



Trade &
Investment
Mine Safety

(CEE3)

NSW Coal Competence Board

EXAMINATION FOR CERTIFICATE OF COMPETENCE AS Mine Electrical Engineer *(Restricted to surface operations only)*

(Coal Mine Health and Safety Act 2002)

Thursday 6 March 2014

1.30pm – 4.30pm

Legislation and standards applicable to surface coal mines

INSTRUCTIONS TO CANDIDATES:

Unless otherwise stated all references to Regulations are to the
Coal Mine Health and Safety Regulation 2006

Or

Work Health and Safety Regulation 2011

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 working in calculations. Neatness in diagrams is essential and will be considered in the allocation of marks. Questions are to be answered as a prospective Qualified electrical engineer at a NSW mine.

- Examination time **3 hours**
- **Each** whole question is designed for a **15 minute** answer
- Candidates should attempt **all** questions
- Candidates must mark this paper with their **Candidate Number only**.
- **All** questions and parts are allocated their respective marking value.
- During the reading time candidates may use a highlighter to mark key parts of questions

QUESTION 1 (10 marks)

Mining cables used for surface operations in reeling and trailing applications are designed to be “fit for purpose” for their duty in a particularly harsh environment. The following questions are related to this design requirement:

- a) Which Australian Standard provides design criteria for Reeling and Trailing cables used in the underground coal mining industry? (2 marks)

/2

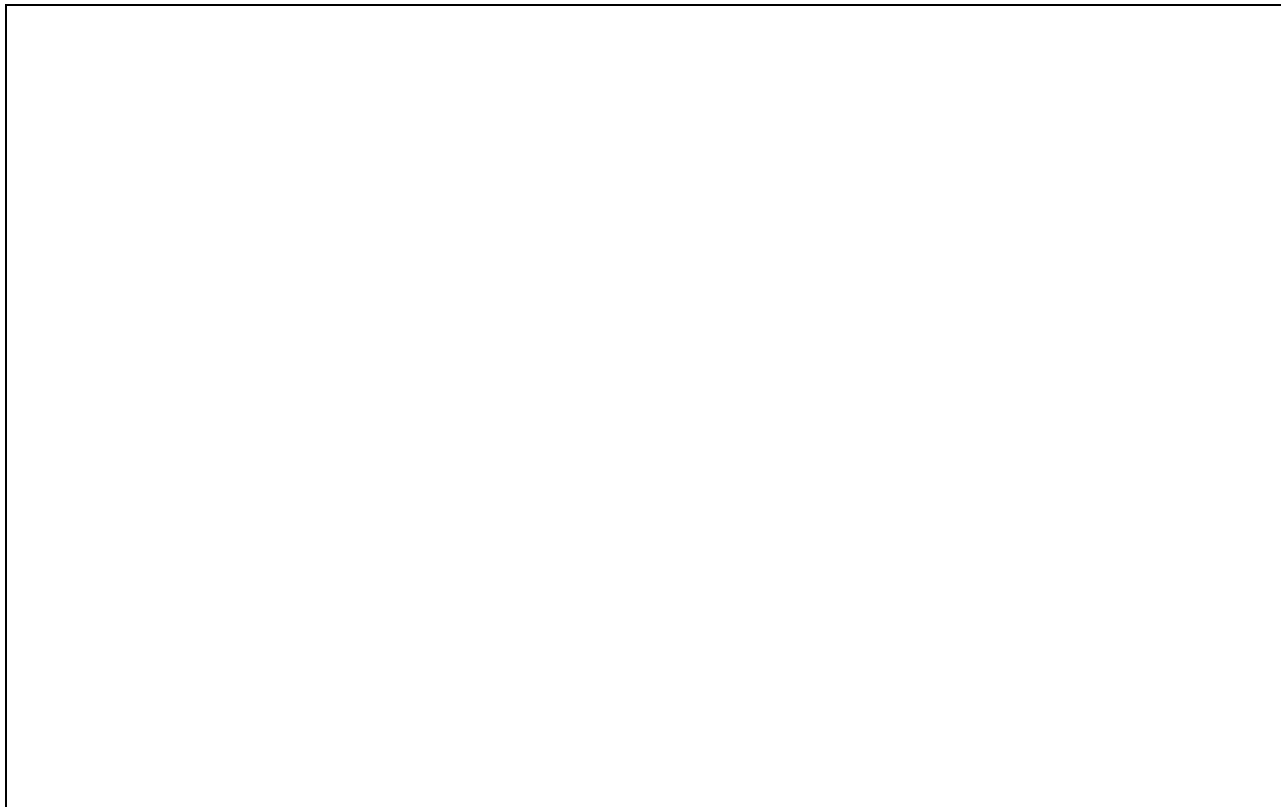
- b) **In the box below**, draw a typical cross sectional diagram of a “type 441 Trailing Cable” and identify the critical design features of the cables internal cores, insulation and screening. (3 marks)

