



ESCOM

ELECTRICAL SAFETY
COMMITTEE

GUIDELINES AND BEST PRACTICES FOR FACTORY ELECTRICAL SAFETY

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What is ESCOM?

The Safety, Health and Environment National Authority (SHENA) and Autoriti Elektrik Negara Brunei Darussalam (AENBD) established the Electrical Safety Committee or “ESCOM” in January 2023; with the objectives of promoting regulatory compliance and raising electrical safety standards within Brunei Darussalam.

Who are the ESCOM members?

The Electrical Safety Committee (ESCOM) comprises representatives and industry experts drawn from relevant government institutions and private organisations, collectively bringing extensive technical experience in electrical engineering, safety management, and industry practice.

ESCOM is **chaired by a representative from the Safety, Health and Environment National Authority (SHENA)**, with a **Deputy Chairperson appointed in accordance with the Committee’s Terms of Reference**. Subject matter experts from regulatory bodies, utilities, and industry may be invited to participate in specific working groups or provide technical input where required.

ELECTRICAL SAFETY BEST PRACTICES			
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Disclaimer:

This document was developed to provide guidance and recommendations, as well as to serve as an industry reference for best practices with the aim of improving electrical safety practices. This Guideline and Best Practices is not a statutory document and does not create or replace any legal obligations under the Workplace Safety and Health Act (Chapter 277) or its subsidiary regulations. In the event of any inconsistency, the provisions of the WSHA and its subsidiary regulations shall prevail. Accordingly, this document should not be construed as implying any liability nor should it be taken to encapsulate all the responsibilities and obligations of the law.

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1 INTRODUCTION

- 1.1 Electrical safety in a factory refers the identification, assessment and control of potential hazards associated with power systems that could cause injury to personnel, damage to equipment, or operational downtime. Such hazards may include equipment malfunctions, faulty wiring issues, or improper grounding.
- 1.2 Factory Electrical Safety comprises all protective measures and plans as well as management controls implemented to prevent electrical hazards and to ensure the safety of personnel, the work area and the operations.
- 1.3 In today's technologically advanced world, electricity is a vital energy source that powers homes, offices, factories, and other industrial facilities. However, this resource can bring serious hazards such as leading to electrical fires and burns to electrical shocks and fatalities, if not properly designed, installed, operated or maintained carefully.

2 DEFINITIONS

In this Guidelines, any word or expression to which a meaning has been assigned, shall have the meaning so assigned and, unless otherwise indicated:

- 2.1 Factory - refers to any workplace where there are employees involved in, but not limited to, processes such as electrical installations, equipment, or systems are used in connection with manufacturing, processing, assembling, testing, maintenance, or similar industrial activities, and where electrical hazards may reasonably arise from such activities. It also includes, electrical works on vessels or vehicles, operation or maintenance of any facility or system related to the public utilities. The worksites that are considered as "factory" is as per outlined in S.5(3)(a) to (s) of the Workplace Safety and Health Act (Chapter 277).
- 2.2 "Competent person (electricity)" in relation to machinery, means any person who has successfully completed an apprenticeship or accredited programme in an engineering trade which includes operation and maintenance of machinery, or has had at least five years' practical experience in the operation and machinery to enable them to analyse risks and to avoid hazards which electricity can create.
- 2.3 "Shall" - indicates a requirement strictly to be followed in order to conform to the standard, and from which no deviation is permitted unless accepted by all involved parties.
- 2.4 "Should" - make a recommendation to indicate that among several possibilities one is recommended as particularly suitable without mentoring or excluding others, or that a certain course of action is preferred, but not necessarily required.
- 2.5 "Can" - used for statements of possibility and capability, whether physical or causal.

