



**Construction, Engineering and
Transport Faculty**

Assessment

UEPOPS428B - Develop H.V. switching programs

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UEPOPS428B - Develop H.V. switching programs

Assessment feedback sheet

Qualification:	Statement of Attainment – HV Switching
Unit of Competency:	UEPOPS428B - Develop H.V. switching programs
Assessment Task:	
Student Name:	
Student ID:	

Assessment Outcome:	For UOC being assessed by multiple assessment activities, each activity will be reported as Satisfactory or Not Satisfactory <input type="checkbox"/> [Satisfactory] <input type="checkbox"/> [Not Satisfactory] <input type="checkbox"/> Resubmission (RS)		
	For UOC being assessed for the final result it will be reported as AC (Competent) or NC (Not yet competent) <input type="checkbox"/> [Competent - AC] <input type="checkbox"/> [Not Yet Competent-NC] <input type="checkbox"/> Resubmission (RS)		
Assessor's comment regarding student performance			
Assessor's comment should be specific and based on the marking criteria for the specific assessment event.			
Assessor's recommendation on how to improve the performance (if there is any gap)			
Assessor's comment should be specific and based on the marking criteria for the specific assessment event.			
Assessor Name/ Signature:			Date:
Student Feedback on Outcome(s): <input type="checkbox"/> The results of my performance have been discussed and explained to me. If you would like to request a review of your results or if you have any concerns about your results, contact your teacher or head teacher.			
Student's signature:		Date:	

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Participant confirmation

Participant confirmation:		
By signing below, I confirm that:		
<input type="checkbox"/> I have enrolled to undertake the assessments indicated above; and <input type="checkbox"/> The assessment criteria has been explained to me and I am aware that I will be assessed against the criteria outlined within the attached assessment documents. <input type="checkbox"/> I have been given fair notice of the date, time & venue for this assessment, and I am aware of my rights and obligations in relation to the assessment process <input type="checkbox"/> I am satisfied that the assessment was fair and valid.		
Student Name (please print):		
Student Signature:		Date: / /
Student Identification Please provide Photo ID for verification by the Assessor	Drivers Licence State of Issue:	Number:
	High Risk Licence State of Issue:	Number:
ESI Network Authorisations: <input type="checkbox"/> Ausgrid <input type="checkbox"/> Endeavour Energy <input type="checkbox"/> Essential Energy		
UEPOPS428B - Develop H.V. switching programs: (Assessor Use Only)		
Assessment component	Assessment outcome	
UEPOPS428B - Theory/Knowledge Assessment	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Not satisfactory
UEPOPS428B - Practical/Oral Assessment	<input type="checkbox"/> Satisfactory	<input type="checkbox"/> Not satisfactory
Overall Assessment Outcome – UEPOPS428B	<input type="checkbox"/> Competent	<input type="checkbox"/> Not Competent
Trainer/Assessor Name (please Print):		
Trainer/Assessor Signature:		
Date of Assessment:		

Assessment resource - version and publication:

Title	[Title]		
Publication authorised by	Nicholas Blanch	Issued version number	[Status]
Date issued	[Publish Date]	Date for review	23/09/2017
Document Repository			

Assessment resource - publication history:

Previous Versions	Current Version	Date	Author	Description of change
	V1.0			Initial Version

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Assessment

Assessment Instructions:

To successfully complete this assessment and be 'deemed' competent participants must:

- answer **all** knowledge assessment questions contained within the written assessment resource to the satisfaction of the assessor.
- Achieve a minimum mark of 100% (i.e. **all answers must be correct**). Each un-answered question is to be marked as incorrect).

Assessment participants may not access any reference material during this part of the assessment

Nominal assessment duration: 20 minutes

Question 1: (Tick the most correct answer – 2 Marks)

From the table below identify those voltages which would be considered to be 'Low Voltage' according to your organisation's electrical safety rules.

Voltage Levels	Considered to be Low Voltage under the Electrical Safety Rules (Yes/No)	
a) Any voltage 12 volts and 40 volts AC	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b) Any voltage between 12 volts and 110 volts DC	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c) Any voltage between 50 volts and 1000 volts AC	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
d) Any voltage between 120 volts and 1500 volts DC	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Question 2: (Circle the most correct answer – 2 Marks)

From the items listed below select the most appropriate definition for 'authorised person'

- a) A person who has acquired through training, qualification, experience, or a combination of them, the knowledge and skills to carry out the task.
- b) A person who has attained a relevant nationally recognized qualification, and who has been licensed by the NSW Department of Fair Trading
- c) A person with technical knowledge or sufficient experience who has been approved, or has the delegated authority to act on behalf of the Network Operator, to perform the duty concerned.
- d) LV or HV overhead conductors which are protected by physical barriers to prevent persons encroaching within the relevant Safe Approach Distances (SADs).

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Question 3: (2 Marks)

In the spaces provided below, write down the five (5) different types or categories that WHS hazards can generally be classified into:

1. ElectricalHazards
2. Chemical..... Hazards
3. Thermal.....Hazards
4. Vibration/ Noise.....Hazards
5. Working at Height..... Hazards

Question 4: (8 Marks)

In the spaces provided below write down the definition for each of the terms

a) De-energised

To deprive of electrical energy or exhaust the electrical energy from: Turning off the ignition de-energizes the spark plugs.

b) Isolated

Function intended to cut off the supply from the whole installation, or a discrete section of it, by separating it from every source of electrical energy for reasons of safety.

c) High Voltage

Above 1000 V AC (AS3000 1.4.98)

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Question 5: (2 Marks)

From the table below identify those voltages which would be considered to be 'High Voltage' according to your organisations electrical safety rules.

a) Any voltage exceeding 1 000 volts AC	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
b) Any voltage between 1 500 volts and 11 000 Volts AC	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c) Any voltage exceeding 1 500 volts DC	<input type="checkbox"/> Yes	<input type="checkbox"/> No
d) Any voltage between 1000 volts and 1500 volts DC	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Question 6: (4 Marks)

In the spaces provided below write down the definition for each of the terms:

- a) Electrical Apparatus

The equipment which are operated with electricity

- b) Earthed

Connected to both the supply neutral and the general mass of earth in accordance with the appropriate requirements of AS3000

Question 7 (6 Marks)

In the spaces provided below write down three (3) common types of HV circuit breaker arc extinguishing mechanisms which may be used within HV circuit breakers.

(A) Oil circuit breakers cool and extinguish the arc which occurs when the separation of contacts which are immersed in the oil.

(B) Air blast uses compressed air to extinguish the electric arc occurs when the contacts are separated

(c) A sulfur hexafluoride circuit breaker uses contacts surrounded by sulfur hexafluoride gas to quench the arc

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Question 8: (Circle the most correct answer – 2 Marks)

Ground-overcurrent or 'earth fault' protection is used to detect earth faults whereby:

- a) the current in a specific neutral or earth conductor is measured
- b) the residual current of the phase conductors of a 3 phase system is measured
- c) the current in a phase conductor is measured.

Question 9: (Circle the most correct answer – 2 Marks)

A differential protection scheme:

- a) Compares the current entering the protected circuit (or zone) to the current leaving the zone
- b) Measures the residual current of the phase conductors of a 3 phase system is measured
- c) Measures the current within a specific neutral or earth conductor connected between the mass of earth and the transformers star point.

