



**Industry &
Investment**

TECHNICAL REFERENCE

EES008-5

Electrical Engineering Safety

**Life – Cycle Management of
Powered Winding Systems**

**Produced by Mine Safety Operations Branch
Industry and Investment NSW
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Public comment period

Please note that this technical reference is published in draft form for the purpose of obtaining public comment.

Your feedback is welcomed and will assist with reviewing and improving the document. A feedback form is provided in the appendices for your convenience.

The closing date for public comment is Friday 20 May 2011.

DRAFT

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Foreword

Industry and Investment NSW (I&I NSW) has a vision for electrical engineering safety, which is:

“A mining and extractive industry that has eliminated death and injuries from electrically powered and electrically controlled equipment.”

Electrical engineering safety encompasses:

- Prevention of electric shock and burns, (electrocution, death or injury as a result of a shock, radiation burns, flash burns, burning particles and plasma)
- Prevention of electrical arcing and surface temperatures that have sufficient energy to ignite gas and/or dust
- Prevention of fires caused by the malfunction of electrical equipment
- Prevention of injury and death from unintended operation, failure to stop or failure to operate, of electrically powered and electrically controlled equipment
- Use of electrical technology to provide safe-guards and monitoring for non-electrical hazards and electrical hazards with a safety integrity level appropriate for the risk.

Supporting this vision is a philosophy of operation outlined in the Strategic and Operational Plan for Electrical and Engineering Safety in NSW Mines, which can be viewed at www.dpi.nsw.gov.au. The philosophy of operation embraces a **System Safety Approach**, applying the **Hierarchy of Risk Controls** and the **Risk Reduction Precedence**, and fostering a **Positive Safety Culture**.

Satisfactory electrical engineering safety has to be achieved in the context of the mining industry's increasing electricity consumption and its use of electrical technology, with resulting increases in size (power rating) and complexity. With this comes a changing risk profile. To adequately manage the safety risks posed by electrical equipment and technology the hazards, risks and risk controls need to be thoroughly understood. This understanding must be at an engineering level, so electrical engineers within the management structure of coal or mining operations will be responsible for development, periodic review and day to day implementation of the Electrical Engineering Safety aspects of a powered winding system.

This document is one of a series dealing with powered winding systems. These documents are consistent with the above philosophy of operation and are a key element in realising the vision and points 4 and 5 for electrical engineering safety listed above.

The documents in the series are:

- EES008.1 Design of Powered Winding Systems - Electrical Engineering Safety – General Requirements & Registration
- EES008.2 Design of Powered Winding Systems - Electrical Engineering Safety – Definitions and types of winders
- EES008.3 Design of Powered Winding Systems - Electrical Engineering Safety – a prescriptive approach
- EES008.4 Design of Powered Winding Systems - Electrical Engineering Safety – a Functional Safety approach
- EES008.5 Life-Cycle Management of Powered Winding Systems - Electrical Engineering Safety Requirements

Current legislation is consistent with this philosophy. In particular Clauses 107 and 113 of the Occupational Health and Safety Regulation 2001 recognise the high risk nature of mine winders, so legislation requires that the Director General design register and item register powered winding systems.

The purpose of this document is to facilitate, within an electrical engineering safety context, the design registration of powered winding systems and to assist coal and mine operators to maintain powered winding systems in a safe state.

Use of this document will:

- Enhance the management of safety risks associated with powered winding systems through good and safe electrical engineering practice
- Contribute significantly toward the prevention of unintended operation of mine winders and preventing any unintended operation from injuring personnel.

Use this technical reference to assess your Powered Winding Systems.

Use this technical reference as an aid to the design of Powered Winding Systems.

This technical reference will be used by Mine Safety Operations to assess powered winding systems for design registration purposes and routine assessment activities.

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Senior Inspector of Electrical Engineering – Special Projects

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1. Establishment

1.1 Title

This is the Mining Industry Technical reference – *Electrical Engineering Safety – Life – Cycle Management of Powered Winding Systems*.

1.2 Purpose

This document is intended to assist operators (coal and mine) in the safe life-cycle management of powered winding systems. It assumes that any powered winding system used at an operation is design and item registered. Full details on how to obtain design registration are given in Guidance Note GNC-005 *NSW DPI Guidance Note – Registration of Plant Designs*.

This technical reference describes acceptable arrangements that can be tailored to suit the particular needs of an operation. It identifies some control measures relevant to electrical circuitry. It is intended to protect the safety of workers, others in the workplace and property.

1.3 Scope

This technical reference extends to all underground operations in NSW that use a powered winding system. This technical reference is intended to provide guidance for any person designing, implementing, managing or reviewing a powered winding system installation.

