NUELAC

NATIONAL UNIFORM ELECTRICAL LICENSING ADVISORY COUNCIL

LIST OF ESSENTIAL PERFORMANCE CAPABILITY REQUIREMENTS FOR LICENSED ELECTRICIANS

Explanatory Note

This policy document was developed by NUELAC's Electrician Working Group, later approved by NUELAC on 13 February 2001 and then released for industry information on 1 March 2001.

NUELAC membership covers various government and industry interests relevant to the safe and competent performance of electrical work. NUELAC therefore includes the electrical industry associations and technical/safety regulators (licensing authorities) of all Australian States/Territories. New Zealand is an observer. The document has been approved by the Electrical Regulatory Authorities Council (ERAC) for use by the various licensing authorities.

The purpose of the document is to provide clear guidance to Registered Training Organisations (RTOs) in Australia about the regulatory requirements that a trainee must satisfy, before he or she can be issued with an Electrician Licence.

Failure by an RTO to provide evidence (to the satisfaction of the relevant licensing authority) that the training (including assessment) delivered to a licence applicant satisfies the stated requirements and forms an integral part of an *approved National Training Package qualification, which means the applicant has successfully passed a "capstone assessment" in accordance with specified requirements, will result in the applicant being required to undertake further assessments at the discretion of the licensing authority.

This document shows both the overall essential capability list as well the critical items within that list, thus detailing part of the requirements for the "capstone assessment" of each trainee.

The over-arching objective is that the training for a prospective electrician must deliver at least the "essential performance capability" requirements, and that the capstone assessment will confirm that the most critical of these has been attained by the applicant.

*Approved National Training Package means an ANTA National Training Quality Council endorsed National Training Package qualification, that includes the "Capstone Assessment Test" as approved by ERAC/NUELAC, within the respective industry's training program where recommended.

Enquiries: *Please contact the Electrical Licensing Authority in your Australian State/Territory.*

LIST OF ESSENTIAL PERFORMANCE CAPABILITIES FOR PROSPECTIVE ELECTRICIANS
(with "Critical Items" shown)

Preface and Context:

The following tables list the various essential or minimum capabilities expected of a licensed Electrician in any State/Territory in Australia. To put this statement into a workplace competency context where relevant, a person seeking an electrician licence needs to be capable of competently and safely performing the tasks set out in the tables, in a wide variety of typical industry environments, working independently and without supervision.

Furthermore, the person needs to know what action, if taken, will void the integrity, compliance and/or certification of electrical equipment or an electrical installation.

"Typical industry environments" is to be taken to include routine types of commercial premises and office buildings to 10 levels, industrial sites of modest complexity (with some HV plant and hazardous areas), institutional premises of modest complexity (eg high schools and non-specialist hospitals), and residential premises (single dwellings, multi-unit buildings including high rise units).

The applicant will be able to competently:-

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
1.	**Demonstrate a knowledge of basic electrical and energy concepts.**	Fundamentals of electrical energy, other energy forms, voltage, current and resistance.	
2.	**Demonstrate a knowledge of the various effects of electric current.**	Physiological effects on humans, heating and other energy conversion effects and principles.	Critical
3.	**Demonstrate a knowledge of resistivity and resistors.**	Ohm's law, material resistivity, resistor parameters and introduction to measuring methods.	
4.	**Demonstrate a knowledge of the various sources of electromotive force (e.m.f.).**	How electrical energy is produced from various forms of energy, including batteries.	
5.	**Explain the operation of a simple practical circuit.**	Include current path, circuit control, load, EMF source and conductors.	Critical