/3

- c) Identify in words the primary engineering reasons for this particular design and layout of the cable construction (2 marks)

/2

- d) Explain with the use of a diagram what is meant by a “Spark Test Unit” when referring to a licensed cable repair workshop. Show in the diagram how this device functions and why is it used? (3 marks)



/3

QUESTION 2 (10 marks)

You have been appointed the Electrical Engineer at a “greenfield” coal mine construction site. On commencement of mining-related activities you are to be appointed as the Qualified Electrical Engineer. As a consequence you will be responsible for developing the Mine’s Electrical Engineering Management Plan (EEMP), and Standards of Engineering Practice.

When considering the requirements of Clause 19 of the *Coal Mine Health and Safety Regulation 2006*:

- a) What Australian Standard must be complied with for installations on the surface of the mine? (1 mark)

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- b) What provision should be made for personnel requiring access to energy supply authority infrastructure on the site?. (1 mark)

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QUESTION 3 (10 marks)

You are the Qualified Electrical Engineer (QEE) where a new piece of mobile plant is being purchased for use on your site.

- a) What would your involvement be in the purchase of this machine as the sites QEE?
(2 marks)

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AS 4871.6 *Electrical Equipment for mines and quarries* Part 6: Diesel powered machinery and ancillary equipment details the requirements for the battery isolator.

- b) What are three specific items required for the battery isolator? (3 marks)

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- c) What are three specific items requirements for single pole battery isolators?
(1 mark)

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- d) What are three specific items requirements for double pole battery isolators?
(1 mark)

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- e) What does the Standard require for protection of cables and harnesses?
(2 marks)

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- f) In particular, what is the new requirement for split conduit/trunking?
(1 mark)

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QUESTION 4 (10 marks)

Generator Installations

You are the QEE at a major new Open Cut Operation. You have a large construction site for the assembly of major production equipment.

A contractor has a requirement to construct a temporary compound for offices and storage containers. The offices and containers will be supplied via a 250KVA Generator.

- a) What five (5) specific items need to be bonded together to form the “Generating set bonding system” as described in AS3010:2005 Electrical Installations – Generating Sets? (2 marks)

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- b) What specific items would you want addressed in your site layout with respect to the electrical installation? (2 marks)