1.4 Authority

This is an Electrical Engineering Safety Technical Reference and is recommended by Industry and Investment, NSW.

1.5 Definitions

Refer to EES008-2 *Design of Powered Winding Systems Electrical Engineering Safety – Definitions and Winder Types*.

1.6 Applicable legislation

Occupational Health and Safety Act 2000
Occupational Health and Safety Regulation 2001
Coal Mine Health and Safety Act 2002
Coal Mine Health and Safety Regulation 2006
Mine Health and Safety Act 2004
Mine Health and Safety Regulation 2007

1.7 Referenced Gazette Notices

Gazette Notice for Powered Winding systems

1.8 Referenced Standards and Guidelines

AS 4024.1 Series - Safety of machinery
AS 61508 Series - Functional safety of electrical/electronic/programmable electronic safety-related systems
AS 62061 Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
Guidance Note GNC-005 *NSW DPI Guidance Note – Registration of Plant Designs.*

1.9 Acronyms

AS: Australian Standard
AS/NZS: Australian New Zealand Standard
FMECA: Failure Modes and Criticality Analysis
OH&S: Occupational Health and Safety

1.10 Who is affected by this Technical Reference?

This Technical Reference is relevant for all operators of coal or mining operations in New South Wales where there is a powered winding system.

2. Introduction

2.1 Electrical engineering management

The life-cycle management of Powered Winding Systems is an integral part of the operation's arrangements for Electrical Engineering.

The purpose of the Electrical Engineering arrangements is to give effect to the Health and Safety Management System with regard to the following objectives:

- To prevent injury to people from sources of electrical energy
- To prevent uncontrolled fires where electrical energy is the ignition source
- To prevent initiation of gas or coal dust explosions by electrical energy
- To prevent unintended operation of plant
- To provide electrical safeguards for electrical and non-electrical hazards with an appropriate safety integrity level
- To generally provide the means by which the safety of electrical plant is managed including requirements of the applicable legislation.

2.1.1 Powered winding system safety related circuits and electrical engineering arrangements

With regard to Powered Winding Systems the operation's electrical engineering arrangements have the following objectives:

- To prevent unintended operation of plant
- To provide electrical safeguards for electrical and non-electrical hazards with an appropriate safety integrity level
- To generally provide the means by which the safety of electrical plant is managed including requirements of the applicable legislation.

There are two approaches to achieving the above objectives and addressing electrical engineering safety aspects of powered winding systems. These are the functional safety approach and the prescriptive compliance approach. Both these approaches incorporate safety circuits; and commissioning, testing, inspection and maintenance are critical in the safe life-cycle management of powered winding systems. If a functional safety approach is taken, proof testing will be a critical element of the ongoing maintenance of SIL levels.

In the case where any safety related part of the 'powered winding system' has programmable electronic components software management and change control are critical. The system of 'Management of Change' for programming of any programmable electronic system (PES) shall be structured, and prevent inadvertent and intentional mismanagement of the system.

- The system of 'Management of Access' to the program for 'fault finding' purposes shall be structured.

Routine verification of the status of programming to detect unauthorised change shall be performed at a predetermined frequency and at the occurrence of a trigger event.

This must be done over the life cycle of the Powered Winding System.

2.2 Plant safety

Powered Winding Systems are a major item of plant; as such they must incorporate ALL plant safety requirements.

Note:

Chapter 5, Occupational Health and Safety Regulation 2001

This applies to ALL plant (equipment, apparatus, tools, machinery etc). It requires a life-cycle approach to the safety of plant. Responsibilities of persons dealing with any aspect of plant are prescribed. Information flow for life-cycle management of the safety is important. Certain plant must be registered.

Chapter 5 of the OH&S Regulation has extensive requirements for plant safety. Powered Winding Systems are covered by these requirements and they need to be integrated within the Electrical Engineering arrangements. These arrangements will need to incorporate checks being made to establish that designers, suppliers, manufacturers, trade agents and hirers of powered winding systems have fulfilled their obligations. Also, the operator needs to be sure that their obligations have been fulfilled, such as an operator who contracts out the design of a powered winding system must ensure that the person who is engaged to design the powered winding system is provided with all relevant information about matters that may affect health and safety.

All people and organisations in the supply chain have responsibilities. An end user should be able to establish that any foreseeable hazards that may arise during the life-cycle have been identified, risks assessed, risks eliminated or controlled, information has been provided and powered winding systems are not used in conditions likely to give rise to hazards.