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
6.	**Determine the resistance, voltage, current and power in any part of a DC circuit using theory and actual measurement methods.**	Theoretical and practical knowledge of measuring instrument use and safe practises whilst using instruments. Include series and/or parallel circuit analysis.	Critical
7.	**Demonstrate a knowledge of the theory and application of Capacitors and Inductors.**	Concepts and characteristics of Capacitors and Inductors and their application in DC circuits.	
8.	**Demonstrate a knowledge of permanent and electro magnetic theory and application.**	Magnetism, magnetic induction, magnetic fields and the fundamental magnetic quantities.	
9.	**Demonstrate a knowledge of electromagnetic induction and state practical examples which make use of this principle.**	Principles of EMF induced in a conductor and its application in electrical machines and devices.	
10.	**Demonstrate a knowledge of Capacitance and Inductance in AC circuits and their effects.**	To include calculation of capacitive and inductive reactance, effects on V and I phase relationships, resonance and impedance in AC series and parallel circuits.	
11.	**Demonstrate a knowledge of alternating voltage & current generation, phase relationships, energy in an AC circuit, and actual measurement methods.**	Explain sinusoidal voltage generation and resultant current flow. Define key terms, calculate and apply measuring techniques to derive required parameters. Eg power factor.	Critical
12.	**Describe Star and Delta three phase AC systems and the reason why three phase is used.**	Multiphase systems and their advantages – reduced current flow, equipment size etc. Calculation (phase diagrams) of line and phase voltages.	
13.	**Demonstrate an understanding of the fundamental safety principles of the AS/NZS 3000:2000 Section 1.**	Definitions, alterations, protection, design, selection and installation of electrical equipment for electrical safety requirements. This includes protection from direct and indirect contact with live parts.	Critical
14.	**Demonstrate a knowledge of power factor, power factor improvement principles and power measurement techniques to AC circuits in 1 and multiphase systems.**	Consequences of low power factor, value of capacitance required for correction, measurement theory and methods to obtain real power and apparent power values.	
15.	**Describe the rationale and operating principles and characteristics of three phase induction motors and generators.**	Concept of a rotating magnetic field, stator and rotor construction. Power, torque and speed relationships.	

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
16.	**Describe methods of electric motor selection, starting, connection and protection.**	Reduced current starting, methods of starting (star-delta etc), typical motor lead terminations and protection (including by electronic devices) of the motor from environmental, overload, internal faults and supply variation conditions.	Critical
17.	**Describe the AS/NZ 3000:2000 and local Supply Authority requirements for three phase motor installations and starters.**	Design of motor circuits for operator control, isolation, automatic starting and emergency stopping. Starting methods required by the local supply authority to limit the transient current.	
18.	**Describe the possible causes of malfunction of three phase induction motors and demonstrate the tests required for diagnosing faults**	Common causes of malfunction – starting equipment failure, insulation deterioration, water ingress etc. Common testing methods – voltage, ampere and insulation resistance checks.	
19.	**Describe the operating principles, typical control methods and characteristics of single phase motors and their key components.**	The rotating magnetic field and components for single phase motors, methods to achieve starting and operating torque. Control methods used including voltage/speed reduction, reversal and impact on performance.	
20.	**Describe the suitability of various types of single phase motors for particular applications and describe the fault finding methods.**	Application of various motor starting/operating torque curves to various mechanical loads. Eg drills, fans and pumps etc.	
21.	**Describe and apply in practice the requirements of AS/NZ 3000:2000 in relation to earthing arrangements and fault loop impedance calculations.**	Earthing arrangements for protective and functional purposes, earthing connections and conductor selection. Calculation of the correct cable size for an installation to achieve protective device and cable co-ordination.	Critical
22.	**Demonstrate a comprehensive knowledge and understanding of the MEN system and its application, including on sub-installations.**	Multiple Earthed Neutral arrangement, resultant fault current path and magnitude, operation of protective devices and implication of MEN link absence during fault condition.	Critical
23.	**Describe the basic construction of transformers.**	Design of different types of core lamination styles, winding types and assembly techniques.	