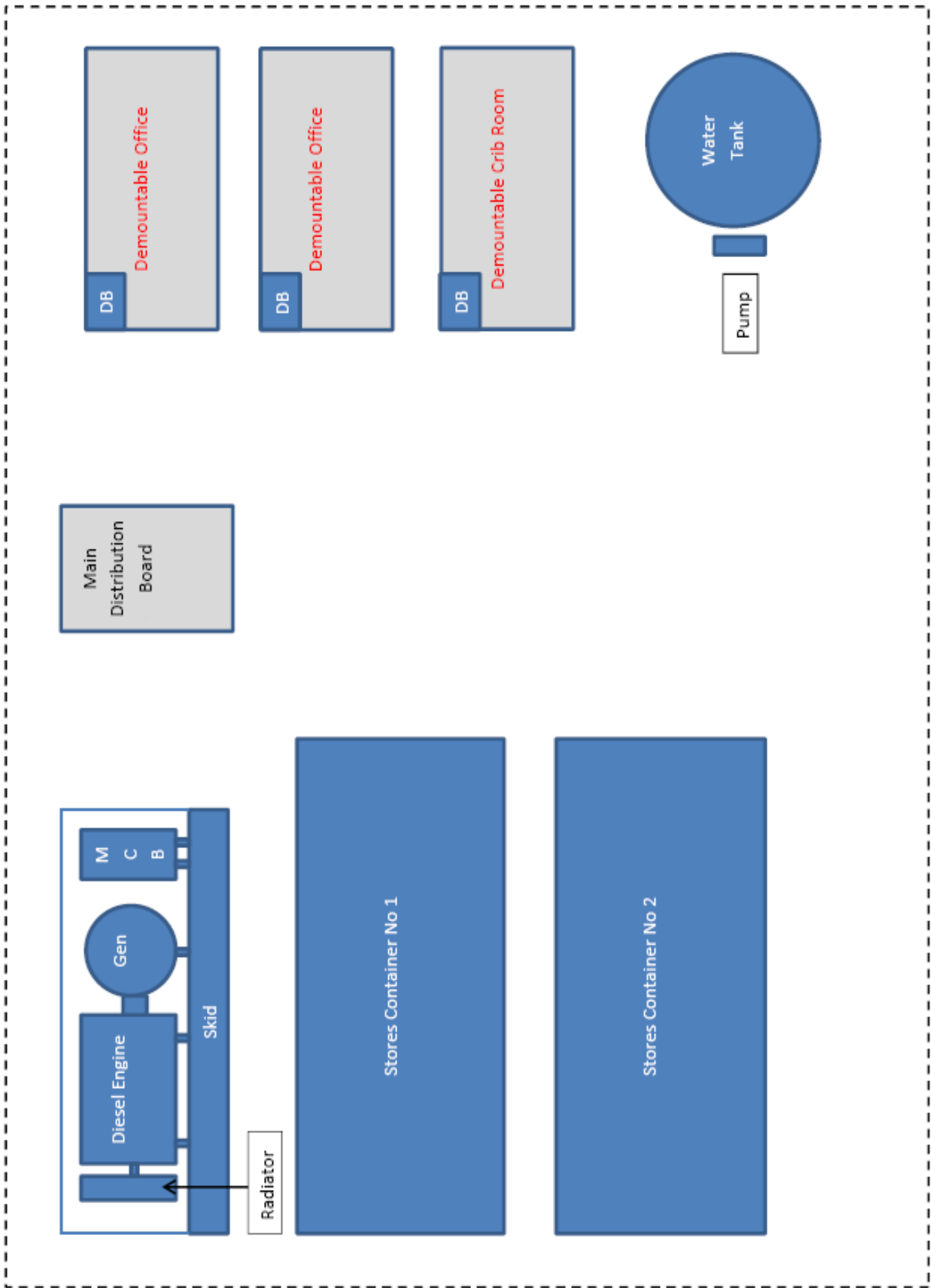
	12
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- c) Is there anything in particular you would require for the water tank installation or storage containers? (2 marks)

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- d) On the attached layout drawing (over page), detail the earthing arrangements you would require for the entire installation and show any specific details and assumptions you have made. (4 marks)

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QUESTION 5 (10 marks)

AS/NZ 2081:2011 Electrical Protection devices for Mines and Quarries.

- a) What limitations does this standard impose on the adjustment of relay parameters?
(1 mark)

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- b) Name four pieces of information that according to the standard should be included on the label of a protection device? (2 marks)

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- c) The Standard nominates a typical maximum EC resistance setting of 45ohms. In determining the relay setting – what are the crucial parameters that need to be considered? (2 marks)

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- d) For earth continuity protection, the standard nominates a minimum permissible shunt resistance of 1kOhm between a pilot core and earth. What does this mean? (1 mark)

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- e) Where remote start functionality is provided via a pilot circuit, what condition is required to be prevented, and how is this achieved? (1 mark)

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- f) The standard recommends a maximum time delay for an earth fault should not exceed 500mSec. Under what circumstances may this value have to be exceeded? What would be your main consideration in exceeding this value? (2 marks)

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- g) The standard nominates a minimum insulation resistance for Earth Fault Lockout protection. What is this value? (1 mark)