- 2.6 “Could” - used to indicate an allowable course of action within the limits in this standard.
- 2.7 “Hazards” - A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.
- 2.8 “Machinery” includes — (a) any oil engine, gas engine, steam engine and any other machine in which mechanical movement, either linear, rotated or both, takes place; (b) any steam boiler, gas cylinder, air receiver, steam receiver, steam container or refrigerating plant pressure receiver; (c) any appliance for transmission of power by ropes, belts, chains, driving straps or bands or gearing; and (d) any electrical generator or electrical motor, but does not include any machinery used solely for the propulsion of vehicles¹
- 2.9 “Verifying” - make sure or prove that (something) is true, accurate, or justified.
- 2.10 “Grounding” - provides a path for current to flow into the ground and excess electric charge to disperse instead of building up and creating a potential hazard.
- 2.11 “Insulation” - means separated from adjoining conducting material by a non-conducting substance which provides resistance to the passage of current, or to disruptive discharges through or over the surface of the substance at the operating voltage, and to mitigate the danger of shock or injurious leakage of current.

3 ACRONYMS AND ABBREVIATIONS

DES	Department of Electrical Services
EIR	Electrical Installation Requirements
IEC	International Electrotechnical Commission
NEC	National Electrical Code
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
QC	Quality Controller
SHENA	Safety, Health and Environment National Authority
WSHA	Workplace Safety and Health Act

¹ Section 4, Workplace Safety and Health Act (Chapter 277).

4 APPLICABLE STANDARDS AND INDUSTRY GUIDANCE

4.1 This guideline cannot be used alone to specify electrical safety in a factory NEITHER can it be applied to hazardous area classification but shall comply with IEC & British Standards but not limited to following:

- 4.1.1 Approved Code of Practice and Guidance (ACOP): Safe Use of Electricity at Construction Sites published by SHENA.
- 4.1.2 BS EN 50110-1 Operation of Electrical Installation.
- 4.1.3 EIR “Electrical Installation Requirement 2011 – First Edition” published by Department of Electrical Services, Prime Minister’s Office Brunei Darussalam.
- 4.1.4 Guidelines and Best Practices for construction Power Part 3: Electrical Safety at Construction Site published by ESCOM Document No.: ESCOM/2024/06, Revision 1.0.
- 4.1.5 IEC 0079-14 – Explosive atmospheres – Part 14: Electrical installation design, selection and installation of equipment, including initial inspection and maintenance.
- 4.1.6 IEC 60204-1, Safety of machinery – Electrical equipment of machines.
- 4.1.7 IEC 60364 Series, Electrical installations in buildings – covers wiring, protection, and safety measures.
- 4.1.8 IEC 60439-1, Low-voltage switchgear and control gear assemblies.
- 4.1.9 IEC 60529, Degrees of protection provided by enclosures (IP code).
- 4.1.10 IEC 60664, Insulation coordination for equipment within low-voltage systems.
- 4.1.11 IEC 60947 Series, Low-voltage switchgear and control gear – includes circuit breakers, contactors, etc.
- 4.1.12 IEC 61010, Safety requirements for electrical equipment for measurement, control, and laboratory use.
- 4.1.13 IEC 61508, Functional safety of electrical/electronic/programmable electronic safety-related systems.
- 4.1.14 The Electricity Safety, Quality and Continuity Regulations, UK Statutory Instruments, 2002.

5 TECHNICAL REQUIREMENT FOR FACTORY

5.1 To ensure that the provisions of these technical requirements in relation to machinery are complied with an employer or user of machinery, shall in writing, employ in a full-time capacity, a competent person who is to be designated responsible for every premises.

5.2 Every employer or user of machinery shall ensure that every exposed and dangerous part of the machinery, which is within normal reach of a person, to be effectively safeguarded by means of insulation, fencing, screening or guarding.

The employer or user of machinery shall ensure that all safety equipment is inspected on a regular basis and tested to ensure that it is in good working order.

Where the machinery constitutes a danger to persons, the premises shall be enclosed. Should the premises be left unattended, the designated entrances shall be kept closed and locked.

5.3 The employer or user of machinery shall ensure that every person authorized to operate machinery is fully aware of the dangers and conversant with the precautionary measures.

5.3.1 Under no circumstances shall the operator of machinery, which requires constant attention, leave his post while such machinery is in operation. Only a person who is authorised and competent may relieve him.

5.4 An employer or user of machinery shall provide devices to start and stop machinery. These devices shall be in a position where they are readily reached by the operator, and these devices shall be so designed as to prevent accidental starting of the machinery.

