (no **Live** metal exposed).

Step 4 *Check* soundness of fuse using an **Approved** insulation/continuity tester.

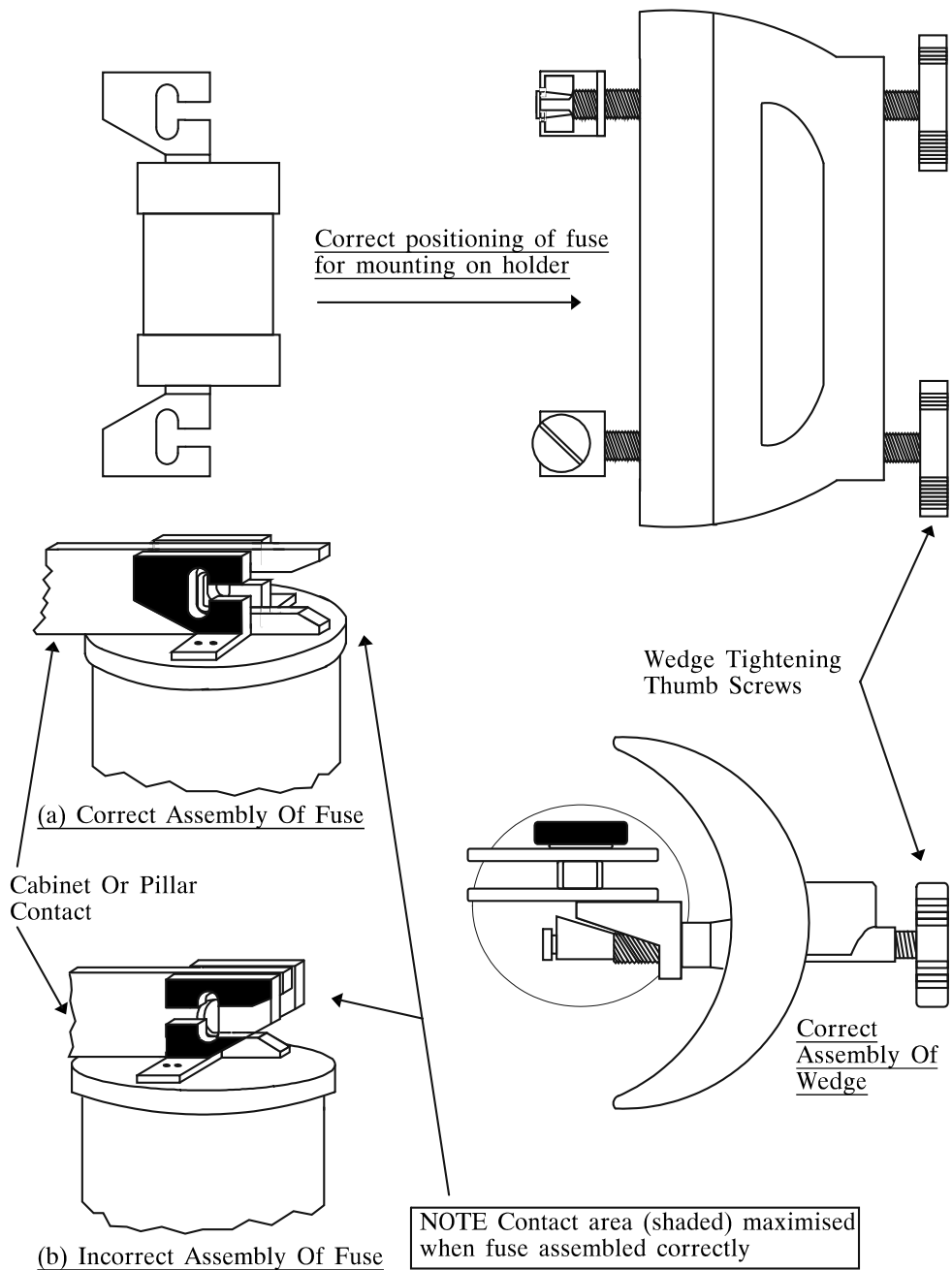
Step 5 *Ensure* thumb-screws/wedges are fully loosened.

Bolt-on HRC Fuses and Rewirable Fuses

Step 1 *Ensure* such fuses are only used on **Apparatus** designed for their use.