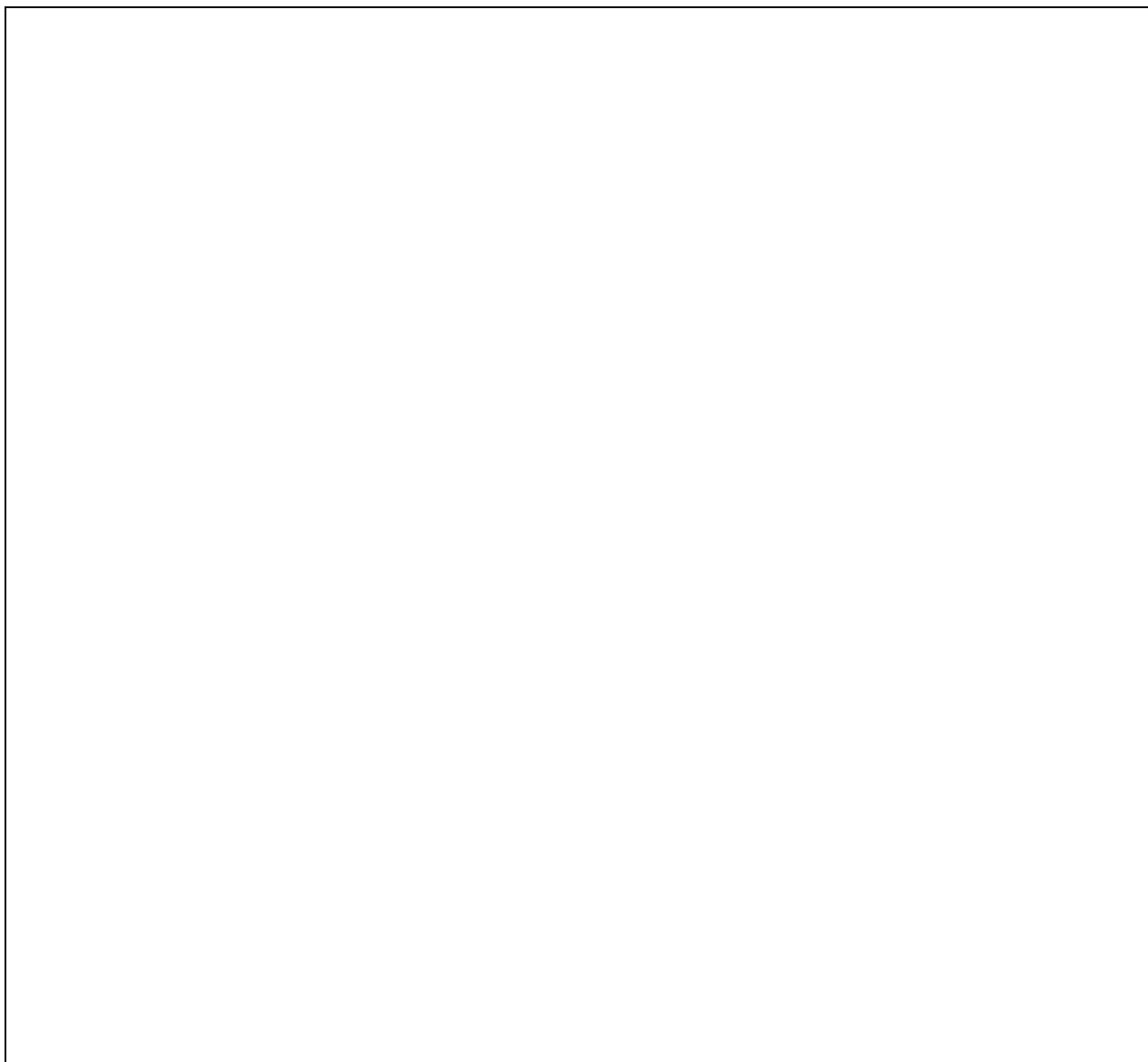
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QUESTION 6 (10 marks)

EES-014 Small Inverters

You have been asked to develop a management plan for the use of inverters on your site.