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
24.	**Demonstrate understanding of the principle of operation of transformers.**	Production of secondary winding induced EMF from primary winding and core. Open circuit and full load parameters.	
25.	**List the main types of transformers.**	Single and double wound, auto, current and voltage transformers.	
26.	**List typical applications of various types of transformers and key safety issues.**	Distribution and transmission systems, large consumers' installations, within electrical equipment, appliances including welders. Safe working procedures when connecting and testing transformers.	Critical
27.	**Describe and apply in practice the requirements for circuit protection using AS/NZS 3000:2000 and other relevant Australian Standards. Eg AS/NZS 3018.**	Causes of excess current (and voltage) within a circuit. Calculation and selection of protective devices to satisfy the required Standards.	Critical
28.	**Demonstrate a knowledge of the SELV, PELV and earth leakage current protection systems and their application in accordance with AS/NZS 3000:2000.**	Protection against both direct and indirect contact using SELV and PELV systems. Protection using Residual Current Device.	Critical
29.	**Demonstrate the ability to select cables for mains and submains using AS/NZS 3000:2000 and AS/NZS 3008.1 based on current carrying capacity, short circuit capacity, maximum demand and voltage drop, for single phase and three phase installations including multiple installations.**	Determination of maximum demand, voltage drop, interpretation of cable supplier data tables and the impact of various installation methods. Selection of the appropriate cable installation route/method.	Critical
30.	**Demonstrate the ability to select cables for final subcircuits using AS/NZS 3000:2000 and AS/NZS 3008.1 based on current carrying capacity, short circuit capability, maximum demand, earth loop impedance and voltage drop.**	Application of maximum demand methods to calculate current requirements and ensure voltage drop is within specification, evaluation of the installation method.	Critical
31.	**Describe the control and protection requirements for installations and equipment. Demonstrate the ability to select suitable equipment and switchgear for a particular installation or part of an installation.**	Main board controls, sub-installation control and submain/final subcircuit controls. Assessment of the prospective short circuit current and operating current. Selection of equipment and suitable protection equipment to protect conductors and installed equipment. Inclusion of RCD's where required.	Critical

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
32.	**Demonstrate an understanding of the AS/NZS 3000:2000 and regulatory requirements for the location of switchboards and arrangement of switchboard equipment in installations**	Suitable locations for switchboards (eg well ventilated and dry) including personnel access requirements. Requirements for metering and equipment positions and the identification of switchboard equipment (and the switchboard).	
33.	**Demonstrate an understanding of the AS/NZS 3000:2000 and regulatory requirements for the installation of electrical equipment in given damp situations and wet areas.**	Damp zones and related equipment requirements. Assessment of the earthing requirements and wiring systems for damp and wet areas as per Section 7 of the AS/NZS 3000:2000 Wiring Rules.	Critical
34.	**Demonstrate the appropriate methods for the installation, modification and testing of electrical installations and equipment for construction and demolition sites, complying with AS/NZS 3012 and applicable workplace safety legislation.**	Assessment of supply requirements, final circuit protection and socket outlet requirements. Portable tool tagging requirements to AS/NZS 3760 and electrical installation testing requirements.	Critical
35.	**Demonstrate knowledge of AS/NZS 3000:2000 requirements for the installation of aerial conductors and underground wiring.**	Various types of aerial conductors and their application/installation methods. Assessment of underground and aerial conductor ratings and selection process. Underground cable installation systems.	Critical
36.	**Demonstrate a knowledge of the AS/NZS 3000:2000 requirements for electrical installations in hazardous areas and an awareness of the standards to which it refers (e.g. AS 2430, AS 2381.1).**	Basics as set out in AS/NZS 3000:2000, awareness of concepts and practices in specialised standards.	Critical
37.	**Demonstrate knowledge of the AS/NZS 3000:2000 requirements and the standards referenced for special electrical installations including emergency systems, and construction/demolition sites.**	Standards for special installations eg Movable premises, Caravan parks and Shows and Carnivals AS 3001, High Voltage Neons AS/NZS 3832, standards for the electrical installations of emergency systems and construction/demolition sites	
38.	**Describe and perform to AS/NZS 3000:2000 and AS/NZS 3017 standards the electrical checks and tests required to ensure electrical installations are safe.**	Tests to ensure the requirements of the Standards have been met, include: visual checks, testing energised and de energised circuits – earth continuity, insulation resistance, polarity test, fault loop impedance tests etc.	Critical