Step 2 *Check* fuses are correctly assembled.

Step 3 *Check* soundness of fuses using an **Approved** insulation/continuity tester.



Action E. Correct Assembly Of HRC Fuses

ACTION F - VERIFICATION OF VOLTAGE CONDITIONS BEFORE AND DURING SWITCHING

For the safety of the operator and to avoid inadvertent losses of supply to customers it is essential that voltage conditions are verified before and after fuses/links are inserted or withdrawn. It is equally important that the verification be carried out in the **Approved** manner with the **Approved** equipment.

1 TEST LAMPS

Step 1 Use only **Approved** Voltage Indicator - See Approved Equipment List at rear of this Manual.

- (a) Whether voltage is present - NIL Intensity
- (b) phase/neutral voltage (240V) - HALF Intensity
- (c) phase/phase voltage (415V) - FULL Intensity

Step 2 *Ensure* before use the test lamps consist of the following safety features, have not been modified and contain only **Approved** replacement parts:-

- (a) a 4000 ohm resistor which reduces the operating voltage and current and limits the short-circuit current in the event of a filament fault.
- (b) a "rough service" double filament lamp
- (c) a 500 mA series fuse
- (d) finger shields
- (e) fully insulated contact prongs

NOTE If voltages other than those stated in Step 1 above require to be measured an **Approved** voltmeter equipped with **Approved** fused leads in accordance with HSE Guidance Note GS 38 must be used. The use of multi-meters should be avoided as "accident history has shown that the use of incorrectly set multimeters has frequently caused accidents."

2 USE OF TEST LAMPS BEFORE AND AFTER SWITCHING

General

Handle and Store test lamps with care.

Inspect immediately before and after use.

Do not leave test lamps connected to **Live** circuits for long periods.

Do not apply test lamps to voltages greater than 500V AC or DC

2.1 Verification of Voltage Conditions Before and During Inserting Fuses/Links to Make an LV System Parallel

Step 1 *Check* between each phase contact and neutral, both busbar and circuit, for the presence of 240V (half-lamp intensity)

6 Tests are required, namely,
Busbar: Red-Neutral, Yellow-Neutral, Blue-Neutral
Circuit: Red-Neutral, Yellow-Neutral, Blue-Neutral

If any indication other than half intensity is obtained the reasons must be established before proceeding with the other checks.

Step 2 (a) *Check* between each phase busbar contact and the other two for the presence of 415V (full-lamp intensity)

3 Tests are required, namely,
Busbars: Red-Yellow, Yellow-Blue, Red-Blue

(b) *Check* between each phase circuit contact and the other two for the presence of 415V (full-lamp intensity)

3 Tests are required, namely,
Circuit: Red-Yellow, Yellow-Blue, Red-Blue

Step 3 (a) *Check* between each phase busbar contact and circuit contact that the test lamps do not light (NIL Intensity)

3 Tests are required, namely
Top phase contacts: Red-Red
Middle phase contacts: Yellow-Yellow
Bottom phase contacts: Blue-Blue

(b) *Confirm* test lamps are working by applying,

Phase - Neutral (half-lamp intensity)

NOTE:- The above checks should be undertaken in the order described (that is Steps 1,2,3) but the order of the individual actions may be varied to suit the layout of particular sets of contacts e.g. skeltag, vertical busbar boards, etc.

After the insertion of the first fuse/link (say the Top) in accordance with Action G:

- Step 4 (a) *Re-check* the other two (Middle and Bottom) sets of contacts for NIL Intensity namely,

Red fuse/link inserted

Check Yellow-Yellow and Blue-Blue contacts

- (b) *Confirm* test lamps are working by applying phase-neutral (half-lamp intensity)

After the insertion of the second fuse/link (say Middle) in accordance with Action G:

- Step 5 (a) *Re-check the remaining bottom contacts for (NIL Intensity) namely,*

Red and Yellow fuses/links inserted

Check Blue-Blue contacts

- (b) *Confirm test lamps are working by applying phase-neutral (half-lamp intensity)*

2.2 Verification of Voltage Conditions Before and During Energising of a Circuit

- Step 1 *Confirm* test lamps are in working order using an APPROVED proving unit or against a known **Live** source (phase-neutral)