- a) In the box below, draw a typical 240V 10A single appliance inverter installation as described in ***EES-014 - Technical Principles for the use of “Stand Alone” Generators at NSW Mines (Coal and Metals) and Extractive Operations.*** (4 marks)



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b) Describe what your earthing requirements would be for this installation. (3 marks)

/3

c) What specific protection devices would you want installed on the circuit? (2 marks)

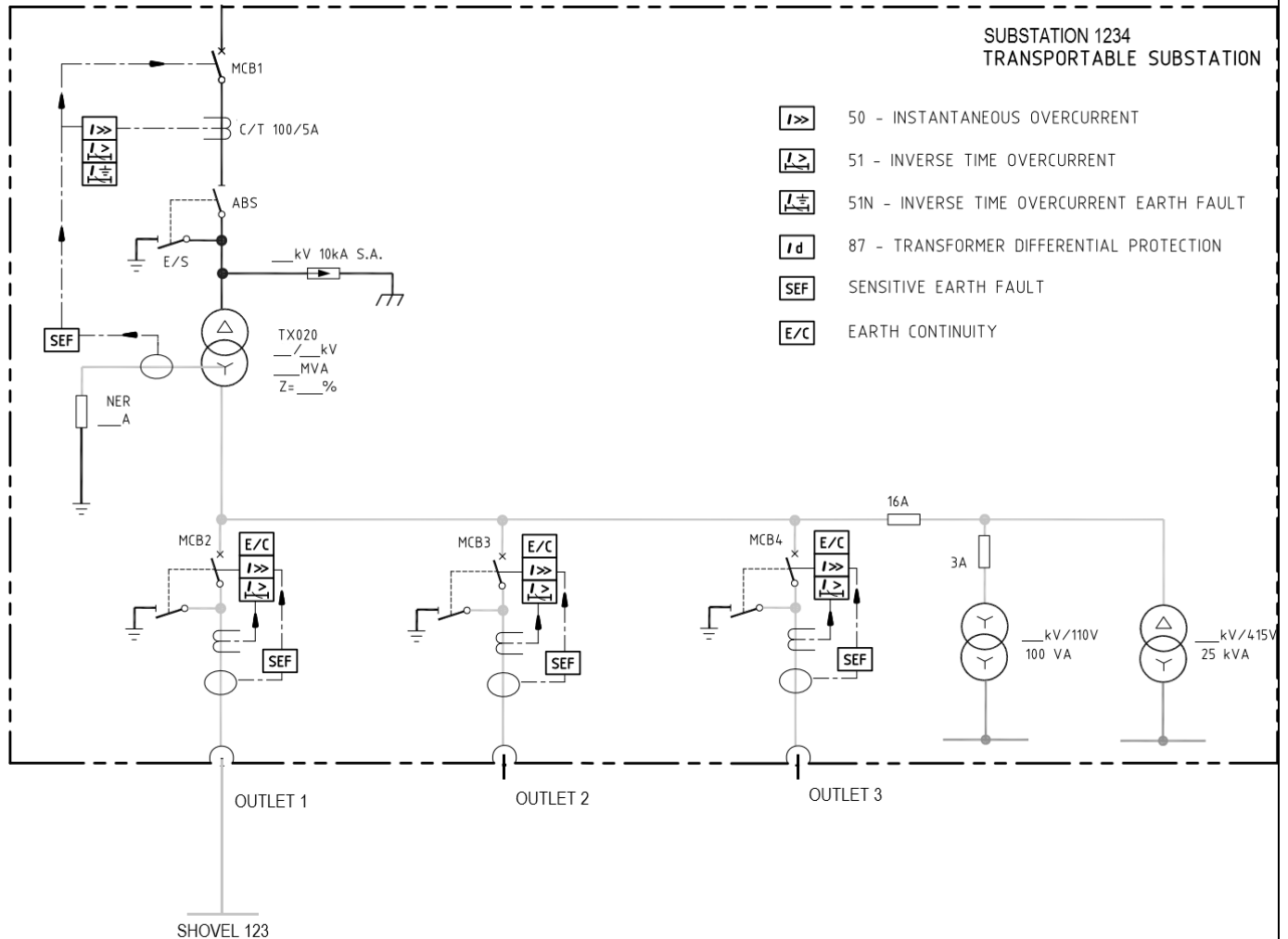
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d) What specific protection devices would you want installed on the circuit? (1 marks)