5.5 Correct sizing of electrical equipment

Correctly sizing and rating electrical equipment for is crucial to ensure safety and compliance with regulations.

5.5.1 Sizing

5.5.1.1 Proper sizing involves selecting equipment that can handle the electrical load while maintaining safety. This includes considering factors like voltage, current, and power requirements, as well as ensuring the equipment can operate safely within the specific operating environment.

5.5.2 Rating and Certification

5.5.2.1 Electrical equipment must be sized, rated and certified for the specific installation. This involves ensuring the equipment is suitably sized for the application that it is being designed for.

5.5.3 Hazardous Area

5.5.3.1 Determine the type of hazardous substance (gas, dust, or fibres) and its concentration in the area. This helps in defining the specific Equipment Group, Equipment Protection Level (EPL), Temperature Rating, IP Rating or Zone.

5.5.4 Installation and Maintenance

5.5.4.1 Equipment must be installed following strict guidelines to prevent ignition sources. This includes using appropriate wiring methods and ensuring all components are properly sealed and protected. Refer to IEC 60079-14.

5.5.4.2 Regular inspections and maintenance are essential to ensure ongoing safety. This includes checking for wear and tear, ensuring seals remain intact, and verifying that the equipment continues to meet safety standards. Refer to IEC 60079-17.

5.6 Correct installation of electrical equipment

Proper installation of electrical equipment is essential for ensuring safety, efficiency, and longevity. The following are suggestions as shown in Table 5-1 Installation of Electrical Equipment are to be followed.

Table 5-1 Installation of Electrical Equipment

Activity	Description of Activity
Plan & Assess	Review site conditions, power requirements, and applicable manufacturer and regulatory standards prior to commencing work.
Secure Approvals	Obtain all required and / or necessary permits and approvals, ensuring compliance with relevant legal and safety regulations.
Prepare Work Area	Keep the workspace clean, well-organized, and safe (such as adequate ventilation, lighting, grounding).
Gather Tools & Materials	Ensure all required tools and equipment are available, suitable and in good working condition.
Verify Specifications	Confirm that equipment and materials meet project requirements and resolves any discrepancies early.
Install Panels & Breakers	Follow manufacturer instructions; ensure secure connections and proper grounding.
Run Wiring	Use correct wire type and gauge; avoid exposed wires and loose connections.
Install Components	Correctly position outlets, switches and fixtures; secure all connections.
Connect Power Safely	Turn off main power; test circuits before energizing.

Activity	Description of Activity
Installers, Maintainers, Inspectors	The competency of Installers, Maintainers, Inspectors shall be verified and attributed on the basis of sufficient evidence that the person: a) possesses the necessary skills required for the scope of work. b) can perform competently across the required range of activities. c) has the relevant supporting skills supporting competency.
Inspect & certify	Conduct final checks for compliance and obtain certification from a qualified inspector

5.6.1 Storage And Handling of Equipment to be installed

- 5.6.1.1 Upon delivery, conduct QC inspections to verify compliance with vendor requirements.
- 5.6.1.2 Store equipment upright in clean, dry indoor areas in accordance with OEM recommendations, maintaining gaps for access and covering with protective sheets.
- 5.6.1.3 Keep air intakes properly sealed and perform regular visual checks for dust accumulation or dampness.
- 5.6.1.4 Provide adequate protection during handling and transportation and comply with project specifications for foundations and grouting.
- 5.6.1.5 Inspect installed equipment for completeness and cleanliness, removing foreign materials before final checks.

5.6.2 Other Miscellaneous Equipment Installation Recommendations

- 5.6.2.1 Classify equipment based on installation location (hazardous or non-hazardous) and install structural supports in accordance with approved drawings.
- 5.6.2.2 Mount panels carefully to avoid mechanical stress and verify alignment prior to tightening bolts using specified torque values.
- 5.6.2.3 Ensure proper grounding, apply touch-up paint as required, and obtain all necessary work permits before commencing activities.
- 5.6.2.4 Assign fire watchers during hot work activities, inspect and colour-code electrical tools, and brief personnels on hazardous area precautions.
- 5.6.2.5 Maintain continuous supervision, install barricades and warning signage, enforce appropriate PPE usage, and conduct daily toolbox meetings.