- Step 2 *Check* phase contacts, of the **Live** side for the presence of 415V (full-lamp intensity)

3 tests are required, namely

RED - YELLOW

YELLOW - BLUE

RED - BLUE

- Step 3 (a) *Check* the phase contacts of the circuit to be energised are not **Live**

3 tests are required, namely

RED/YELLOW/BLUE - NEUTRAL (NIL-intensity)

- (b) *Confirm* test lamps working by applying phase-neutral

- Step 4 *Insert* first fuse/link (say the red) in accordance with ACTION G

- Step 5 (a) *Check* between Red phase contact of circuit being energised and neutral for 240V (half-lamp intensity)

- (b) *Check* between Yellow phase contact of circuit being energised and neutral for 0V (NIL lamp intensity)

- (c) *Check* between Blue phase contact of circuit being energised and neutral for 0V (NIL intensity)

- (d) *Confirm* test lamps working by applying **Live** phase-neutral

NOTE *Stop* switching if either contact (Yellow or Blue) indicates 240V (half-lamp intensity) or more, as this probably means a phase-phase fault on the circuit being energised.

If the circuit being energised supplies three phase loads a slight glow may be noticed from the test lamps. This may be due to a backfeed from the energised phase via the customers meters or three phase loads.

Step 6 *Insert* second fuse (say yellow) in accordance with ACTION G

Step 7 (a) *Check* between Yellow phase contact of circuit being energised and neutral for 240V (half-light intensity)

(b) *Check* between Blue phase contact of circuit being energised and neutral for 0V (NIL intensity)

(c) *Confirm* test lamps working

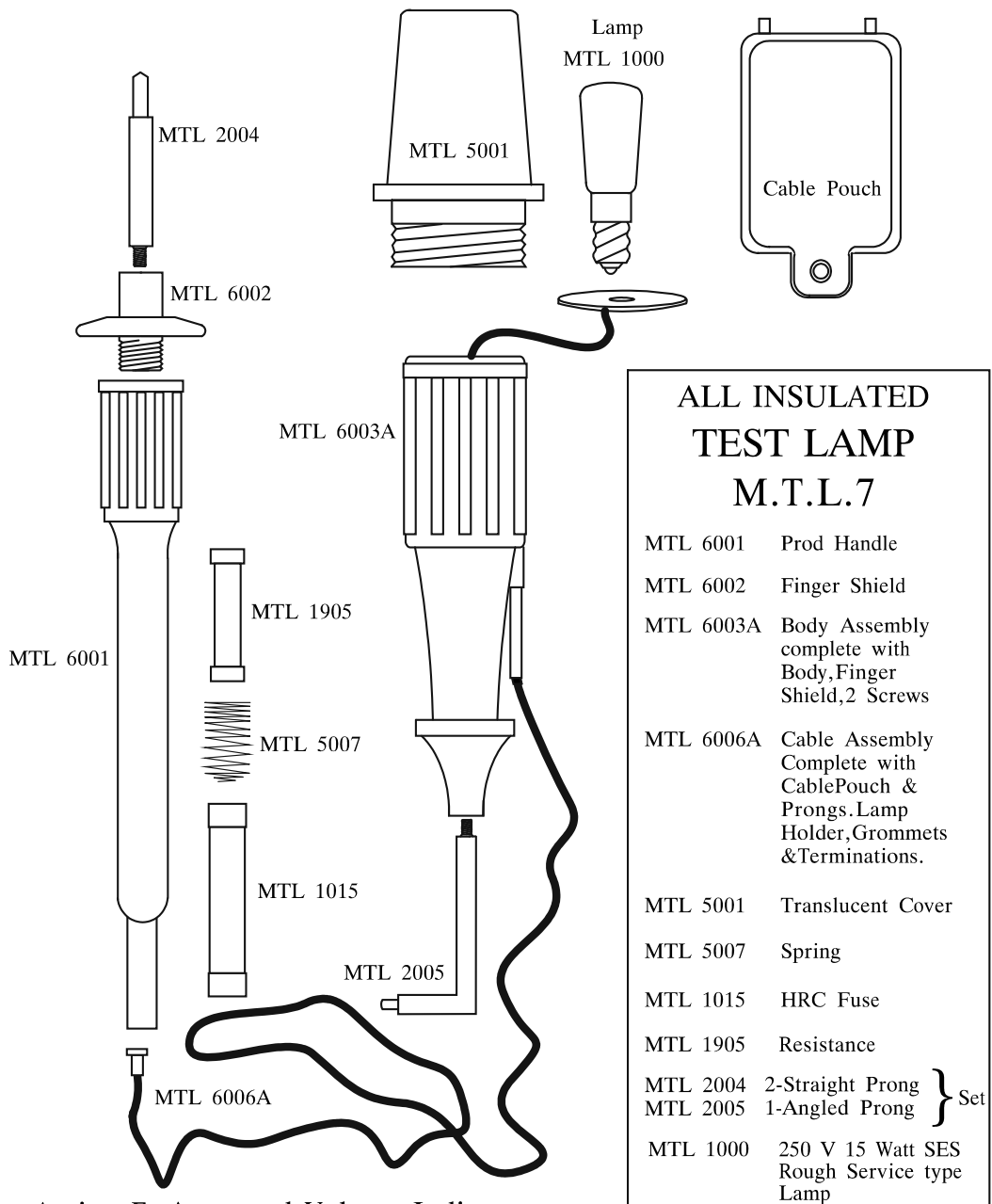
Step 8 *Insert* third fuse (say blue) in accordance with ACTION G

