

# Electrical engineer of coal mines other than underground coal mines

August 2016

## 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 diagrams, tables and relevant circuits where applicable and showing full workings in calculations. Credit marks will be given for such work in assessing marks for these questions. If you unable to fit your answer in the allocated space provided please utilise the blank page opposite the question.

Neatness in diagrams is essential and will be considered in the allocation of marks. Provide answers in point form wherever appropriate. State any assumptions you make in order to answer the question.

Questions are to be answered from the perspective of an electrical engineer nominated to exercise the statutory function of electrical engineer by a mine operator at a NSW mine.

Electronic aids may not be used, apart from calculators.

All questions are compulsory and candidates must attempt each question.

All questions are of equal value, but parts of questions may vary in value. The marks applicable to each part of a question will be indicated adjacent to the question.

Place your identification number only, NOT your name, on your paper.

10 minutes reading time is allowed prior to the start of the examination. Candidates can use a highlighter to mark points of importance during the reading time, but may not begin answering the questions. The examination time is three (3) hours. Each whole question is intended to be able to be answered in 15 minutes.

This examination is a closed book examination.

## Question 1 (total 10 marks)

The following questions relate to AS3007:2013 – *Electrical equipment in mines and quarries – Surface installations and associated processing plant*.

- What is the specific requirement for removal of power in a closed electrical operating area? (1 mark)
- What design provisions are to be included for the prevention of Arc Flash / Blast protection injury? (1 mark)
- What is the requirement for miniature circuit breakers inside low voltage distribution boards where two or more circuit breakers are mounted in the same row? (1 mark)
- What needs to be maintained over the full life cycle of electrical equipment as far as information requirements? (1 mark)
- What is the general rule for protection of electrical equipment and live conductors when it comes to protection against overloads and faults? (1 mark)
- What is the requirement for inspecting earth fault current limiting devices? (1 mark)
- What are the specific requirements for isolating equipment and machinery for electrical isolation? (1 mark)
- When should cable reel interlock limits operate – name two of these? (1 mark)
- What are the “no go zones” when it comes to overhead powerlines >33kV? (2 marks)

## Question 2 (total 10 marks)

The following questions relate to AS3007 - *Electrical Equipment in mines and quarries – Surface Installations and associated processing plant*.

- In accordance with which Australian standard are reclaim and transfer tunnels to be assessed against to determine if they contain hazardous areas (gas or dust or both)? (1 mark)
- Where gas monitoring is provided in reclaim and transfer tunnels, what are the two trip mechanisms that need to be put into place? (2 marks)
- What needs to be considered with any conveyor systems in reclaim and transfer tunnels when fire or flammable gases are detected? (2 marks)
- Describe how you would approach the use of portable tools and appliances being supplied with a portable welder / generator on your site in a reclaim tunnel for repairs to be conducted? (5 marks)

## Questions 3 (total 10 marks)

Clause 32 of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* requires the operator of a mine to manage the risks to health and safety associated with electricity.

With regard to this clause of the Regulation:

- What must occur before a circuit is energised for the first time, or first energised after the circuit is recommissioned? (1 mark)
- For electrical plant at a mine, what provisions must be made with regard to isolation? (2 marks)
- What must be included on plans for electrical installations? (4 marks)
- What arrangements must be in place with regard to mains-fed hand-held electrical equipment? (1 mark)
- For electrical equipment energised at greater than extra-low voltage, what electrical protection must be in place? (2 marks)

## Question 4 (total 10 marks)

- In the space provided below, draw a detailed earth system, including rough dimensions, which you would expect to find under a typical 66kV/11kV substation where the soil resistivity is measured at 40Ω-metres. The drawing will include your placement of the substation on the earth system and all relevant features and earth connections including the security fence.

Include into the drawing, the overhead earth wire from the 66kV overhead aerials supplying the installation. (6 marks)

- How would you want the earth system dealt with after construction and before placing into service? (2 marks)

- c) What test value would you expect from any tests conducted on the earth system and how would check that they are correct? (2 marks)

## Question 5 (total 10 marks)

Electrical Work on Energised Electrical Equipment.

*Work Health and Safety Regulation 2011 and Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*

- a) Provide 4 examples of work involving electrical equipment that may not be considered electrical work under the *Work Health and Safety Regulation 2011*. (2 marks)
- b) According to the *Work Health and Safety Regulation 2011*, when is electrical work on energised electrical equipment permitted? (1 mark)
- c) According to the *Work Health and Safety Regulation 2011*, what are the preliminary steps that must be taken prior to commencing electrical work on energised electrical equipment? (2 marks)
- d) According to the *Work Health and Safety Regulation 2011* how should electrical work on energised electrical equipment be carried out? (3 marks)
- e) According to the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* what is the waiting period after submitting a High Risk Activity notification for electrical work on energised electrical equipment a high risk activity? (1 mark)
- f) According to the requirements of the prescribed HRA notification form, what information is required to be submitted with the application? (1 mark)

## Question 6 (total 10 marks)

You have been asked to supply and install a 415V motor for a new pump installation that is required to pump 60 litres of water per second up over a high wall of 150m vertically. The pump has an efficiency of 80% with a motor efficiency of 80% and power factor of 0.7 lag.

- a) What will be the motor current of the pump installation? (4 marks)
- b) What size motor would you choose for this installation? (2 marks)
- c) How much capacitance needs to be added to get the power up to 0.95 lag? (4 marks)

## Question 7 (total 10 marks)

There has been an increase in the number of electrical incidents relating to fires on mobile plant.