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
39.	**Demonstrate the reporting of test results for an electrical installation as typically required to satisfy regulatory requirements.**	Statutory documentation requirements and the practices necessary to achieve compliance.	
40.	**Demonstrate the knowledge and skill to perform effective safe isolation of any equipment, including switch and lock off, circuit isolation, equipment testing and tagging procedures.**	The sequential steps needed to achieve an isolated, tested and safe work area. Preparation of a written isolation procedure.	Critical
41.	**Describe the construction, specifications, colour coding and application of various types of cords and cables.**	Conductor material, stranding, colour coding, sheathing types and other construction parameters of cords and cables. Typical application examples of the various cable types and interpretation of cable manufacturers data.	
42.	**Demonstrate the skill to prepare and terminate cords and cables.**	Requirements for cable jointing and termination in a variety of installation situations and accessories.	
43.	**Demonstrate the Selection and attachment of electrical accessories, using appropriate fixing devices and methods.**	Various fixing devices, methods and the tools which may be used – need for safety whilst performing this work.	
44.	**Demonstrate the knowledge and skill to install and terminate a variety of electrical cables in a wide range of applications (including final subcircuits) to AS/NZS3000:2000.**	Installation requirements for a wide range of typically used electrical cables in a variety of situations: e.g. thermoplastic, elastomer sheaths, XLPE, high temperature cables. Separation from other services (and fire wall penetrations).	Critical
45.	**Demonstrate the knowledge and skills for the installation of wiring support systems**	Steel conduit, PVC conduit, ladder/perforated tray, trough/duct, including ratings, space, etc.	
46.	**Describe and perform the circuit tests required for electrical cables in a range of installations, with attention to the final subcircuit tests.**	Earth continuity, insulation resistance, fault loop impedance, polarity and correct circuit connection tests.	Critical
47.	**Instal final subcircuit wiring into switchboards and connect to switchboard equipment in accordance with AS/NZS 3000:2000 and local supply authority requirements.**	Termination of subcircuit cabling at switchboards and connection to components.	Critical

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
48.	**Connect consumers mains to an installation, in accordance with AS/NZS 3000:2000 and local supply authority requirements.**	Installation of consumers mains in buildings and underground. Termination at pillars, pits and mains connection boxes. Bonding of metallic meter enclosures.	Critical
49.	**Determine and apply AS/NZS 3000:2000 and AS/NZS 3008 requirements for the installing, terminating and testing of MIMS and Armoured cables. This is to include the cable type selection to AS2381 (or other standards) requirements.**	Assessment of cable ratings according to installation method and location. Installation and termination of MIMS and armoured cables and accessories and necessary tests.	
50.	**Determine and apply AS/NZS 3000:2000 requirements for the installing, terminating and testing of catenary supported cables, pendant-type socket outlets and trailing cables.**	Assessment of the requirements for installation of cables and accessories supported by catenary wire, techniques of installing trailing cables.	
51.	**Demonstrate ability to read, sketch and interpret electrical diagrams.**	Purpose and characteristics of schematic, block and wiring diagrams, typical symbols used.	Critical
52.	**Design and connect switching circuits, including via electronic logic controls, as per AS/NZS 3000.**	Lighting and equipment control circuits. PLCs at basic level. Other types of logic controllers (eg C Bus).	
53.	**Describe basic statutory occupational safety and health responsibilities for employers and employees, including supervisory requirements and employees' own "duty of care".**	Occupational Safety and Health regulations and electrical safety regulations - legal requirements, safety committees and duty of care.	Critical
54.	**Demonstrate understanding of the requirements for personal safety in the workplace including safe isolation and application of safety practices.**	Adoption of safe working practices, incident reporting process and responsibility to co- workers. Reference to safe electrical work guidelines issued by regulators, including supervision requirements applying to apprentices and trainees.	Critical
55.	**Describe a workplace safety check, identify potential workplace hazards and suggest measures for accident prevention.**	Workplace safety inspections. Reference to guidelines issued by both electrical safety regulators and general workplace safety regulators including the supervision requirements applying to apprentices/trainees..	