Step 9 *Check* between BLUE phase contacts of circuit being energised and neutral for 240V (half-light intensity)

Step 10 *Check* for the presence of three phase voltage across the phase contacts of the circuit which has been energised for the presence of 415V (full-lamp intensity)

3 tests are required, namely,

RED - YELLOW, YELLOW - BLUE, BLUE - RED



Action F. Approved Voltage Indicator
John Drummond Engineering Ltd

ACTION G - INSERTION AND WITHDRAWAL OF FUSES OR LINKS

1 GENERAL

Ensure assembly of correct tools/equipment and checking their safe condition has been carried out, in accordance with ACTION E.

Ensure verification of voltage conditions is carried out, in accordance with ACTION F.

Assess risks and use appropriate PPE.

Do not remove or withdraw the neutral link.

Apply special precautions required when operating in underground Link Boxes, in accordance with ACTION D.

2 INSERTION OF FUSES OR LINKS TO MAKE A SYSTEM PARALLEL OR TO ENERGISE A CIRCUIT

2.1 Withdrawable Links and HRC/Rewirable Fuses in Insulated fuse-carriers

Step 1 *Carry out* assembly of correct tools/equipment and checking of their safe condition in accordance with ACTION E.

Step 2 *Carry out* verification of voltage conditions in accordance with ACTION F.

Step 3 *Fit* detachable handle to link, or if appropriate, to insulated fuse-carrier.

Step 4 *Wear **Approved*** rubber gloves if handle is not fully insulated to ScottishPower standards or if there is any risk of the operator of handle slipping.

Step 5 *Check* both fuse/link contacts will fit the fixed contacts of the pillar/link box.

Step 6 *Insert* the bottom contact of the fuse/link into the lower fixed contact of the pillar or link box.

Step 7 *Swivel* the top contact of the fuse/link smartly into the upper fixed contact using the already inserted lower contact as a pivot in a single, uninterrupted movement.