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Question 10: (6 Marks)

Review the single line network diagrams below, and complete the table by ticking the box next to the most correct answers

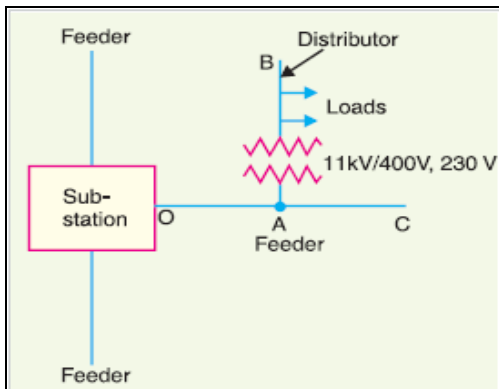


Figure A

- ☒ Radial Network
- ☐ Ring Main Network
- ☐ Interconnected Network

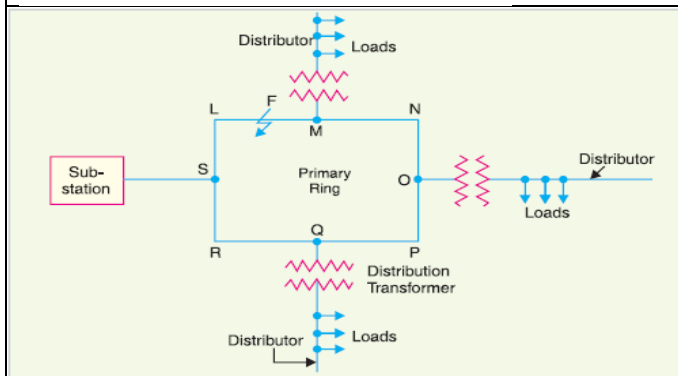


Figure B

- ☐ Radial Network
- ☒ Ring Main Network
- ☐ Interconnected Network

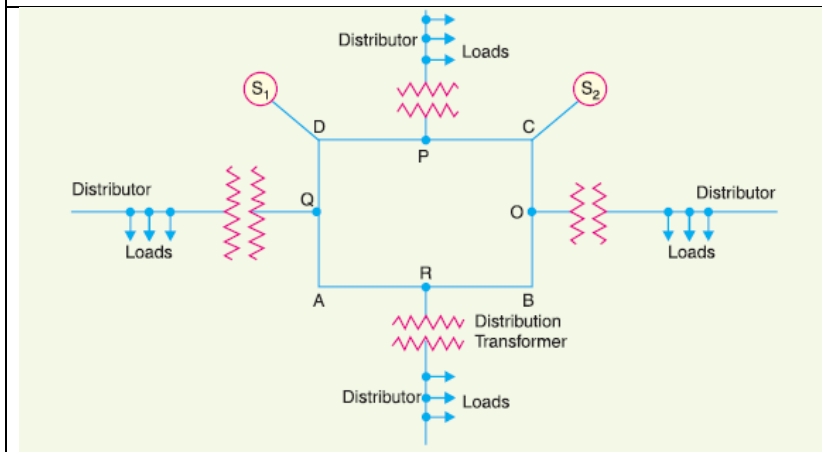


Figure C

- ☐ Radial Network
- ☐ Ring Main Network
- ☒ Interconnected Network

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Question 11: (Circle the most correct answer – 2 Marks)

Which statutory requirement states that it is the employer's responsibility to provide such information, instruction, training and supervision necessary to ensure the health and safety at work of all employees?

- a) NSW Health and Safety Regulation 2001
- b) NSW Workers Compensation act 2011
- c) NSW Occupational Health and Safety Regulation 2010

Question 12: (Circle the most correct answer – 2 Marks)

Voltage fluctuations are short duration variations in voltage levels due to changes in, or switching of loads within the supply network.

- a) True
- b) False

Question 13: (Circle the most correct answer – 2 Marks)

From the items listed below, choose the most correct definition for the term 'Risk':

- a) The likelihood of any harm or Injury happening
- b) The potential for harm or injury to occur at the worksite
- c) Anything that could cause harm or injury to persons at the work site.

Question 14: (Circle the most correct answer – 2 Marks)

Voltage 'transients' within the electricity distribution network.

- a) are short duration 'spikes' or sudden increases in the supply voltage level generally due to effect of lightning strike upon the distribution network and/or network switching.
- b) A substantial voltage transient will only occur if the lightning strikes the local network or in the immediate vicinity
- c) Switching transients are short-term distortions (milliseconds) to the voltage waveform caused by switching operations
- d) May be limited by the installation of lightning protection systems (including surge arresters, and earthing systems) and protective equipment for rapid isolation of faults.

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Question 15: (6 Marks)

In the spaces provided below write down the (Six) general steps used for isolation of HV equipment within a RADIAL HV network:

- a) Switching to prepare for the isolation i.e. load shedding;
- b) Isolation - including operation of equipment, placement of High Voltage Access Permit Point Locks and High Voltage Access Permit Point Tag(s);
- c) Earthing - which includes proving that Electrical Apparatus is de-energized and placing of isolation earths;
- d) Issuing of High Voltage Access Permit;
- e) Removal of Isolation Earths;
- f) De-isolation - including removal of Permit Locks and High Voltage Access Permit Point Tags;
- g) Reverse switching.

Question 16: (2 Marks)

Under your organisation's HV electrical safety rules, what is the safe approach distance/minimum safe working distance (in mm) that an Authorised PERSON must maintain from any uninsulated part of their body to any exposed conductor with voltage of between 1 000 volts and 11 000 volts **AC**?

NOMINAL OPERATING VOLTAGE

High voltage up to and including 22kV
(Operating Work only)

ABSOLUTE LIMIT OF APPROACH (millimetres)

300

.....mm

Question 17: (Circle the correct answers – 3 Marks)

Which of the items below best describes Voltage 'regulation' within the electricity distribution network?

- a) Voltage regulation is the maintenance of the distribution system voltage within a specified upper and lower limit bandwidth to ensure quality of power supply to the consumers
- b) Voltage regulation is intended to respond quickly to voltage drops or rises within the distribution network associated with load fluctuation to ensure that customers voltage level do not exceed specified upper or lower limits
- c) Voltage regulation is achieved by the use of distribution transformers fitted with off load tapchangers
- d) Voltage regulation is generally controlled at a zone substation by the transformer supplying the HV distribution system by an Off Load Tap Changer.

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Question 18: (3 Marks)

Under your organisation's HV electrical safety rules, what is the safe approach distance/minimum safe working distance (in mm) that an HV Aware (Instructed) PERSON must maintain from any uninsulated part of their body to any exposed conductor with voltage of up to 1 000 volts DC?