5.6.2.6 Keep work areas clean, organized and safe throughout the process.

5.6.3 Tools and Equipment

5.6.3.1 Inspect all tools and equipment are in good condition and fit for purpose before use.

5.6.3.2 Essential tools and equipment may include, but are not limited to, boom trucks, electrical hand tools, welding machines, mobile cranes, hydraulic pallet jacks, ladders, spirit levels, torque wrenches, and measuring tapes.

5.6.3.3 Tools used in hazardous areas must be intrinsically safe and compliant with relevant standards.

5.6.3.4 All tools used in classified areas must be intrinsically safe and fully compliant with relevant standards.

5.6.4 Industry Codes, Regulations and Guidelines which may be applicable for reference are, but are not limited to the following:

5.6.4.1 Department of Electrical Services (DES)

5.6.4.2 Berakas Power Company (BPC)

5.6.4.3 Brunei Darussalam National Grid Code, 2nd Revision, AENBD

5.6.4.4 Other applicable relevant IEC / BS codes

5.6.5 Other Safety Precautions

5.6.5.1 Implement best practices in installation and maintenance, including compliance with applicable standards, regular inspections, proper grounding and bonding, accurate labelling, and thorough documentation.

5.6.5.2 Use high-quality materials, maintain proactive maintenance schedules, and ensure personnel are adequately trained, competent and certified their assigned roles and tasks.

5.6.5.3 Leverage modern technologies such as thermal imaging and smart sensors for enhanced safety, reliability and operational efficiency.

5.7 Lock out and tag out (LOTO) for electrical equipment

5.7.1 Lock Out Tag-Out (LOTO) procedures are necessary to protect workers from the release of hazardous energy that involves any electrical equipment or machineries.

5.7.2 The process of LOTO involves disconnecting energized parts, applying locking and tagging, testing to verify the absence of voltage and when required, temporarily grounding equipment to protect workers.

- 5.7.3 Examples of energy sources include electrical, mechanical, hydraulic, pneumatic, chemical and thermal energy.
- 5.7.4 Unexpected starting of equipment during maintenance activities can result in serious injury to personnel. Therefore, implementing LOTO temporarily eliminates electrical hazards for the duration of work performed on or near energized electrical components.
- 5.7.5 Whenever working on equipment which is normally energized with electrical energy, mechanical loading or rotating energy, pressurized lines or vessels containing gases or fluids, or otherwise subject to stored energy, proper/correct LOTO procedures of these devices are mandatory to ensure that proper safe working environment is established.

5.8 Power Quality

5.8.1 Overview

- 5.8.1.1 Power quality refers to the stability and consistency of electrical power supplied to equipment and systems, including voltage stability, frequency consistency, and the absence of disturbances such as harmonics and transients.
- 5.8.1.2 Poor power quality can lead to operational inefficiencies, increased downtime, and higher maintenance costs, while also reducing equipment lifespan and posing safety risks.

5.8.2 Impacts on Operations and Equipment

- 5.8.2.1 Voltage sags, swells, and transients can disrupt industrial processes, causing machinery malfunctions and production delays.
- 5.8.2.2 Harmonic distortion and electrical noise compromise system stability, leading to unreliable performance and potential overheating, which may result in fires or frequent tripping of circuit breakers.
- 5.8.2.3 Over time, these issues accelerate equipment wear, degrade performance, and increase energy consumption, ultimately raising operational costs.

5.8.3 Mitigation Strategies

- 5.8.3.1 To maintain power quality, businesses should implement power conditioning solutions such as UPS systems and voltage regulators, conduct regular monitoring and analysis, and schedule timely maintenance and upgrades.
- 5.8.3.2 These measures help stabilize voltage, prevent unexpected failures, and extend equipment life.

5.8.4 Flicker and Its Effects

- 5.8.4.1 Flicker - rapid fluctuations in light intensity caused by voltage variations often results from large load changes, such as motor startups or welding operations.
- 5.8.4.2 It can cause visual discomfort, headaches, and fatigue, and in severe cases, trigger migraines or seizures in sensitive individuals.
- 5.8.4.3 For equipment, flicker leads to performance degradation, nuisance tripping, and shortened lifespan.
- 5.8.4.4 Mitigation includes power quality monitoring, voltage stabilization, and ensuring secure electrical connections.