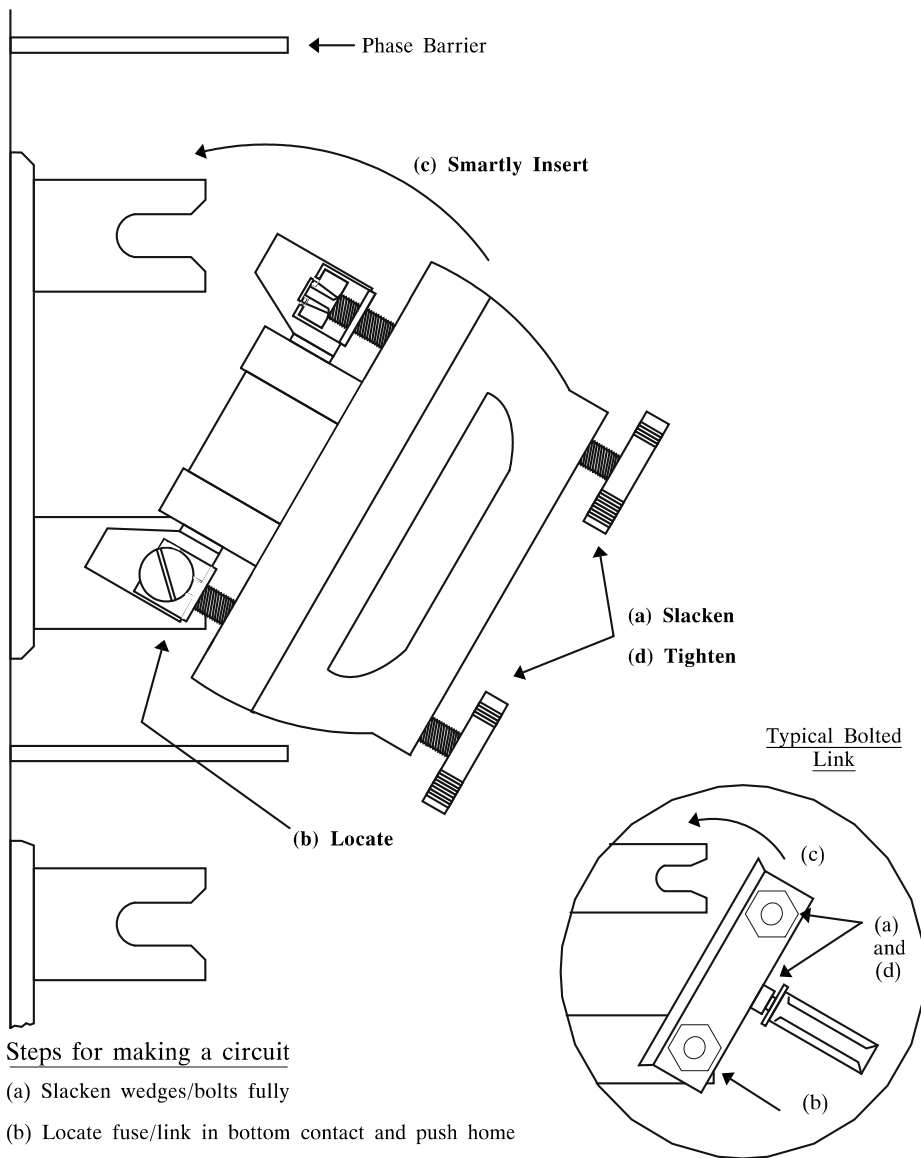
or If the design of the pillar prevents the swivel action:

Step 6/7 *Insert* the fuse carrier/link into the pillar fixed contacts in a positive, uninterrupted, horizontal motion so that the top and bottom contacts connect at the same time.

- Step 8 *Hold* the fuse carrier/link fully into the fixed contact jaws by applying hand pressure.
- Step 9 *Tighten* the fuse carrier/link wedges or screws using other hand.