.....150.....mm

Question 19: (Select the most correct answer– 1 Marks)

The basic safety rule for work on or near High Voltage exposed electrical apparatus states that:

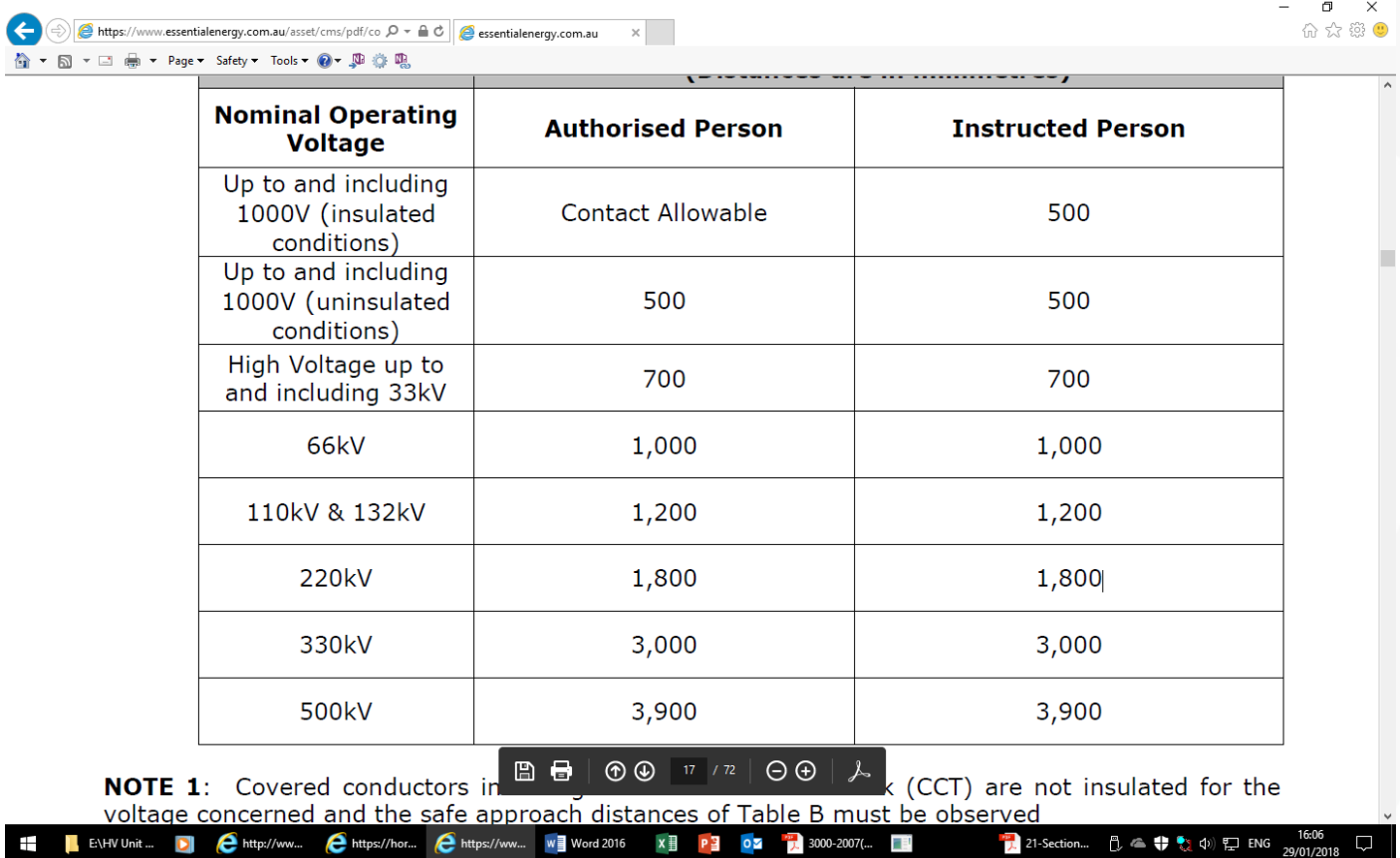
- a) The exposed HV conductors or electrical apparatus must be regarded as alive until advised to the contrary by an Authorised Person
- b) The exposed HV conductors or electrical apparatus must be regarded as alive until isolated, proved de-energised and earthed**
- c) The exposed HV conductors or electrical apparatus must be regarded as alive until a clear and visible break, signifying isolation, has been established
- d) The exposed HV conductors or electrical apparatus must be regarded as alive until isolated, proved de-energised, earthed and short-circuited by an approved means.

Question 20: (1 Mark)

Insert the correct Safe Approach Distances in the table below

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

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Nominal Operating Voltage	Authorised Person	Instructed Person
Up to and including 1000V (insulated conditions)	Contact Allowable	500
Up to and including 1000V (uninsulated conditions)	500	500
High Voltage up to and including 33kV	700	700
66kV	1,000	1,000
110kV & 132kV	1,200	1,200
220kV	1,800	1,800
330kV	3,000	3,000
500kV	3,900	3,900

NOTE 1: Covered conductors in guyed towers (CCT) are not insulated for the voltage concerned and the safe approach distances of Table B must be observed

Question 21: (Select the most correct answers– 2 Marks)

Within an electricity transmission or distribution network, faults are generally classified as:

- a) Open circuit faults
- b) Short circuit faults
- c) Expensive or inexpensive faults
- d) Earth faults
- e) Manor, minor or insignificant faults
- f) Symmetrical or unsymmetrical faults

Question 22: (Circle the most correct answers – 3 Marks)

From the list below, select the item/s which the Access Permit/Access Authority issuer must advise the Access Permit/Access Authority Recipient (and preferably all persons working on equipment or job for which the Authority is being issued):

- a) a confirmation of the description of the work to be carried out;.
- b) the time and date of issue of the access permit/access authority.
- c) the locations where electrical apparatus has been earthed and short-circuited
- d) warnings of adjacent live exposed conductors or electrical apparatus (if applicable)

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e) any screens, tapes / barriers that are erected to define the Work Area.

Question 23: (Circle the most correct answer – 2 Marks)

From the list of items below select an example of a distribution network open circuit fault:

- a) Loss of one phase of a three phase supply due to a blown fuse
- b) Loss of two phases of a three phase supply due to a damage distribution transformer winding.

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Question 24: (Circle the most correct answer – 2 Marks)

From the list below, select the item/s that the Access Permit/Access Authority Issuer has a responsibility to confirm prior to issuing the access permit/access authority:

- a) Personally check over the precautions that have been taken to ensure that the high voltage has been de energised and totally isolated from any supply
- b) Confirm the high voltage access permit detail to ensure that the electrical apparatus descriptions are correct and in accordance with established labels
- c) Erect appropriate and adequate warning signs and barriers. Discuss with the access permit recipient/holder, the work to be done to ensure that the high voltage access permit covers sufficient electrical apparatus to enable the intended work to be performed safely.
- d) Fully understand which electrical apparatus is safe to work or test, on or near and which is still to be regarded as live and the location of isolating points and earths or short circuits
- e) Ensure that the access permit recipient/holder understands the location and labelling of any earths to be applied by the work party, which are to be listed on the high voltage access permit and that this understanding agrees with the operator's understanding.

Question 25: (Circle the most correct answer – 3 Marks).

From the list of items below select those which best describe a distribution network short circuit faults:

- a) An abnormal connection of very low impedance between two points of different potential, whether made intentionally or accidentally
- b) Can only occur where there has been an insulation failure between conductors
- c) Three phase short circuit faults clear of earth and three phase fault to earth are balanced or symmetrical faults while other remaining faults are unsymmetrical faults.
- d) Are faults which result in the flow of abnormal high currents through the equipment or transmission/distribution lines.

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Question 26: (Circle the most correct answer – 3 Marks).

All sections of this question must be answered correctly.

From the list of items provided below select those which best describe a symmetrical or balanced fault :

- a) A fault which gives rise to symmetrical fault currents that are displaced with 120 degrees from each other.
- b) Can only occur where there has been an insulation failure between conductors
- c) A fault which occurs when all the three phases are simultaneously short circuited.
- d) A fault which results in a short circuit between line to line to line (L-L-L) and line to line to line to ground (L-L-L-G).

Question 27: (Select the most correct answers– 2 Marks)

In the space provided below, describe the circumstances under which the Permit To Work/Access Permit/Access Authority recipient can refuse to accept a Permit To Work/Access Permit/Access Authority.

If a member of the work party cannot or does not sign off an Access Permit before leaving the work area, the Recipient must contact the person and advise them to return to the work area, or, if this is not practical, the Recipient may in exceptional circumstances sign off for that person, by signing Recipient's name and documenting in brackets as to why the person had not signed off. If the Recipient cannot contact the person, the Recipient must contact the person's supervisor advising of the situation and seek permission to sign the person off. The Recipient must ensure that the absent member of the work party does not subsequently re-join the work party without signing onto the Access Permit again, or is made aware of the cancellation of the Access Permit, whichever the case may be.

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Question 28: (Select the most correct answers– 2 Marks)

Unsymmetrical distribution system faults:

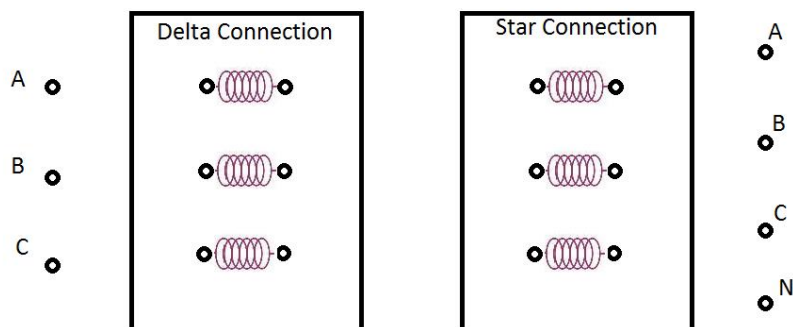
- a) Are more common and less severe than symmetrical faults
- b) Consist of mainly three types of faults, namely line to ground (L-G), line to line (L-L) and double line to ground (LL-G) faults.
- c) Are less common and more severe than symmetrical faults
- d) Are also called unbalanced faults since their occurrence causes unbalance in the system (i.e. fault impedance values are different in each phase causing unbalance current to flow in the phases)

Question 29: (Circle the most correct answer – 3 Marks).

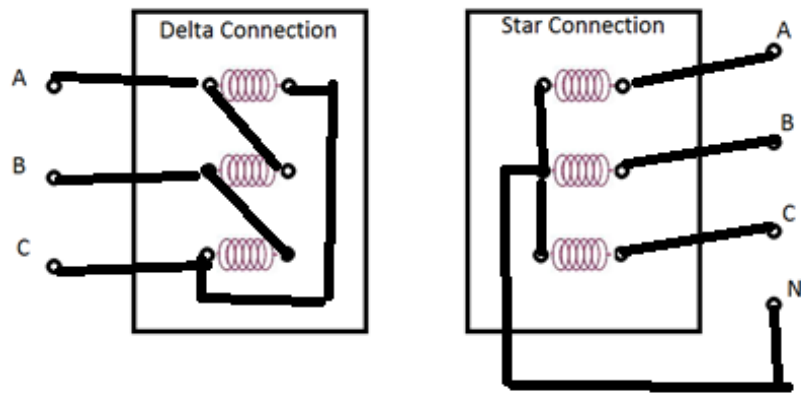
All sections of this question must be answered correctly.

The diagram below represents the primary and secondary windings of three phase HV – LV distribution transformer. Complete the diagram by drawing the following:

- a) Correct connections between each of the 11Kv transformer windings to create a 'DELTA' connection of the transformer primary windings
- b) Correct connections between each of the LV transformer windings to create a 'STAR' connection of the transformer Secondary windings.
- c) Correct connections between the HV transformer terminals (marked A, B, C) and the DELTA connected transformer primary winding
- d) Correct connections between the LV transformer terminals (marked A, B, C, N) and the STAR connected transformer Secondary winding



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Question 30: (3 Marks).

All sections of this question must be answered correctly

Referencing the circuit breaker diagram provided below, complete the table provided by identifying of the main components of the circuit breaker:

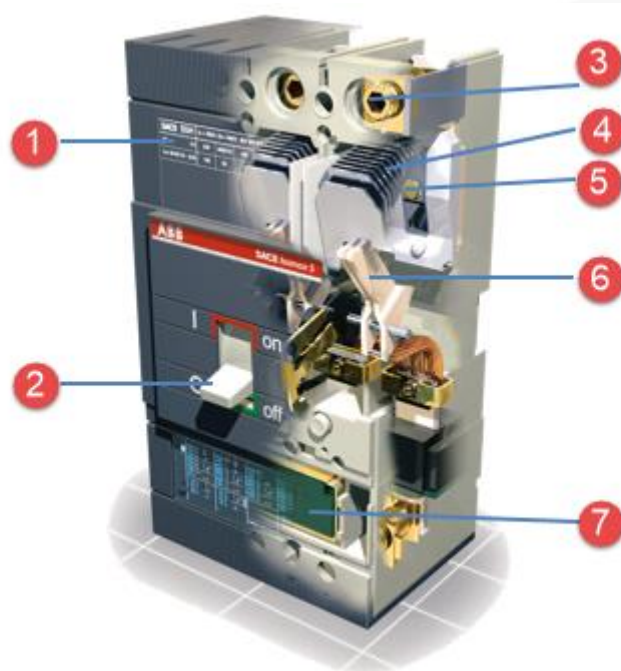


Diagram number	Circuit breaker components description
----------------	--

1 Name plate

2 Actuator lever

3 Terminal

4 Solenoid

5 Bimetallic strip

6 Calibration
Screw

7 Arc
divider/extinguisher

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Question 31: (Select the most correct answers– 2 Marks)

Assume you have been provided a current transformer with a ratio of 200/5. If the primary current passing through this CT was 180 amps, the secondary current would be:

- a) 10 amps
- b) 2 amps
- c) 5 amps
- d) 180 amps
- e) 36 amps
- f) 4.5 Amps

Question 32: (Select the most correct answers– 2 Marks)

In the spaces provided below, briefly describe who can receive a Permit To Work/Access Permit/Access Authority under the requirements of your organisations HV electrical safety rules

Only an authorised person shall receive an Access Permit. A recipient may be asked to produce their current authorisation card. The recipient of an Access Permit shall have the following responsibilities:
I Be satisfied that the Access Permit provides access for the work as requested and is appropriate to the work being undertaken; and

II Understand the limits of the Access Permit, the precautions and control measures that have been taken and any relevant warnings; and

III Ensure control measures, as required, have been applied and are maintained including testing and proving de-energised at all work sites covered by that access permit; and

IV Endorse the Access Permit as having been received; and

V Ensure the limits of the Access Permit, the precautions, control measures and any warnings or instructions, as applicable that are entered on the Access Permit are communicated to, and understood by and are observed by all persons signing on the Access Permit; and

VI Ensure no member of the work party commences work until they have signed onto the Access Permit and all members of the work party have signed off prior to cancellation of the Access Permit; and

VII Be present at the work site for the duration of the permit and ensure that the Access Permit is available for the duration of issue; and

VIII Ensure working earths, low voltage short-circuits and personal protective bonds are applied and removed where required. Working earths are specific to a single access permit and cannot be shared unless consultation occurs between the access permit recipients.