- a) What standards are applicable for automotive plant and equipment for Mines and Quarries? (1 mark)
- b) Who is responsible for the installation, maintenance, and repair of automotive electrical equipment on site? (1 mark)
- c) What equipment does this standard apply to? (1 mark)
- d) How would you ensure the applicable equipment on your site is fit for purpose? (1 mark)
- e) How is older equipment that was purchased prior to the implementation of this standard required to be dealt with? (1 mark)
- f) List the “not negotiable” items that you as the Qualified Electrical Engineer would enforce for your mobile equipment fleet that you believe would reduce the risk of electrical fires. (3 marks)
- g) What would be your specific requirements for jump starting units located on service vehicles in relation to standards and the personnel required to use them? (2 marks)

## Question 8 (total 10 marks)

The following represents a number of typical electrical engineering scenarios that are encountered in a typical coal operation.

- a) Determine the full load current on the primary side of the transformer when a 500kW DOL pump motor is installed. The transformer supplying the installation is a 2MVA 11kV/1kV with an impedance of 5%. Make any necessary assumptions in the calculation. (2 marks)

- b) You have three (3) 2500KVA transformers with impedances of 6%, 7%, and 8 % respectively. What would be the resultant fault level on the secondary bus when connected in parallel to a 66kV supply with a declared fault level of 450MVA? (2 marks)
- c) What CT ratio would you expect to be installed for a Transformer primary installation that is rated at 5MVA 11kV with 6% impedance? (2 marks)
- d) Calculate the short circuit current of a 1MVA 11kV / 415V transformer which is connected DY11 with an impedance of 4.69%? (2 marks)
- e) A 66/11kV transformer has a 25A NER fitted (resistor only type rated for a duty of 10s), what would you expect the total resistance of this unit to be? (2 marks)

## Question 9 (total 10 marks)

You are the Electrical Engineer at a large modern surface mine. You are involved in a project that will introduce a new item of plant at your mine and you will be involved in managing its safety life-cycle.

The safety lifecycle requires that a 'safety requirements specification' be produced?

- a) Why is it required? When is it produced? What information does it contain? (3 marks)
- b) You are asked to identify workers to perform the various safety life-cycle tasks on the project.
  - i) List and briefly describe three (3) factors that you would consider when determining the adequacy of a person's competence to do a particular safety life-cycle task. (3 marks)
  - ii) At what stage in the safety life-cycle of the plant should the safety-related systems be validated and why?(1 mark)
  - iii) During validation of the safety-related system the supplier informs you that a software change is required. Briefly explain the process that is required when changes are to be made to safety-related systems. (3 marks)

## Question 10 (total 10 marks)

Schedule 3 of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*, "High risk activities", nominates activities at mine sites that are classified as high risk. One of these activities is *2 Electrical work on energised electrical equipment*.

1. Electrical work on energised electrical equipment is identified as a high risk activity (but not if the electrical work is testing whether or not the equipment is energised).
2. The waiting period for the activity is 7 days.
3. No additional information or documents are required to be provided.

You have identified that from time to time you could have to do live fault finding within your coal processing plant. You have completed the prescribed *Notifying the regulator of a high risk activity form* and have been advised by the regulator that they will be on site before the nominated 7 day to review your systems.

- a) The *Work Health and Safety Regulations 2011* (WHSR) gives specific regulations that cover Electrical work on energised electrical equipment, who does the WHSR apply to? (1 mark)
- b) With respect to your site, when is Electrical work on energised electrical equipment—permitted? (4 marks)
- c) Before any electrical work on energised electrical equipment commences: the person who is nominated by the *Work Health and Safety Regulations 2011* (WHSR) must ensure? (4 marks)
- d) The *Work Health and Safety Regulations 2011* (WHSR) specify certain aspects of how the work is to be carried out. Name any two of these? (1 mark)

## Question 11 (total 10 marks)

From the *Work Health and Safety (Mines and Petroleum Sites) Regulations 2014* – Schedule 2 Principal Control Plans – matters to be addressed

Your **Electrical Engineering Control Plan** must take the following into account to manage the risks to health and safety from electricity at your mine.

**Schedule 2**, Clause (3) (b) Identifies:

The rating and design of plant for the prospective electrical fault level, electrical load, operating frequency, operating voltages and Arc fault control

As a newly appointed Electrical Engineer at a mine you become aware that the ageing electrical infrastructure within your mine has not been assessed or appropriate controls implemented to deal with Arc Fault Control.

- a) Formulate an action plan to manage this risk at the operation in relation to Arc Fault Control (3 marks)
- b) You need to draft a memo to your Mine Manager in relation to these risks and the requirement for Capital Expenditure for Arc Blast Control at your mine. What would be your key elements in the memo? (3 marks)
- c) What would your Control Plan define as the limits for each Arc Fault Category Level for PPE? (4 marks)

## Question 12 (total 10 marks)

As the Electrical Engineer you are a member of the senior management team of a coal operation and you have a duty to:

- Develop, supervise, monitor and review the electrical engineering standards and procedures forming part of the operations of the mine, and
- Supervise the installation, commissioning, maintenance and repair of electrical plant at your mine.

Management of change is a critical management focus in your day to day operations at the site.

- a) What is meant by the term, “management of change” process, with respect to your operation? (3 marks)
- b) Is the “management of change” process a requirement of legislation, and if so where or how is it identified? (3 marks)
- c) Set out and describe a simple “management of change” procedure using a flow diagram. (4 marks)

## More information

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## Acknowledgments

Electrical Engineer Examination Panel

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