2.2.1 Information relating to plant safety – general

The information must be able to establish full compliance with legislation. As such Chapter 5 of the OH&S Regulation must be extensively referenced in powered winding system specifications. The information must encompass:

- All available information concerning health and safety
- Testing or inspections to be carried out
- Installation, commissioning, operation, maintenance, inspection, cleaning, transport, storage and, if it is capable of being dismantled, dismantling
- Systems of work necessary for the safe use
- Knowledge, training or skill necessary for persons undertaking inspection and testing
- Emergency procedures
- Any document relating to the testing and inspection.

2.2.2 Information relating to Powered Winding Systems

Refer to sections 4.2 and 4.3 of EES 008-1

Note: Mining machinery is becoming more complex and the use of programmable systems is common place. With this type of machinery come more detailed information requirements. For this type of plant information is required on:

- Compliance with AS/NZS4024, AS61508, AS62061.
- Programmable Electronic Devices - Security / Access, Change Management, Routine verification, SIL levels.
- Plat gates, cages and at the bottom of shafts and drifts.
- Results of maintenance repair and overhaul activities.

2.2.3 Plant registration

Powered Winding Systems are required to be design and item registered. The life-cycle management of Powered Winding Systems must encompass obtaining registration and the regular review of whether plant is registered; remains registered or if there are special conditions of use as a result of registration.

3. Commissioning program

A detailed commissioning program shall be prepared before commencing final commissioning of the Powered Winding System.

The commissioning shall verify the correct functioning of all elements of the ultimate (if applicable), primary and secondary safety circuits. Refer EES008-2 & 3.

The Commissioning shall form part of the verification plan if a functional safety approach is taken – refer to EE008 – 1, 2 & 4.

This commissioning program shall be reviewed for adequacy by a person with the appropriate competencies. A commissioning program shall be developed and implemented for:

- New installations
- Relocated installations
- When EUC maintenance has involved replacement of parts or components of safety related circuits. When components of the system are replaced by 'non like' components
- When the 'Philosophy of Operation' of the winder is changed
- Re-registration of the Powered Winding System.

The commissioning tests detailed in the commissioning program shall be conducted by:

- A competent Electrical Engineer in co-operation with,
- A competent Mechanical Engineer in co-operation with,
- The Manufacturer and Purchaser representatives.

The commissioning shall be witnessed by a competent electrical engineer and a competent mechanical engineer.

The record of the results of the commissioning shall be verified by the manager of electrical engineering and the manager of mechanical engineering.

Commissioning records shall define all testing and record the results of such testing of safety equipment, safety equipment settings, operating times of safety equipment, over speed settings, and any other tests relevant to the EUC.

Commissioning records shall be kept in the safety file.

4 Routine testing and audits

4.1 Routine testing

Where a functional safety approach is taken the routine testing will form part of the proof testing requirements (refer to EE008 – 2 & 4). Where a functional safety approach is taken the proof testing of ALL safety circuits will need to be incorporated in an inspection and testing regime in order to maintain the required safety integrity levels. The period between proof testing will depend on the extent of redundancy and/or diagnostic coverage provided in the safety related circuits, systems and devices.

Testing shall be carried out by people authorised by a competent electrical engineer and competent mechanical engineer.

All devices associated with the EUC Control that operate the primary safety circuit of the EUC Control shall be statically tested **weekly**.

All devices associated with the EUC Control that operate the secondary safety circuit of the EUC Control shall be statically tested **monthly**.

In addition to these tests, the following requirements shall also be met:

- 4.1.1 Brake testing** Brake testing shall be done in accordance with MDG 33.
- 4.1.2 Over Speed testing** All Over Speed devices shall be dynamically tested **six monthly** and a record of these test results logged.
- 4.1.3 Over Travel testing** All Over Travel devices shall be dynamically tested **monthly** and a record of these test results logged.
- 4.1.4 Ultimate Safety Circuit testing** The operation of the Ultimate Safety circuit (where installed) shall be dynamically tested **monthly** and a record of these test results logged.
- 4.1.5 Primary Safety Circuit testing** The operation of the Primary Safety circuit shall be dynamically tested **weekly** and a record of these test results logged.
- 4.1.6 Testing records** Testing records shall be retained by the mine in a record book and/or electronically.
- Testing records shall define all testing and record the results of such testing of safety equipment, safety equipment settings, operating times of safety equipment, over speed settings, and any other tests relevant to the EUC.

4.2 Safety audits

The purpose of the audit (known as ‘the safety audit’) is to have all safety requirements of the EUC system and associated equipment and documentation being used with the EUC activities, verified as acceptable by an independent auditor or external auditor (working under the auspices of a nationally recognised program or quality management system) with the appropriate competencies.

Note: For auditing purposes a competent person is a person with a thorough knowledge of winder design features and expertise and experience in testing and auditing of powered winding systems used in mines.

