ENSURING THE
EXPERTISE TO GROW
SOUTH AFRICA

Electrical Engineering Code of Practice

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ECSA

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DEFINITIONS

In this Code of Practice, any word or expression defined in the Act has that meaning and, unless the context otherwise dictates.

Act means the Engineering Profession Act

Candidate means a person who is registered in terms of Section 19 (2) (b) of the Act.

Category of registration means the categories of registration provided for in Section 18(1)(a) of the Act, i.e. Professional Engineers, Professional Engineering Technologists, Professional Certificated Engineers and Professional Engineering Technicians.

Code of Conduct means the Code of Conduct for Registered Persons in terms of the Act

Council means the Engineering Council of South Africa established in terms of Section 2 of the Act.

Designer means the person undertaking work in relation to any structure, including drawings, calculations, design details and specifications.

Electrical engineer means a Professional Engineer registered in terms of 18. (1) (a) (i) of the Act who has experience specifically in the of sub-discipline of Electrical Engineering.

Electrical engineering technician means a Professional Engineering Technician registered in terms18. (1) (a)(i) of the Act who has experience specifically in the sub discipline of Electrical Engineering;

Electrical engineering technologist means a Professional Engineering Technologist registered in terms of 18. (1) (a)(i) of the Act who has experience specifically in the sub discipline of Electrical Engineering;

Electrical engineering work means Engineering Work identified specifically in the discipline of Electrical Engineering.

Engineering work means the work identified in terms of Section 26 of the Act.

Project Engineers means a registered person responsible for the management of the engineering work within a project and its technical aspects

Registered person means a person registered with the Engineers Council of South Africa in terms of the Act under one of the categories referred to in Section 18 and 19

Risk means the effect of uncertainty on the objectives of a design and is expressed in terms of a combination of the consequences of an event and the likely hood of occurrence.

Specialist work means Electrical Engineering Work that requires training, knowledge and

experience outside the normal education curriculum and beyond that which is obtained in the general practice of the profession.

The Code means this code of practice document.

ABBREVIATIONS

CoP	Code of Practice
ECSA	Engineering Council of South Africa
FAT	Factory Acceptance Test
Pr Cert Eng	Professional Certificated Engineer
Pr Eng	Professional Engineer
Pr Tech Eng	Professional Engineering Technologist
Pr Techni Eng	Professional Engineering Technician
QCP	Quality Control Plan
Reg Eng Tech	Registered Engineering Technician
SAT	Site Acceptance Test

1. INTRODUCTION

This Code of Practice has been developed by the Engineering Council of South Africa (ECSA) to supplement the Code of Conduct for Registered Persons: Engineering Profession Act, 46 of 2000.

Section 27 of the Engineering Profession Act (Act 46 of 2000) empowers the Council to draw up Codes of Practice in addition to code of conduct and requires all registered persons to comply with such codes. While Code of Conduct regulate behaviour, Codes of Practice regulate Engineering practice.

Section 18(1) of the Act provides for registration of professionals and candidates in four categories of registration, namely Engineers, Technologists, Technicians and Certificated Engineers. Section 18 (2) prohibits persons so registered from practicing in a category other than that in which they are registered.

In line with these requirements, this Code of Practice classifies Engineering Work in the discipline of Electrical Engineering in terms of its complexity and stipulates the category of registration and the level of competence required for the execution of such work.

The Code does not repeat the expected ethical values and professional standards which are found in the Code of Conduct and Overarching Code of Practice.

1.1 Scope and Application

1.1.1 The code:

a) applies to the discipline of Electrical Engineering and its sub-disciplines.
b) identifies specific Engineering Work within the Electrical Engineering field.
c) classifies Electrical Engineering Work according to the complexity of the work, its sensitivity with respect to public safety and environmental stewardship. It must be acknowledged that all electrical engineering work involves risk due to nature of the product (electricity) and the impact of its incorrect control.
d) sets out the level of competence required by persons registered in any of the categories of registration provided for in Section 18.1 of the Act for the performance of Electrical Engineering Work of varying complexity.

e) stipulates requirements for the practice of Electrical Engineering Work and provides a statement of recognized good practice.

1.1.2 Where a Code or Act is referenced the latest version thereof shall apply.

1.1.3 This Code does not regulate those activities conducted by engineering practitioners under the Pr Cert Eng registration category.

1.2 Purpose

1.2.1 In terms of the Standards Act no, 29 of 1993, "a code of practice is a description of -

a) the terminology to be used;
b) the method to be applied or the procedure to be followed;
c) the material to be used;
d) any other requirements to be met (e.g. competency) in connection with the execution in an orderly, systematic, practical, efficient, safe and effective manner of an act performed, with a view to achieving a stated purpose or obtaining a stated result."

1.2.2 The purpose of the code is to:

a) identify Engineering Work in the discipline of Electrical Engineering and to classify such work in terms of its complexity.
b) establish the appropriate level of competence required for the execution of various classes of Electrical Engineering Work; and
c) to make provision for and regulate the execution of Electrical Engineering Work by registered professionals in other fields.
d) set and reinforce technical and ethical standards for the execution of Electrical Engineering Work.

1.3 Legal Framework

This Code of Practice shall be read in conjunction with the Engineering Profession Act. 46 of 2000,the Code of Conduct , the Occupational Health and Safety Act – Electrical Regulations and all other relevant legislation.

2. ELECTRICAL ENGINEERING WORK

2.1 Identification and Classification of Electrical Engineering Work

Engineering work can be identified from the gazetted, Identification of engineering work regulations. In addition, there has been new additions under the current electrical engineering specializations due to the advent of new challenges in the electrical engineering field, these can be categorised as follows:

- Computer and Software Engineering
  - Big data engineer (e.g. Machine Learning, Data analytics, data security and privacy, etc)
  - Biometrics Engineer
  - