

## Electrical engineer of coal mines other than underground mines certificate of competence

Written examination held 2 August 2018

### CEE3 – Legislation and standards applicable to surface coal mines

#### Instructions to candidates

Unless otherwise stated all references to Act and Regulations are to the

*Work Health and Safety Act 2011*

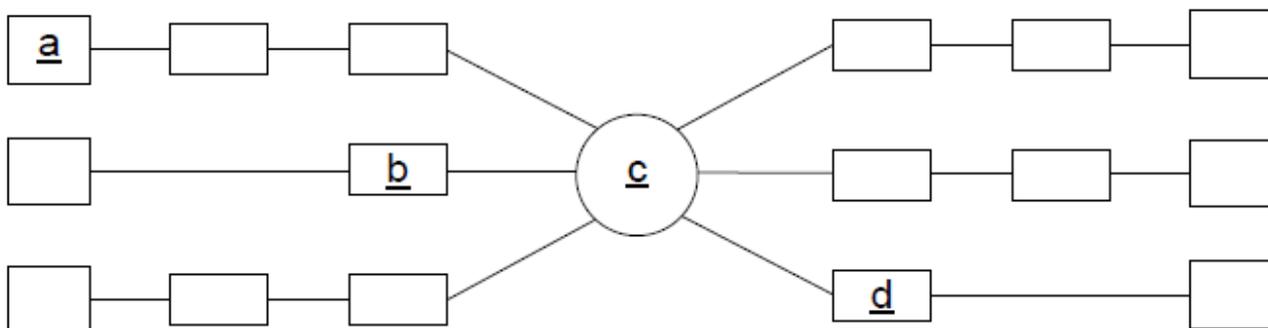
*Work Health and Safety Regulation 2011*

*Work Health and Safety (Mines and Petroleum Sites) Act 2013*

*Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*

It is expected that candidates will present their answers in an engineering manner making full use of

#### Question 1



a) Identify what each of the lettered elements represent; (4 marks)

- a.
- b.
- c.
- d.

b) Define the term “Critical Control” (2 marks)

c) Identify the controls that you would expect to be in place for to prevent the likely hood of electric shock to a person fault finding within a motor control cubicle. (2 marks)

d) Which of the identified controls would be considered critical? (2 marks)

## Question 2

As the **new** manager of electrical engineering at a large open cut mining operation you have reviewed several areas of the operation within the first few days of your arrival and have identified potential poor standards of electrical maintenance in some critical areas.

- a) What process would you follow from here, when you first identify these issues considering the size of the operation? (2 marks)
- b) What are your thoughts as to how this situation could have developed, identify several possibilities and provide details? (2 marks)
- c) What initial steps would you consider taking to remedy the issues noted, especially areas where non-compliance issues are identified? Include what time period would you allow the equipment to continue operating under these conditions. (2 marks)
- d) Who would you involve in the process? (2 marks)
- e) What would be your expected outcomes and long term process plan? (2 marks)

## Question 3

As the qualified electrical engineering at any open cut coal operation in nsw you are required to develop your electrical engineering control plan for your operation.

A fundamental foundation of this plan will be your Fault and Load Flow Studies which when plugged into your current and future mine development dictates your electrical design. A primary consideration is Voltage Regulation for your systems.

- a) Explain in your own terms what "Voltage Regulation" means? (2 marks)
- b) Explain what effects poor Voltage Regulation will have on your operation? (2 marks)

### Scenario:

Your dragline has just completed a move to a completely new location on the mine site which is kilometres further away from the surface supply point in the mine. The supply for this new machine position has been extended through from the previous location.

Commissioning of the dragline has started and you are experiencing Voltage regulation issues.

- c) Explain what issues can develop if poor Voltage Regulation is evident in this situation? (2 marks)
- d) Identify four areas which could be changed to improve your voltage performance (these can be short term or long term)? (4 marks)

## Question 4 - Management of mobile equipment fires

You are the electrical engineer at a NSW open cut coal operation and you have a contract company working with your own electrical team completing repairs to a Conveyor Starter and Conveyor Drive in your workshop.

You have been alerted that one of the tradesmen has received an electric shock while attempting to open the door to the starter enclosure with power on.

At the time of the incident, 415 Volt power was being supplied to the starter panel, which is further stepped down to various control circuit voltages within the starter.

- a) What process needs to be initiated directly after the person is in safe care and how would you go about this? (3 marks)
- b) You are initially unaware of the voltage potential that the tradesman made contact with in the incident – identify the process which you would follow at your mine in this situation? (2 marks)
- c) Is this a “notifiable incident”, if so under what clause of the WHS Regulations, and in what time period? (2 marks)
- d) What matters would you consider as part of your investigation? (3 marks)

## Question 5

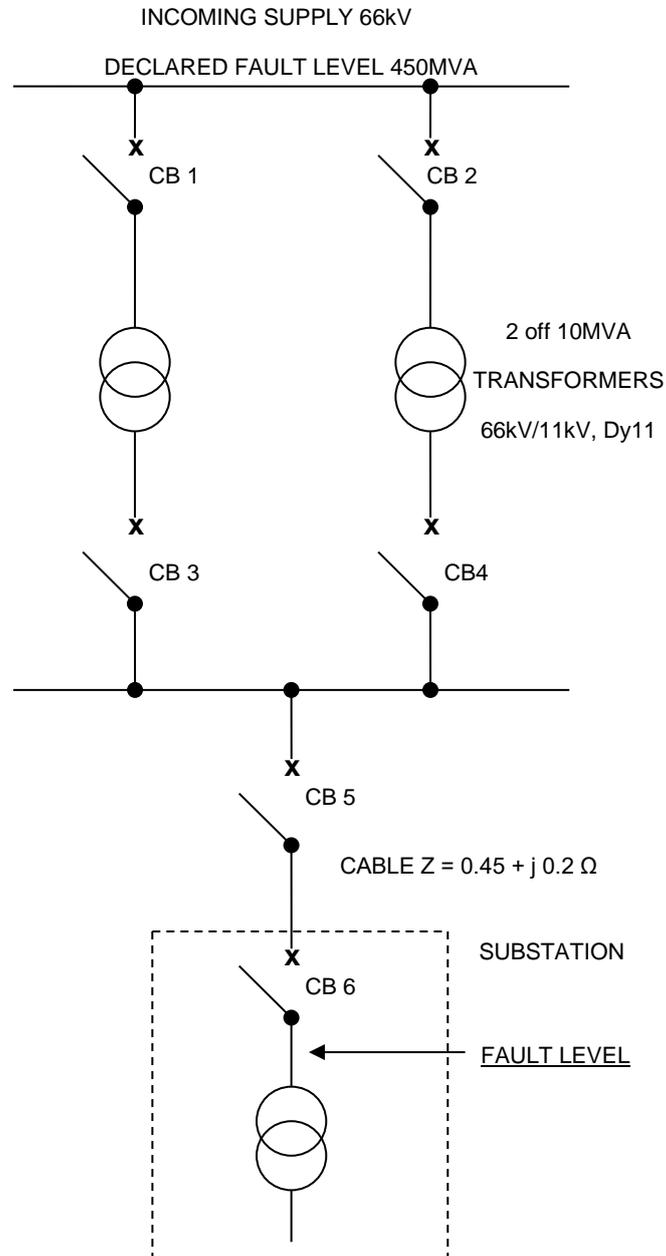
You have been asked to provide input into the specification for the electrical safety attributes for a fleet of new haul trucks fitted with high voltage electric traction.

- a) Explain how you will develop this specification, what tools would you use? (3 marks)
- b) What hazards do you think will need to be addressed? (3 marks)
- c) What documentation would you expect from the supplier to verify the integrity of each safety attribute? (3 marks)
- d) What competencies would you require for your tradesman / contract personnel to maintain this type of equipment? (1 mark)

## Question 6 - Fatigue management

Calculate the fault level for the following scenario in Figure 1.

**FIGURE 1**



Using a base of ten (10) MVA, determine the fault level on the load side of circuit breaker - 6, (CB 6) when:

- Circuit breaker - 4 (CB 4) is open; all other circuit breakers are closed. (3 marks)
- All circuit breakers are closed. (3 marks)
- With all circuit breakers closed are there any issues you would need to be concerned about? (2 marks)
- If any concerns from c) above, how would you overcome these (2 marks)

## Question 7

The mine operator has asked you to prepare for the introduction of the first fully autonomous overburden drill at your site.

- a) Identify three critical tasks to be completed prior to the equipment going into service and briefly describe how you would go about the tasks identified? (3 marks)
- b) What would you consider to be the critical risk items that need to be considered in the design and ongoing operation of the overburden drill? (3 marks)
- c) The applicable Australian Standard for remote controlled equipment describes a number of safeguarding techniques with specific failure modes that shall be assessed. Name two of these? (2 marks)
- d) If an OEM was to update the software on board this machine, what requirements would you place on the OEM and what would have in place from your site requirements? (2 marks)

## Question 8

The mine operator has advised that the site will be relocating its tailings dam to a new location with a larger capacity pump to enable more water to be returned to the adjacent CHPP. The pump motor will be energised at 415V. There is no nearby substation, so a power supply will need to be constructed to the new site from approximately 2km away. Question (a) will only deal with getting power to the new pump site and Question (b) will deal with the specific pump installation

- a) Provide an electrical drawing showing what you envisage the reticulation of the new power supply would look like and with a road crossing to contend with along the way to the pump site? Provide details of any assumptions you have made in your drawing. (3 marks)
- b) Provide a single line electrical schematic for this pump installation from the new power supply shown in (a) above to the new pump. Including:
  - The protection devices you would want in your installation
  - Show any voltage levels including transformer sizing.
  - Show your earthing arrangements for the installation
  - What size motor would you expect on this installation
  - Show any assumptions made (5 marks)
- c) describe what commissioning tests you would want done on the 2km length of the new power supply prior to initial introduction of the supply? (2 marks)

## Question 9

The following questions relate to fault level and protection studies.

- a) What is meant by the term “Declared fault level” and where does this fit into the overall site fault level and protection study? (1 mark)

- b) How would you set up the control system for your protection devices in your high voltage substation and explain the reasons behind your choices? (2 marks)
- c) Explain the procedure you would have in place for an instantaneous overcurrent trip on your sites 66kV overhead aerials? (3 marks)
- d) Who would be permitted to undertake the work in c) above and list what your competency requirements would be for this person over a 5-year term? (2 marks)
- e) What would your instructions be if initial inspections did not reveal a reason for the instantaneous overcurrent trip? Explain what you would want done after receiving this phone call? (2 marks)

## Question 10

You have received notification that a contractor has received an electric shock whilst using a 240 Volt rota-broch. The worker has been transported to hospital as per the site electric shock protocol and the power has been isolated to the equipment.

- a) What protection should be in your safety management system to prevent this incident from occurring? (5 marks)
- b) what would be the specific requirements for using this equipment with the generator? (5 marks)

## Question 11

You have recently taken over as the manager of electrical engineering of a surface mine. You have been reviewing the electrical control plan and the number of notifiable incidents relating to fires on electrical haul truck. The mine has reported 10 fires over the last 12 months. Six are associated with grid boxes and 4 are in relation to electrical wiring on Light Vehicles.

- a) What areas of your safety management system may have failed to allow these incidents to occur? (2 marks)
- b) With respect to the grid box fires, what options could you consider to prevent a recurrence? (4 marks)
- c) With respect to electrical fires on light vehicles, what options could you consider to prevent a recurrence? (4 marks)

## Question 12

### Clause 32 Electrical safety

- (1) In complying with clause 9, the operator of a mine or petroleum site must manage \_\_\_\_\_ to \_\_\_\_\_ and safety associated with electricity at the mine or petroleum site.
- (2) In managing risks to health and safety associated with electricity at the mine or petroleum site, the operator must ensure:
  - (a) that electrical installation work at the surface is carried out in accordance with the \_\_\_\_\_, and
  - (b) that before a circuit is first energised at the mine or petroleum site, or is first energised following the circuit being recommissioned:

- (i) the circuit is tested in accordance with the \_\_\_\_\_ by a competent person, and
- (ii) there is a process in place whereby the operator (or an individual nominated to exercise the statutory functions of electrical engineering manager or electrical engineer at the mine or petroleum site) can be adequately notified about that testing as soon as is reasonably practicable after the testing occurs, and
- (c) that adequately \_\_\_\_\_ switchgear is provided that permits power to be safely \_\_\_\_\_ and safely restored and that does not permit \_\_\_\_\_ restoration of power if there is a risk of \_\_\_\_\_, fire, explosion or unplanned operation of plant, and
- (d) that arrangements are in place for switching the power off or restoring power as part of normal operations in the event of a \_\_\_\_\_ or an emergency, and
- (e) that, for electrical plant at the mine or petroleum site (other than plant connected, and in close proximity, to a wall socket with a switch):
  - (i) an isolation facility is provided, and
  - (ii) the electrical plant is clearly identified as being isolated from electricity by the facility, and
  - (iii) the facility is clearly identified as the isolator for the electrical plant, and
  - (iv) persons required to work with the electrical plant are \_\_\_\_\_ in the correct use of the facility, and
- (f) that \_\_\_\_\_ of the electrical installations at the mine or petroleum site showing the following matters are kept and maintained as required and are easily accessible by each worker required to access them:
  - (i) the location of each main electricity reticulation line,
  - (ii) the location of all high voltage cables, \_\_\_\_\_ and switchgear,
  - (iii) the location, rating, identifying label and purpose of each main isolator, substation and high voltage switchboard,
  - (iv) any information required to perform \_\_\_\_\_ programs,
  - (v) the location of all known buried electrical \_\_\_\_\_ at the mine or petroleum site,
  - (vi) in the case of a mine or petroleum site (other than an underground mine), the general location of each item of high voltage mobile plant supplied with electricity by a trailing cable,
  - (vii) in the case of an underground mine, the location of each fixed communication device at the mine, and
- (g) that arrangements are in place so that \_\_\_\_\_ electrical plant fed by a flexible reeling or trailing cable:
  - (i) is not connected to power if there is an earth fault in the cable, and
  - (ii) has its power interrupted automatically if the \_\_\_\_\_ of the connection to earth is interrupted, and

- (h) that arrangements are in place to ensure that mains-powered hand-held electrical equipment used at the mine or petroleum site operates at no more than 250 volts and has an earth leakage of not more than 30 milliamperes sensitivity, and
  - (i) that an effective earth system is provided at the mine or petroleum site to minimise, so far as is reasonably practicable:
    - (i) touch, transfer and step potential, and
    - (ii) the effects of lightning causing the ignition of methane, the ignition of explosives or detonators or the creation of dangerous touch voltages, and
  - (j) that all electrical installations (other than isolated circuits) have a continuous and effective connection to the earth system, and
  - (k) that all isolated circuits comply with section 7.4 of the Wiring Rules, and
  - (l) that the electricity supply to all electrical plant at an underground mine, and all mobile plant fed via flexible reeling or trailing cables in any other mine or petroleum site, is designed so that:
    - (i) the magnitude of earth fault currents to the plant is limited (in order to control step and touch potentials), and
    - (ii) so far as is reasonably practicable, the most likely type of electrical fault is a low energy earth fault (in order to minimise the amount of energy released), and
  - (m) that the reliability of any electrical safeguards provided to control the risk from both electrical and non-electrical hazards is sufficient for the level of risk being controlled, and
  - (n) that short circuit protection and over current protection is provided on all circuits (including sub-circuits), and
  - (o) that, except for circuits that are isolated from earth, or that have a supply voltage that is extra-low voltage:
    - (i) earth leakage protection is provided on sub-circuits, and
    - (ii) earth fault protection is provided on all distribution and control circuits.
- (10 marks – ½ mark per answer)

## More information

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## Acknowledgments

Electrical engineer of coal mines other than underground mines examination panel

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