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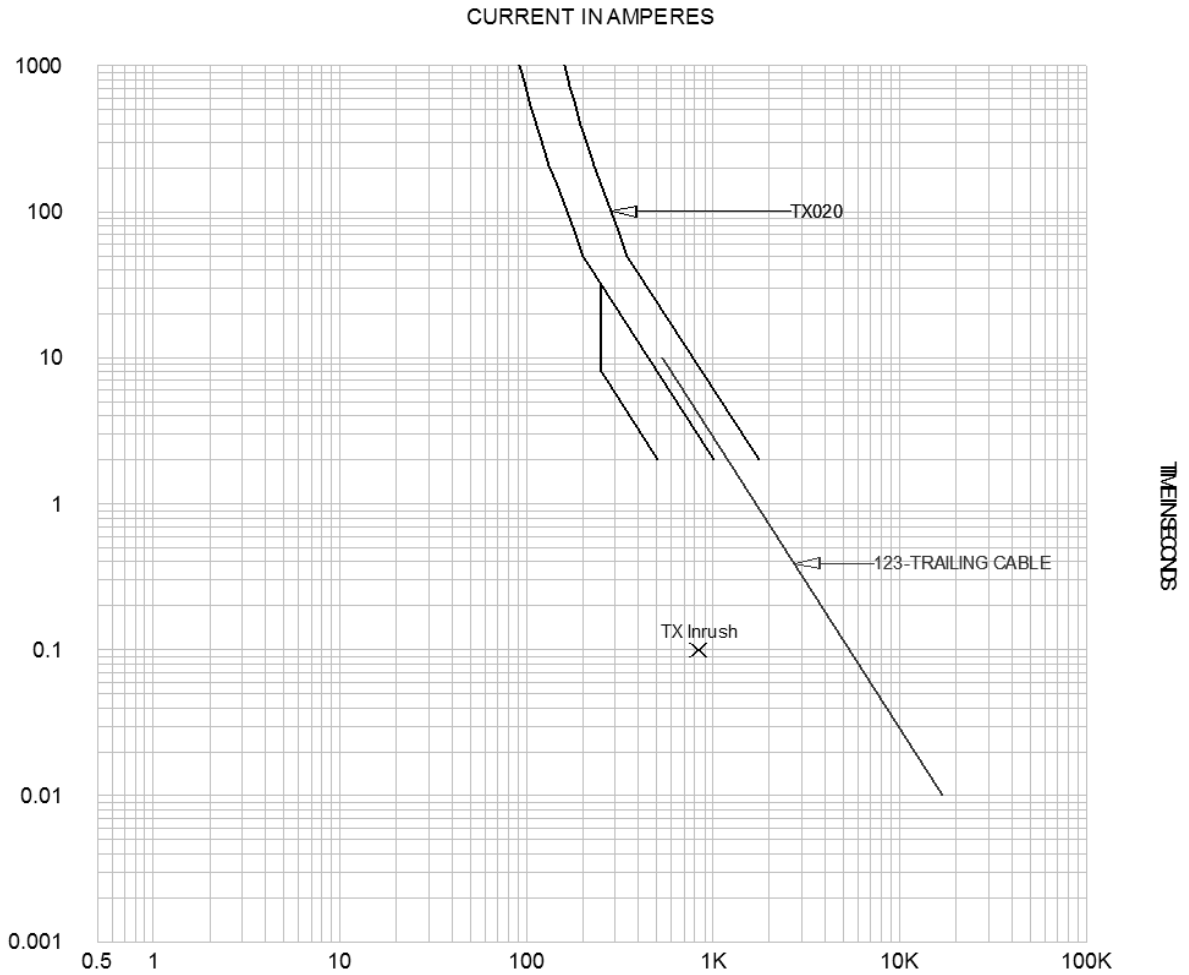
QUESTION 7 (10 marks)

The schematic below shows an open cut transportable substation connected to an electric face shovel. The substation is used to supply up to two shovels at any particular time.