4.2.1 Safety audit procedures

All Powered Winding Systems shall be audited at five yearly intervals for registration purposes.

The safety audit shall be designed to assess the safety condition of the Powered Winding System and will address/review all safety aspects of operation, servicing, and maintenance of the EUC. It should include, but not be restricted to, the following:

- Review registration including modifications
- Review design calculations, drawings, and specifications.

Note: For ongoing audits these documents may require only sighting if a previous audit indicates that the documents have been examined and are acceptable.

- Review the structure, logic and code of any programmable electronic system (PES).
- Verify that all safety devices are in place and functioning. List each device on a sheet, test for performance and enter test results on the sheet.
- Witness static and dynamic testing of all safety devices and ensure that persons authorised to conduct these tests are fully conversant with the purpose and method of these devices and of safely carrying out this testing.
- Verify that records are kept correctly for the following:
 - Brake Testing
 - Static Safety Device Testing
 - Dynamic Safety Device Testing
 - Primary Safety Circuit Testing
 - Maintenance Program Results
 - Safety File
 - Radio Frequency Control File

4.2.2 Safety audit results

Any safety issue found during the audit, and needing attention, should be resolved with the Operator.

If a difference of opinion arises over the requirement of a safety device or the consequence of a perceived hazard, and it cannot be resolved, then the auditor shall include this in the final report to the mine. If the audit is part of a registration application the matter shall be specifically addressed in the application.

To complete the audit, the auditor shall conclude the report with attachments that will clearly indicate the safety condition of the Powered Winding System. The auditor will give a copy of the report to the operator and relevant electrical, mechanical and mining engineers.

Failure to have a safety audit on the Powered Winding System completed, and any non-conformances that may affect the safety of the powered winding system rectified, renders the powered winding system registration invalid.

5. Maintenance program

Powered Winding Systems must be incorporated in maintenance activities.

The operations Electrical Engineering arrangements must include arrangements for maintenance of an electrical installation at a NSW operation. This may be integrated into a Maintenance Management Plan.

All electrical parts of a Powered Winding System must be maintained so as to ensure that:

- Inspections, maintenance and cleaning are carried out having regard to procedures recommended by the designer or manufacturer or developed by a competent person
- The safe and satisfactory operation is not impaired by interference, damage, ageing or wear
- It is not used in a manner that exceeds the operating limits imposed by its design or installation
- Compliance with the regulations
- All safety features and warning devices are maintained and tested

Note: This will be an integral part of maintaining the SIL and will require the identification of safety related functions and systems.

- If it has been damaged to the extent that its operation or condition is impaired and the risk to health or safety is increased a competent person assesses the damage and provides advice on:
 - The nature of the damage
 - Whether it is able to be repaired and, if so, what repairs must be carried out to minimise risks to health and safety
 - Repair, inspection and, if necessary, testing is carried out by a competent person
- Repairs are carried out so as to keep it within its design limits.

A detailed maintenance program should be prepared before commencing operation of the powered winding system. This maintenance program shall be reviewed for adequacy by a person with the appropriate competencies.

The maintenance program shall identify those tests to be witnessed and/or conducted by a person with the appropriate competencies.

Maintenance shall be carried out by a person, or persons, authorised by the operator, or operator's representative, as competent and authorised to perform such maintenance.

Note: This is often the Manufacture/Installer of the Powered Winding System.

The maintenance scheme should be developed, implemented and periodically reviewed by a **qualified electrical engineer**.

Maintenance actions on electrical installations within the Powered Winding system should only be undertaken by a qualified engineer, a qualified tradesperson, or persons under the supervision of a qualified engineer or tradesperson.

A record is made and kept of all inspections and tests made and maintenance carried out on the powered winding system. The following information is to be recorded:

- The name of the person who made the inspection or carried out the test or maintenance
- The date on which or dates over which the inspection was made or the test or maintenance was carried out
- The result or outcome of the inspection, test or maintenance
- The date by which the next inspection and test must be carried out.

All maintenance carried out on a Powered Winding System shall be entered into a book, or some secure and readily accessible electronic media, kept specifically for this purpose.

It is important that the Safety File for the powered winding system reference these maintenance records.

6. Appendices

Feedback Sheet

Your comment on this Technical Reference is essential for its review and improvement.

Please make a copy of this Feedback Sheet and send your comments to:

The Senior Inspector of Electrical Engineering
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Phone: (02) 4931 6641
Fax: (02) 4931 6790

How did you use (or intend to use) this technical reference?	
What did you find most useful about the technical reference?	
What did you find least useful about the technical reference?	
Do you have any suggestions to improve the technical reference?	

Thank you for completing and returning the Feedback Sheet.

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