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Question 33: (2 Marks)

What would the value of current flow (in amperes) through a person who is in contact with a 6.6 kV HV uninsulated conductor if we assume that the total resistance of the circuit through the person's body and to earth is 24 000 Ohms?

2.75 amp

Answer:

Question 34: (6 Marks)

Describe the definition of High Voltage (HV) in terms of a voltage level:

Exceeding 1 000 V a.c. or 1 500 V d.c.

Question 35: (Circle the most correct answer(s) – 5 Marks)

Identify which of the items listed below **could be are considered to be** electrical stresses which can potentially generate a stator winding fault within a HV AC induction motor:

- a) Supply voltage transients, due to lightning, opening, or closing of circuit breakers or due to variable frequency drives
- b) Coil movement due to the stator current loosening the top sticks and also may cause damage to the copper conductor and its insulation.**
- c) Supply under-voltage or over-voltage conditions
- d) Stator lamination failure
- e) Stator winding slot insulation failure

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Question 36: (2 Marks)

Under your organisation's HV electrical safety rules, what is the safe approach distance/minimum safe working distance (in mm) that an Authorised Person must maintain from any uninsulated part of their body to any exposed conductor with voltage of between 1 000 volts and 11 000 volts **AC**?

250

..... mm

Question 37: (3 Marks)

Under your organisation's HV electrical safety rules, what is the safe approach distance/minimum safe working distance (in mm) that an HV Aware (Instructed) Person must maintain from any uninsulated part of their body to any exposed conductor with voltage of up to 1 000 volts **AC**?

150

.....mm

Question 38: (Insert the missing words in the space provided – 3 Marks)

Under your organisation's HV electrical safety rules, what is the safe approach distance/minimum safe working distance (in mm) that an HV Aware (Instructed) PERSON must maintain from any uninsulated part of their body to any exposed conductor with voltage of up to 1 000 volts DC?

150

.....mm

Question 39: (Circle the most correct answer – 2 Marks)

In a low voltage distribution system, the term Multiple Earthed Neutral System incorporates:

- a) A system where the neutral conductor is earthed at various points along its length
- b) A method of maintaining the neutral substantially at earth potential at any point on the conductor
- c) The consumer's main earth is connected to the neutral link in the customer's main switchboard
- d) A method of maintaining the neutral at earth potential on the consumer's premises
- e) All of the above.

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Question 40: (Circle the most correct answer – 2 Marks)

HV Electrical Electricity Distribution equipment is deemed to be isolated if it has been:

- a) Separated from all possible sources of electrical energy by means which prevent unintentional energisation of the electrical apparatus and which is assessed as a suitable step in the process of making safe for access purposes
- b) Connected to the general mass of earth by a conductor to ensure and maintain the effective dissipation of electrical energy, for the purposes of making safe for access
- c) Disconnected from the Low Voltage Network via the Low Voltage fuses, which have been opened and removed so that there can be no possible energisation
- d) Assessed as being safe by an Authorised Person and Working Earths have been applied within sight of the working area
- e) Out of service or de-commissioned.

Question 42: (Circle the most correct answer – 2 Marks)

The basic principles for Safe Electrical Work Practices are:

- a) All low voltage electricity works shall be regarded as live until isolated, proved de-energised according to approved procedures
- b) The Authorised employee carrying out the electricity works should hold a National Competency Certificate in Workplace training and assessment
- c) All high voltage electricity works shall be regarded as live until isolated, proved to be de-energised, earthed and short circuited and an Access Permit is issued.
- d) All of the above
- e) Both (a) and (c) above

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Question 43: (Circle the most correct answer – 2 Marks)

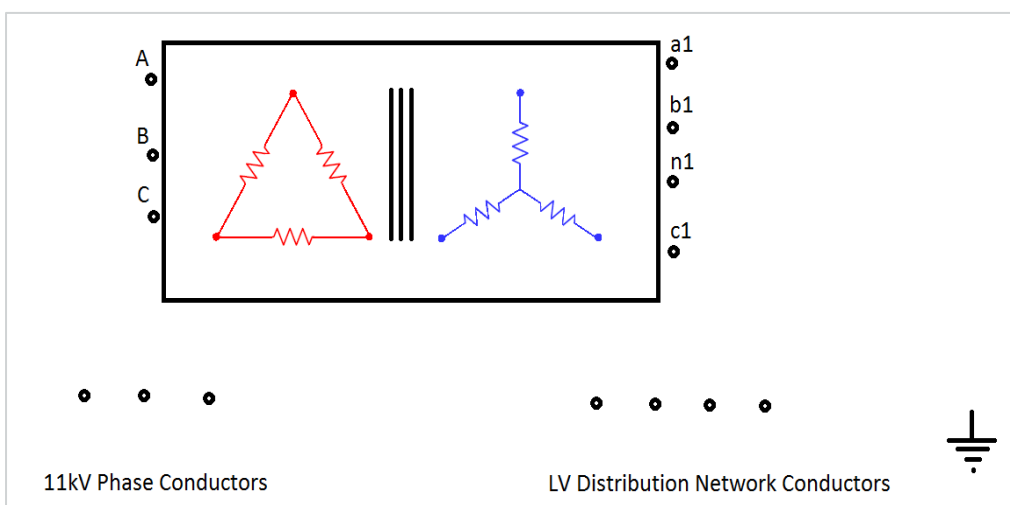
To ensure safety of personnel undertaking maintenance on or near HV electrical equipment, High voltage apparatus must be regarded as alive until:

- a) It has been isolated
- b) It has been proven to be de-energised
- c) It has been earthed
- d) It has been short circuited by a means approved by the Network Operator
- e) An access permit has been issued to a person authorised to receive an access permit
- f) All of the above.

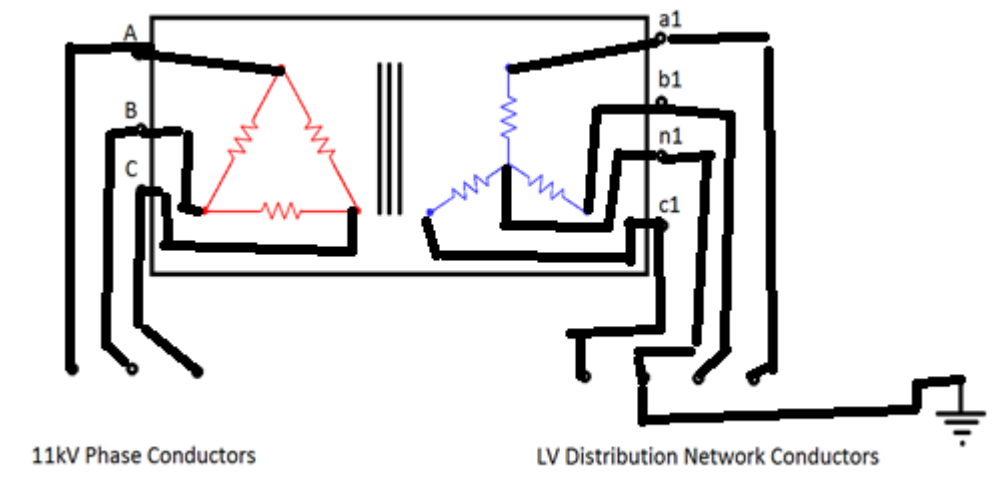
Question 44: (16 Marks)

The diagram below represents a Delta/Star connected three phase HV – LV distribution transformer. Complete the diagram by drawing the following:

- a) Correct connections between the 11Kv phase conductors and the HV terminals marked A, B, C
- b) Correct connections between HV terminals and the Transformer Primary Winding.
- c) Correct connections between the Transformer Secondary Winding and the LV terminals marked a1, b1, n1, c1
- d) Correct connections between the LV terminals marked a1, b1, n1, c1 and the LV distribution conductors and earth



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Question 45: (Complete the calculations – 12 Marks)

Assuming the transformer in the diagram on the previous page has a phase to phase voltage of 11 000 volts being supplied to its primary winding, has a transformer ratio of 27.5 and has 6 Amps flowing in the primary winding, calculate the following:

- a) The Phase to Earth Voltage for the 11kv conductors supplying the primary winding of the transformer

11 kv

- b) The Phase to Phase voltage between the LV conductors of the transformer secondary winding.

692 v

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- c) The load current being drawn from the transformer secondary winding.

165 amp

- d) The phase to earth voltage of the LV conductors connected to the transformer Secondary Winding.

400v

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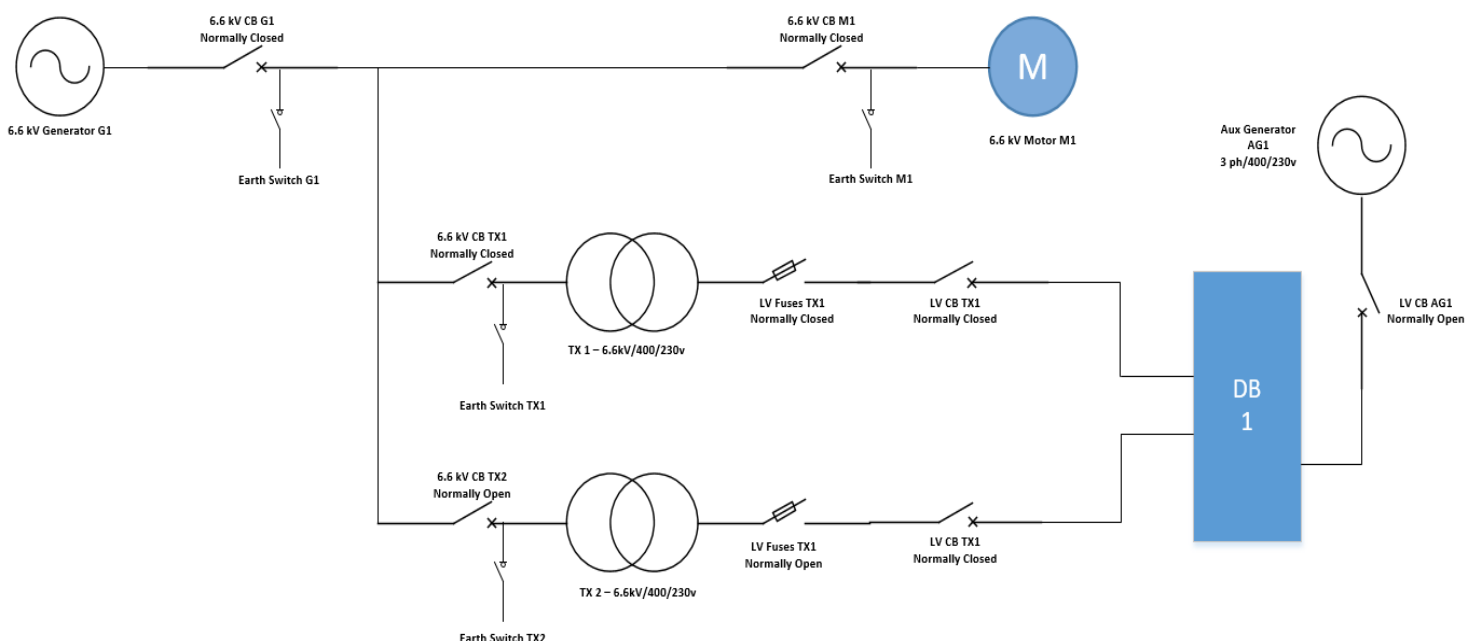
Question 46: (Complete the calculations – 12 Marks)

Refer to the single line/schematic diagram below, and using the table provided on the following page, develop a 'step by step' switching instruction which meets the following six key criteria:

1. Isolate LV Distribution Board DB1 from Transformer TX1
2. Ensure no interruption in supply to Distribution Board DB1 and maintain load fed from Distribution Board DB1 via Auxiliary Generator AG1
3. De-energise Transformer TX1
4. Isolate Transformer TX2 from Generator G1 and Distribution Board DB1 to allow maintenance to be carried out on both HV primary cable connections and LV secondary connections.
5. Ensure no interruption in supply to 6.6 kV motor M1

For the purposes of this exercise, assume:

- That there is no Automatic Voltage Regulation (AVR), nor any Automatic Transformer Selection/Change-Over systems present.
- That TX1, TX2 and Auxiliary Generator AG1 have load indicating instruments (ammeters) available to monitor 3 phase LV load.
- That Distribution Board DB1 and Auxiliary Generator AG1 have indicating instruments to monitor 3 phase voltages phasing and phase rotation.



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Question 46 – Switching Instruction:

Switching Step	Switching Instruction/Action to be taken
1	Open 6.6 KV CBTX1
2	Open earth switch TX1
3	Open LV CB Tx1
4	Open 6.6 KV CBTX2
5	Open LV CB Tx2
6	Open earth switch TX2

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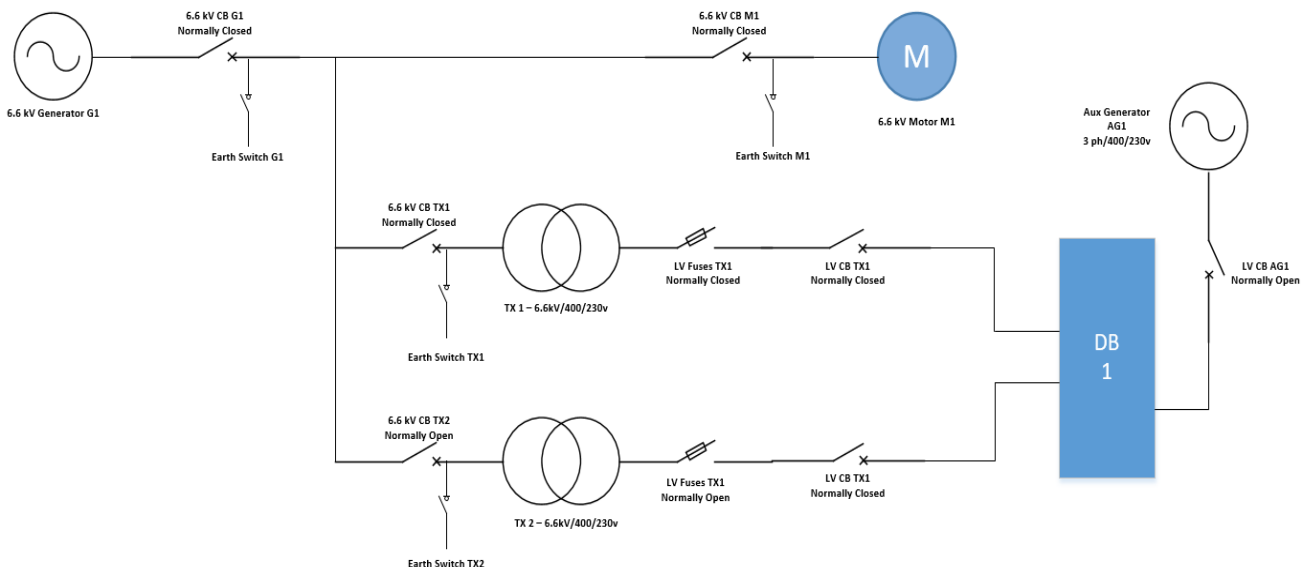
Question 47: (Complete the calculations – 12 Marks)

Refer to the single line/schematic diagram below, and using the table provided on the following page, develop a 'step by step' switching instruction which meets the following key criteria:

- Isolate LV Distribution Board DB1 from Transformer TX1
- Ensure no interruption in supply to Distribution Board DB1 and maintain load fed from Distribution Board DB1 via Transformer TX2
- Isolate Transformer TX1 from Generator G1 and Distribution Board DB1 to allow maintenance to be carried out on both HV primary cable connections and LV secondary connections.
- Ensure no interruption in supply to 6.6 kV motor M1

For the purposes of this exercise, assume:

- That all HV circuit breakers are of a 'rack down and removable truck' type
- That there is no Automatic Voltage Regulation (AVR), nor any Automatic Transformer Selection/Change-Over systems present.
- That TX1, TX2 and Auxiliary Generator AG1 have load indicating instruments (ammeters) available to monitor 3 phase LV load.
- That Distribution Board DB1 and Auxiliary Generator AG1 have indicating instruments to monitor 3 phase voltages phasing and phase rotation.



[illegible]

Question 47 – Switching Instruction:

[illegible]

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Question 48: (Complete the calculations – 12 Marks)

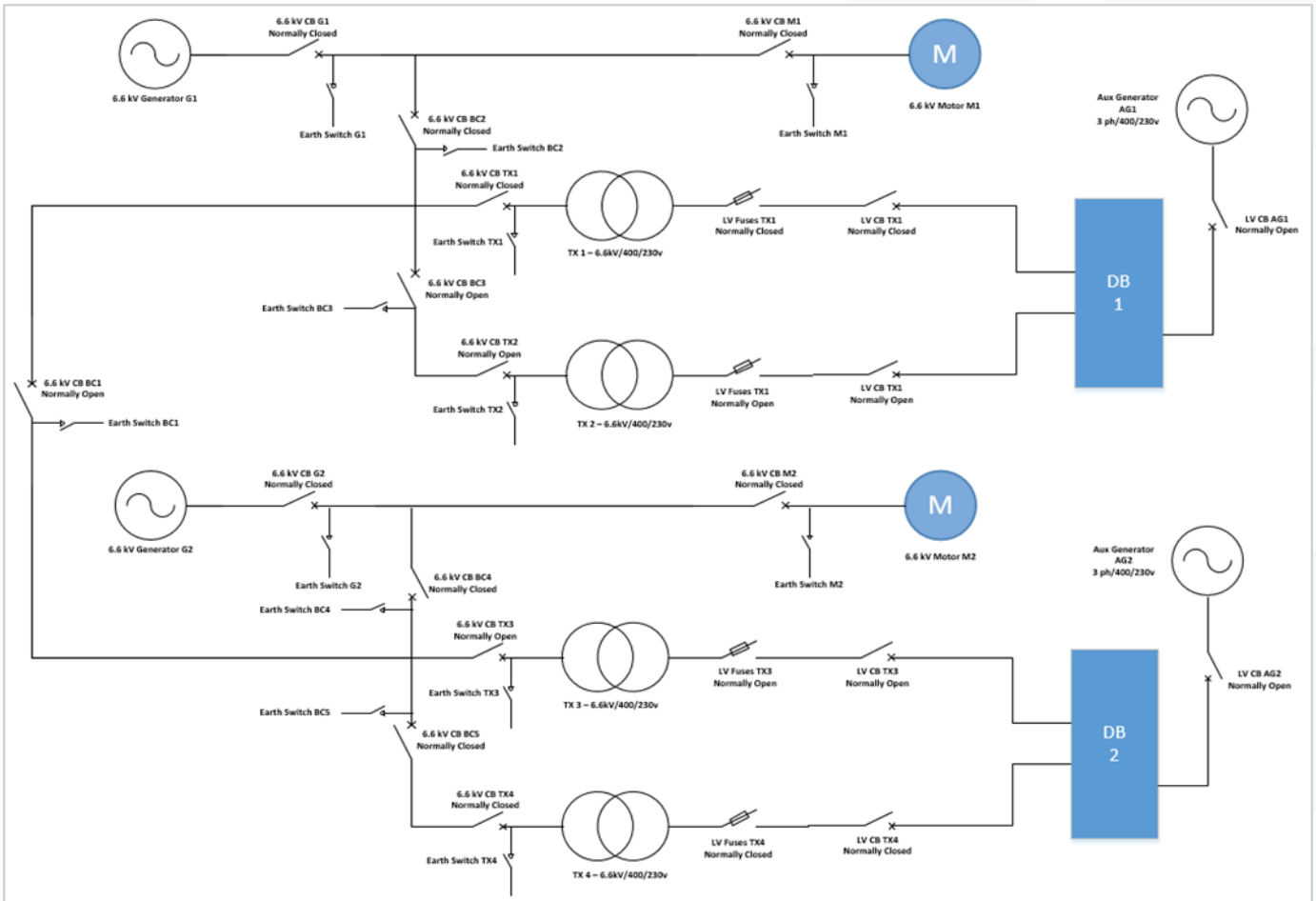
Refer to the single line/schematic diagram below, and using the table provided on the following page, develop a 'step by step' switching instruction which meets the following key criteria:

- a) Isolate 6.6 kV Generator G1
- b) Ensure no interruption in supply to 6.6 kV Motor M1 or Distribution Board DB1, and maintain load fed from Distribution Board DB1 via Transformer TX2
- c) Isolate Transformer TX4 from Generator G2 and Distribution Board DB2 to allow maintenance to be carried out on both HV primary cable connections and LV secondary connections.
- d) Ensure no interruption to 6.6 kV Motor M2 or Distribution Board DB2, and maintain load fed from Distribution Board DB2 via Transformer TX3

For the purposes of this exercise, assume:

- That there is no Automatic Voltage Regulation (AVR), nor any Automatic Transformer Selection/Change-Over systems present.
- That TX1, TX2, TX3 and TX4 have load indicating instruments (ammeters) available to monitor 3 phase LV load.
- That Distribution Board DB1 and Distribution Board DB2 have indicating instruments to monitor 3 phase voltages phasing and phase rotation.
- That all HV circuit breakers are of a 'rack down and removable truck' type

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Question 48 – Switching Instruction:

Switching Step	Switching Instruction/Action to be taken
1	Open 6.6KV CB G1
2	Open earth switch G1
3	Open 6.6 CB TX4
4	Open 6.6KV CB BCS
5	Open LV CB TX4
6	Open earth switch TX4

[illegible]

Question 48 – Switching Instruction (continued):

[illegible]

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Question 49: (Short Answer – 4 Marks)

With reference to the to the single line/schematic diagrams of questions 47 and 48, in the space below briefly explain what additional precautions and/or steps within the switching instructions may have to be added if the transformers (TX1, TX2, TX3 and TX4 were fitted with Automatic Voltage Regulation (AVR) systems.

Make sure that no open circuit at Current transformer secondary.

The voltage needs to be gradually reduced to load before disconnecting of supply to avoid voltage surge and occurrence of electric arc.

Make sure to balance the load before switching off.

Question 50: (Short Answer – 4 Marks)

With reference to the to the single line/schematic diagrams of questions 47 and 48, in the space below briefly explain what additional precautions and/or steps within the switching instructions may have to be added if the transformers (TX1, TX2, TX3 and TX4 were fitted with Automatic Transformer Selection or Change-Over systems.

Isolating the Identified Electrical Apparatus

Isolation that involves the operation of a switch must only be treated as effective if one of the following has occurred:

I If the switch is an under-slung low voltage switch or fuse – the carriers are removed from the assembly and the carriers are secured with a danger tag to the pole; and

II For a withdrawable switch or fuse – it has been withdrawn from live contacts and a danger tag fitted; and

III For a non-withdrawable switch where the contacts are visible and unauthorised access is prevented – the contacts are seen to be open and a danger tag is fixed to the structure in an obvious location; and

IV The switch is lockable – the contacts appear to be open as shown by the operating mechanism and the switch has been locked and a danger tag fitted; and

V The switch is not lockable but is in a lockable room or panel – the contacts appear to be open as shown by the operating mechanism, a danger tag is fitted to the switch and the door to the room or panel is locked to prevent unauthorised access.

If the switch cannot be locked and unauthorised access cannot be prevented by a danger tag, the switch cannot be used as isolation.

Where switches are spring, hydraulically or pneumatically operated, the stored energy must be discharged to prevent inadvertent closing.

Where switches can be operated by any remote switch control circuits such remote control must be disabled and danger tagged.

Isolation by the removal or separation of connections (disconnected) must only be treated as effective if:

VI The connection is totally removed; or

VII The connecting conductor is securely tied back away from its normal position.

VIII When interconnected neutrals need to be broken the isolation must be confirmed by use of a volt meter and a remote independent earth to ensure that there is less than 10 volts present on either side of the break. If more than 10 volts exist, reconnect the neutral conductors and investigate.

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NOTE: The preferred method of isolation is to have system neutrals remain connected. When interconnected system neutrals or earths are connected or reconnected, precautions must be taken to prevent contact with exposed conductors across either side of the break.

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Question 51: (Short Answer – 4 Marks)

With reference to the to the single line/schematic diagrams of questions 47 and 48, in the Space below briefly explain what additional precautions and/or steps within the switching instructions may have to be added if the transformers (TX1, TX2, TX3 and TX4) were fitted with Automatic Transformer Selection or Change-Over systems.

- ...
- I** Identify and isolate the required conductors; and
 - II** Secure points of isolation to prevent unauthorised operation or interference; and
 - III** Fit 'Danger do not Operate' tags to all isolation points; and
 - IV** Clearly identify and establish the clearance area; and
 - V** Prove de-energised at the work site; and
 - VI** Issue Access Permit for work; and
 - VII** Control the risks from hazardous induced voltages or unknown supplies using one or more of the controls listed below:
 - Control 1** – Isolate the conductors from all **possible** sources of electrical supply.
 - NOTE:** Possible sources of electrical supply may include sources at customer's installations, such as standby generators, embedded generators, inverter/ UPS systems, multiple control supplies, auxiliary control systems, and transformation up from extra low voltage systems.
 - Control 2** - The wearing of Personal Protective Equipment, which includes the wearing of an insulating glove (with approved outer gloves) on EACH hand, rated for the voltage being worked upon
 - Control 3** - The short-circuiting of all low voltage exposed conductors, which includes the use of short-circuits to connect all exposed conductors including the neutral conductor and street light conductor. Fuse links must not form part of an earthing and short-circuiting path. Personal Protective Bonds may also be required if working from a conductive structure.
 - NOTE:** These controls apply to all work on de-energised low voltage exposed conductors up to the point of common coupling only.
 - VIII** Prevent inadvertent contact with nearby live exposed conductors

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Question 52: (Short Answer – 3 Marks)

In the space below list three (3) communications mechanisms that are commonly used to centrally coordinate HV switching programs designed to electrically isolate HV equipment within an electrical network.

.....**PANPAN, PANPAN, PANPAN** emergency calling sign shall be used in accordance with procedure *CEOP2060*

Personal Locator Beacons (PLBs) may be utilised in emergency situations in accordance with *CECM1000.21 – Personal Safety* or an industry approved standard.

Undertaking close approach vegetation control (CAVC)
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Question 53: (Complete the table – 12 Marks)

In the table below, identify the preferred sequence of implementing the switching program elements to support effective coordination of a HV switching program.

Switching Program Element	Step Sequence
Implement switching program	12
Nominate switching coordinator	1
Liaise with switching operators, gain confirmation of completion of each switching step.	8
Coordinator - Review switching program against single line diagrams/schematics	2
Coordinator - Establish current operational status of equipment and compare to single line diagrams/schematics and operational status reflected within switching program	3
Coordinator - Identify/select communication mediums to be used to coordinate switching program	4
Coordinator – Set go/no go timings for implementation of switching program	6
Coordinator – Test communication mediums/channels	5
Nominate individuals (switching operators) to be involved within switching program	7
Record timings of completion of each relevant switching step upon switching program master document	9
Coordinator – Brief switching operators on switching program and go/no go timings	10
Liaise with switching operators, provide instruction and authorisation to perform the relevant switching step.	11

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Upon completion of switching, record issue of Access Permits/Permits to work upon switching program master document	13
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Question 54: (Short Answer – 6 Marks)

In the spaces provided below write down seven (7) general steps used for isolation of HV equipment within a RING MAIN HV network:

1. The decision as to whether or not to operate switchgear rests with the operator.

2. Before Operation - Points to Consider

Make any proposed operation clear to all personnel involved at the **Location** and to the **Control Person**, who is designated as the **Person** in charge of the operation.

Examine the **Apparatus** for signs of distress, interference, pollution, undue noise or temperature rise or other indications, which may affect its capability.

Examination of overhead **Apparatus** shall be visual from ground level.

Identify the switch to be operated and confirm identity from the circuit labelling.

Air-Break Switch Disconnectors shall also be checked

3. Note all power flow direction

4. Note which equipment will be effected

5 During Operation - Points to be Considered

Carry out operations only on receipt of a switching instruction from the **Control Person**, unless in emergency, i.e. **Danger** to life or limb.

Give undivided attention to the operation being carried out.

Suspend operations immediately if any **Apparatus** or **System** abnormalities are identified, and consult with the **Control Person** before proceeding further.

Use remote operating facilities where provided.

Use the reverse operation delay handle for all operations. Where there is no delay feature,

the operation shall not be carried out **Live** without reference to the **Control Person**.

6. After Operation – Points to be Considered

If the **Apparatus** shows signs of distress, such as emission of smoke, oil or flame, unusual noise or an undue temperature rise, do not attempt to operate but evacuate the area immediately and notify the

7. Control Person with a view to remote isolation and subsequent examination.

After operation, always allow time for the **System** to return to normal before further action. At least 60 seconds must elapse before further operation.

Even in emergency, do not reopen any item of switchgear with the exception of Circuit Breakers, until at least 60 seconds after closing.

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