2.2 Hinged-type Links with Captive Lower End, Operated using link poles.

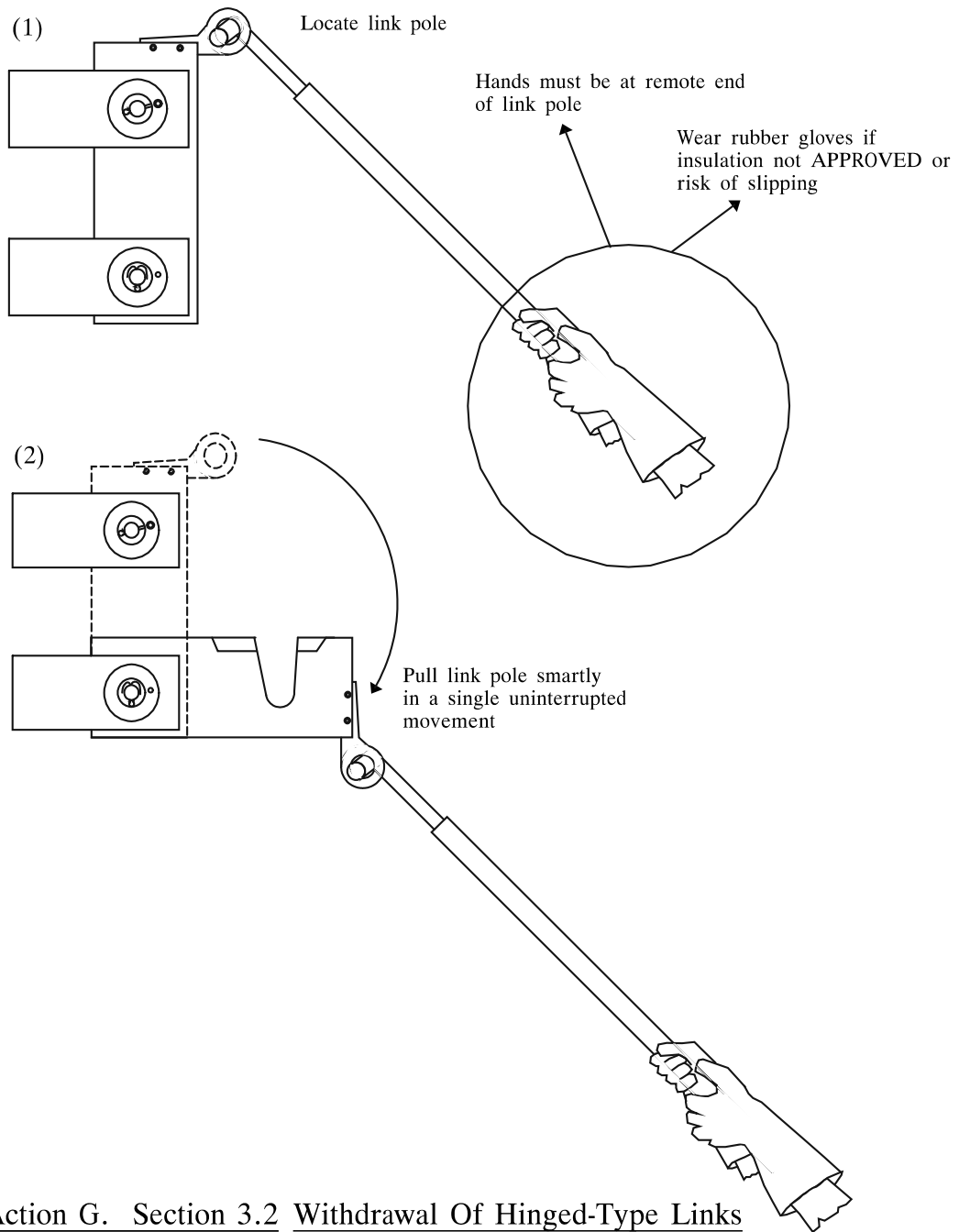
- Step 1 *Carry out* assembly of correct tools/equipment and checking of their safe condition in accordance with ACTION E.
- Step 2 *Carry out* verification of voltage conditions with accordance ACTION F.
- Step 3 *Hold* link pole at remote end to ensure maximum clearance, wearing **Approved** rubber gloves, from **Live** conductors.
- Step 4 *Check* link top and bottom tightening devices are fully slackened.
- Step 5 *Insert* link pole into link top lobe.
- Step 6 *Close* link smartly in a single uninterrupted movement.
- Step 7 *Tighten* link top tightening device.
- Step 8 *Tighten* link bottom tightening device.



Steps for making a circuit

- (a) Slacken wedges/bolts fully
- (b) Locate fuse/link in bottom contact and push home
- (c) Smartly pivot fuse/link about bottom contact to locate top contact
- (d) Tighten wedges/bolts while applying inward pressure to fuse/link
- (e) Remove any detachable handle

Action G. Section 2.1 Insertion Of Withdrawable Fuses Or Links



Action G. Section 3.2 Withdrawal Of Hinged-Type Links

3 WITHDRAWAL OF FUSES OR LINKS TO REMOVE SYSTEM PARALLEL OR DE-ENERGISE CIRCUIT

3.1 Withdrawable Links and HRC/Rewirable Fuses in Insulated Carriers

- Step 1 *Wear **Approved** rubber gloves if manufacturers special tool is to be used which may not be fully insulated to ScottishPower standards, or if there is any risk of tool or operator slipping.*
- Step 2 *Fit detachable handle to link or, if appropriate, insulated fuse-carrier.*
- Step 3 *Apply pressure to fuse carrier/link and *slacken* wedges or screws until loose, but not so loose that insulated carrier might become separated from fuse.*
- Step 4 *Grip fuse carrier or handle.*
- Step 5 *Pull fuse carrier/link smartly out of fixed contact jaws in single uninterrupted movement so that both top and bottom contacts are broken at the same time.*