5.9 Equipment Inspection and Maintenance

5.9.1 Importance of Regular Inspections

- 5.9.1.1 Routine inspections and maintenance are critical for ensuring safety, reliability, and compliance.
- 5.9.1.2 These checks help identify wear and tear, verify seals, and confirm that all electrical equipment and installations meet applicable standards.
- 5.9.1.3 Inspections should also assess manufacturing processes, quality control systems, and adherence to national and regional regulations, including SHENA and WHSA requirements.

5.9.2 Inspection Frequency and Compliance

- 5.9.2.1 Industrial electrical inspections should occur at regular intervals—typically quarterly to annually—based on facility needs and regulatory requirements.
- 5.9.2.2 Inspections may be performed in-house or by qualified professionals using specialized tools.
- 5.9.2.3 Any issues identified must be addressed promptly to maintain safety and functionality.
- 5.9.2.4 Compliance with SHENA, WHSA, and international standards such as IEC, BS, NEC and OSHA is mandatory.

5.9.3 Inspection Checklist and Roles

- 5.9.3.1 A structured checklist ensures thorough evaluations of electrical systems.
- 5.9.3.2 Factory owners should engage certified inspectors to verify regulatory compliance and risk engineers for detailed assessments using advanced tools like infrared cameras to detect overheating or loose connections.

5.9.3.3 These measures help prevent downtime and extend equipment life.

5.9.4 Key Inspection Areas

Regular inspections should cover three (3) areas as follows: -

- GENERAL (ALL EQUIPMENT)
- INSTALLATION – GENERAL
- ENVIRONMENT

5.9.4.1 **Panels and Enclosures:** Check seals, damage, and overheating.

5.9.4.2 **Wiring and Connections:** Inspect for fraying and tighten loose connections.

5.9.4.3 **Circuit Protection:** Verify correct sizing and functionality of breakers and fuses.

5.9.4.4 **Grounding and Bonding:** Ensure proper bonding to prevent shocks.

5.9.4.5 **Outlets, Switches, and Lighting:** Confirm operation and labelling.

5.9.4.6 **Motors and Generators:** Look for wear, overheating, or abnormal noise.

5.9.4.7 **Emergency Shutdown Systems:** Test for proper function.

5.9.4.8 **Surge Protection Devices:** Confirm effectiveness.

5.9.4.9 **Signage and Labelling:** Ensure clarity and compliance.

5.9.4.10 **Specialised Machinery:** Inspect per OEM recommendations.

6 TRAINING AND AWARENESS OF ELECTRICAL SAFETY

6.1 Scope of Training

Workers should receive adequate safety and health training, in the form of information and instructions specific to his workstation or job:

6.1.1 On recruitment,

6.1.2 In the event of a transfer or a change of job,

6.1.3 In the event of the introduction of new work equipment or a change in equipment,

6.1.4 In the event of the introduction of any recent technology,

6.1.5 The training shall be:

- 6.1.5.1 Adapted to take account of new or changed risks, and
- 6.1.5.2 Repeated periodically if necessary (recommended 3 yearly).

6.2 Competent Person

- 6.2.1 For the purposes of this Guidelines, a Competent Electrical Person (CEP) is an individual whom the company has formally assessed and deemed to possess the necessary experience, knowledge, skills, and training to perform electrical work safely on the organization’s electrical systems.
- 6.2.2 Competence is typically demonstrated through relevant formal qualifications as depicted in Table 6-1 Competency Training such as certification in electrical installation, a degree in electrical engineering, or qualifications in electrical maintenance, as well as successful completion of job-specific training (e.g., DES PassKad or equivalent) required for the tasks assigned.
- 6.2.3 Reference shall be made to DES-approved courses.