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
56.	**Demonstrate the knowledge and practices that are essential for working safely with electrical equipment and tools and knowledge of testing and tagging procedures to AS 3760.**	Testing and tagging procedures, common causes and prevention of electric shocks and incidents . Safe use of hand and power tools , including power actuated fastening devices, ladders, elevated work platforms, etc	
57.	**Describe the method of rescuing a person in contact with live electrical conductors or equipment.**	Fundamental principles of emergency procedures.	Critical
58.	**Describe the emergency first aid requirements for an electric shock victim and demonstrate the knowledge and application skill of EAR and CPR.**	Application and learning of EAR and CPR procedures to resuscitate and stabilise a victim. Use of fire extinguishers to control electrical fire at accident site.	Critical
59.	**Demonstrate knowledge and understanding of the significant dangers of High Voltage equipment and distribution systems.**	Step and touch voltages, induced voltages, creepage and clearance requirements. Stored energy and earthing requirements. The use of safe working procedures.	Critical
60.	**Describe the types of potential operational situations that may be encountered in various areas of industry, that will require assistance from more experienced industry personnel.**	Eg 1. The need to isolate and earth an item of equipment supplied at High Voltage, for repair or maintenance work. Eg 2. The need to sequentially shutdown and isolate a gas fired boiler in preparation for electrical maintenance.	
61.	**Describe the type of assistance that may be needed for operational situations that could be encountered in various areas of industry.**	Continuing the above examples Eg 1.Consulting experienced local operational personnel to obtain advice on H V Switching procedure and earthing arrangements. Eg 2. Consulting experienced personnel for the advice to shut down the boiler in a safe manner.	

	ESSENTIAL CAPABILITY	COMMENTS	Critical Item
62.	**Describe methods of commissioning and/or decommissioning electrical equipment or an installation, using a systems approach.**	Commissioning: Circuit voltage testing, phase rotation checks, systematic loading up, correct installation functioning and instrumentation/-control parameter checks. Decommissioning: Identification of all circuits, impact on other equipment, isolation, tagging, testing, securing and earthing where required, safe removal of equipment/ conductors.	Critical
63.	**Describe the functioning of basic electronic circuits used in common electrical power circuit applications including related hazards and safety requirements..**	Basic theory and measurement. Common applications are motor starters, lighting dimmers, inverters, line conditioners, smoke alarms, backup supplies, etc. Hazards and safety requirements associated with Static Electricity Discharge from components.	
64.	**Describe basic control techniques and diagnostic methods for simple DC motor control circuits and applications**	Understanding of concepts and basic applications in modern plant systems including motor interlocking safety issues.	
65.	**Demonstrate an understanding of the basic operation of various types of luminaires and the purpose of components and ancillary equipment including related hazards and their safety requirements.**	HP and LP discharge luminaires, fluorescent luminaires, filament luminaires etc. used in lighting systems together with their respective ancillary equipment and related hazards and safety requirements. Refer to AS/NZS 3000 4.3.6.1.	
66.	**Demonstrate the knowledge and skills for diagnosing and rectifying faults in electrical apparatus and associated circuits.**	Required for safe working practices with electrical systems and installations. All repairs must be compliant with the relevant standards. This item is crucial as all previous skills are utilised to effectively perform a fault find function.	Critical

Note 1: Under the Capstone Assessment covering the "critical" items, items 57 and 58 are expected to be covered only by a written assessment, although proper practical skill and knowledge will be expected to be developed during the course of training.

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