3.2 Hinged-type Links with Captive Lower End, Operated using link poles

- Step 1 *Hold **Approved** link pole at remote end to ensure maximum clearance from **Live** conductors.*
- Step 2 *Slacken link bottom tightening device, but not so loose that the link will become dismantled.*
- Step 3 *Slacken link top tightening device, but not so loose that the link will become dismantled.*
- Step 4 *Pull open link smartly by inserting **Approved** link pole in link top pin lobe.*

4 REPLACEMENT OF 'SKELTAG' BOLT-ON FUSES

- Step 1 *Hold **Approved** link pole at remote end to ensure maximum clearance from **Live** conductors.*
- Step 2 *Insert link pole in hole at top of hinged link.*
- Step 3 *Pull open link smartly in single uninterrupted movement.*
- Step 4 *Remove fixing nuts using **Approved** insulated tee-bar and insulated socket.*

- Step 5 *Remove* blown fuse wearing **Approved** rubber glove(s).
- Step 6 *Fit* replacement fuse wearing **Approved** rubber glove(s).
- Step 7 *Tighten* fixing nuts using **Approved** insulated tee-bar and insulated socket.
- Step 8 *Check* voltage across the open link using **Approved** test lamps as per ACTION F.
- Step 9 *Close* link smartly using **Approved** link pole in a single uninterrupted movement.
- Step 10 *Check* voltage using **Approved** test lamps in accordance with ACTION F.

ACTION H - VERIFICATION OF VOLTAGE CONDITIONS AFTER WITHDRAWAL OF FUSES/LINKS

Step 1 *Withdraw* fuses or links in accordance with ACTION G.

Step 2 *Check* using test lamps whether voltage conditions are as expected namely

(a) if **LV** parallel has been broken:-

Check for the presence of 415V (full-lamp intensity) on either side of the withdrawn fuses/links, particularly to ensure customer supplies are maintained.

(b) if circuit has been de-energised:-

Check using test lamps, which are proved before and after the check, that all three phases are not **Live**. (Nil-Intensity)

ACTION I - SECURING APPARATUS TO MAINTAIN SAFETY

1 GENERAL

When fuses/links are opened so that work can take place 'adequate precautions' must be taken to ensure the apparatus does not become **Live** during the course of the work. This means the point(s) of isolation must be secured in accordance with ScottishPower Safety Rules (E & M) 4th Edition before the work starts.

2 WITHDRAWABLE LINKS AND FUSE-CARRIERS

- Step 1 *Withdraw* fuses/links in accordance with ACTION G paragraph 3.1.
- Step 2 *Fit* insulated shields to prevent re-insertion of fuses/links over cabinet/pillar or link box fixed contacts.
- Step 3 *Apply* **Caution Notice** as near to point(s) of isolation as practicable.
- Step 4 *Remove* fuses/links from the area.
- Step 5 *Retain* fuses/links in safe custody.
- Step 6 *Close* and *secure* cabinet/pillar door or link box cover.

3 HINGED-TYPE LINKS WITH CAPTIVE LOWER END

- Step 1 *Open* links using correct link-pole in accordance with ACTION G paragraph 3.2.
- Step 2 *Lock* links open using **Approved** cover or locking bar, where provided.

 or if this is not practicable
- Step 2 *Tighten* the captive tightening device at the lower end of the opened link

 and
 either 2(a) *Fit* insulated shields over open contacts,
 or 2(b) *Fit* **Approved** lanyard and **Safety Padlock**.
- Step 3 *Apply* **Caution Notice** as near to point(s) of isolation as practicable.
- Step 4 *Close* and *secure* cabinet/pillar door.

ACTION J - REPORTING THAT SWITCHING HAS BEEN COMPLETED

Once **Switching** has been completed or if any difficulties are encountered which prevent the **Switching** from being completed in the agreed manner:

Step 1 *Confirm* to the issuer of the instruction, unless instructed otherwise;-

- (a) Completion (or otherwise) of the **Switching**
- (b) Status of the **System**
- (c) Details of customers disconnected or restored.