Table 6-1 Competency Training

Category	Courses	Candidate
General Worker	Contractors Safety Awareness (CSA). General Safety Awareness, including Tool Safety.	Labourer
E01	Contractors Safety Awareness (CSA). General Safety Awareness, including Tool Safety.	Electrician
	Electrical Installation Regulations (EIR). Wiring of Premises (WP). Domestic & Industrial from Meter to final circuits (1-Phase & 3-Phase).	
E02	Contractors Safety Awareness (CSA). General Safety Awareness, including Tool Safety. DES Electrical Safety Rules & System Operating Regulations. Street Lighting – Installation & Maintenance	Electrician Technician
	Road Safety Awareness (RSA). Low Voltage Switching Applications. Electrical Installation - Domestic & Industrial LV Main Distributions. Electrical Installation - Domestic & Industrial LV Main Distributions (LVSA).	
E03	General Safety Awareness, including Tool Safety. Safety Rules & System Operating Regulations.	Engineers
	High Voltage Switching Applications. Basic Protection Relays.	

Category	Courses	Candidate
	Medium Voltage Switching Applications. HV Electrical Work – Transmission & Distribution System.	
E05	(CSA) Cable Jointing & Terminations (CJT). General Safety Awareness, including Tool Safety. Cable Jointing and Termination.	Electrician Technician Engineers
Hazardous Area Environment	Contractors Safety Awareness (CSA).	Electrician Technician Engineers
	Electrical Installation Regulations (EIR).	
	Wiring of Premises (WP). Domestic & Industrial from Meter to final circuits (1-Phase & 3-Phase).	
	CEHA-Certified Equipment for Hazardous Area/CompEx/IECEX CoPC.	

6.3 Unqualified personnel

Unqualified personnel (e.g., office workers, administrative staff) who may encounter but not work directly with electrical systems, require general awareness training on avoiding electrical hazards in their environment.

6.4 Emergency response training

Adequate no. of persons are required to work on with, or near an electrical installation shall be provided with training and information so that they are able to give appropriate first aid treatment for electric shock and/or burns.

7 SIGNAGES

7.1 Signages

- 7.1.1 The purpose of safety signage in the factory / workplace is to warn or inform drivers in the area to prevent accidents by warning of hazards, provide guidance on safe procedures and emergency responses and increase awareness of safety requirements.
- 7.1.2 The signage may be distinguished as depicted in and adopted in factory where necessary or appropriate.
- 7.1.3 Signages must be clear and easy to understand, easily noticed, clean and well maintained that they are always visible, reflective and well-lit if they need to be visible in darkness.




7.2 Lane Markings

7.2.1 The purpose of safety lane marking in a factory is to provide visual guided line to improve the safety movement within the factories / warehouse by using specific colours and patterns on floors to designate pedestrian walkways, vehicle traffic routes, hazardous areas and storage zones.

7.2.2 The markings separate pedestrian and vehicle traffic thus also improving traffic movement efficiency within the factories.

7.2.3 The common safety markings and designate meaning as follow may be adopted in factory where necessary or appropriate.

Table 7-1 Different Types of Signages

Prohibited Signage	Warning Signage	Mandatory Signage
<p>1. To specify that an action that is not allowed preventing danger.</p> <p>2. A white background with a red circular border and a red diagonal bar across the centre that forbids certain actions i.e. “No unauthorised personnel”, “No entry”, “No smoking” and etc.</p> 	<p>1. To warn or alert personnel of potential dangers, hazards or risks present in the area.</p> <p>2. A yellow triangle with a black border and a black pictogram on the yellow background, i.e. “High Voltage”, “Trailing Cable”, “Falling objects” and etc.</p> 	<p>1. To provide a wide range of safety information must be abide in certain area of the factory or workplace that must be adhered to in a specific area.</p> <p>2. A blue circle with text / images for required actions i.e. ‘No storage Permitted’</p> 

8 REFERENCES

1. Workplace Safety and Health Act, Chapter 277
2. Workplace Safety and Health (Construction) Regulations
3. IEC 60079 Series – Explosive Atmospheres
4. IEC 60204-1: Safety of Machinery – Electrical Equipment of Machines
5. IEC 60417: Graphical Symbols for Use on Equipment
6. IEC 61000 Series – Power Quality
7. IEEE Recommended Practice for System Grounding of Industrial and Commercial Power Systems