- a) Fill in the missing values in the above drawing with what you might typically expect to find on this substation. (2 Marks)
- i. Transformer voltages
 - ii. Transformer MVA rating
 - iii. Transformer impedance
 - iv. NER rating

- b) On the time/current graph provided, draw typical protection curves for the protection devices for MCB1 and MCB2 shown in the drawing. Clearly show which curves represent which protection devices. (2 Marks)



/2

- c) Explain what considerations you made in the positioning of the time-current curves. (4 Marks)

/4

- d) To achieve “best practice” what minimum 3-phase fault level would need to be present at the shovel high voltage bus? (1 Mark)

/1

- e) What is the maximum allowable setting for the earth continuity protection? (1 Mark)

/1

QUESTION 8 (10 marks)

The following are extracts from the titled Australian Standards as listed below. Fill in the missing words from the various extracts. (1/2 Mark each)

AS3000:2007 – Wiring Rules

Clause 1.5.3.1 - Protection shall be provided against _____ arising from contact with parts that are _____ in normal service (direct contact) or parts that become live under _____ conditions (indirect contact)

Clause 1.5.4.1 - _____ shall be provided against _____ that may arise from contact with parts that may become live in _____ service.

Clause 1.8 - All electrical installations and any _____, _____ or repairs to electrical installations shall, _____ to being placed in service or use, be _____ as far as practicable and _____ to verify that the installation meets the requirement of this standard as applicable.

AS4836:2011 – Safe Working on or near low voltage electrical installations and equipment

Clause 2.1 – To _____ on or near any _____ installations and equipment, it is first necessary to determine whether it is _____ to do so. This can be done before starting work by applying a _____ system at each and every work site. The first aim shall be to _____ the risk.

Clause 2.3.3 – Persons working on or near _____ conductors of electrical equipment should be aware that fault currents or up to 20 times the rated current of the supply transformer can flow for short times during _____ fault conditions

/10

QUESTION 9 (10 marks)

As the Qualified Electrical Engineer (QEE) for a mine site, you have been asked to provide a Technical Specification for mobile and transportable plant to be operated on the surface.

- a) List any specific standards / guidelines that you would reference in your specification. (1 mark)

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- b) List (in point form) some of your specific requirements for your specification? (4 marks)

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- c) What would you consider to be safety critical that you would not compromise on in your specification? (1 mark)

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- d) Where would you install any emergency stops and what specific requirements would you ask for from the supplier? (2 marks)

	/2
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- e) What documentation would you insist on being provided prior to accepting the machine? (2 marks)

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QUESTION 10 (10 marks)

As the new Qualified Electrical Engineer at very large open cut mining operation you have reviewed several areas of the operation within the first few days of your arrival and identified poor standards of electrical maintenance in some critical areas.

- a) What thoughts come to mind when you first identify these issues, considering the size of the operation? (2 marks)

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- b) What are your thoughts as to how this situation could have developed? Identify several possibilities and expand if necessary. (2 marks)

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c) What initial steps would you consider taking? (i.e How would you continue operating this equipment if there were non-compliance issues?) (2 marks)

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d) What people would you involve in developing an action plan? (2 marks)

	/2
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e) What would be your targeted outcomes, and how long could you expect this process to take? (2 marks)

	/2
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QUESTION 11 (10 marks)

As a Qualified Electrical Engineer you are expected to have a sound understanding of Acts, Regulations Standards, Gazette notices, Code of Practices and Guidelines.

- a) List what Acts and Regulations govern the use electricity in NSW Coal mines. (2 marks)

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- b) With the aid of any sketches describe your understanding of the relationship of Acts, Regulations Standards, Gazette notices, Code of Practices and Guidelines. *The next page has been left blank for any sketches.* (4 marks)

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c) In the event of an electrical notifiable incident at your mine site. (4 marks)

- i) Who is responsible to make any notifications
- ii) Whom is to be notified
- iii) What time frames are notifiables to be report

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QUESTION 12 (10 marks)

Explain in your own words and sketch to show your understanding of the following:

- a) The principles of operation of a three-phase synchronous motor and state two advantages of using a synchronous motor (4 marks)

/4

- b) Draw and label a typical torque/speed for 500 KW three phase induction motor (3 marks)

/3

c) With the aid of sketches draw:

- i) DC shunt motor
- ii) DC series motor
- iii) DC compound motor

(3 marks)

/3

END OF QUESTIONS
END OF PAPER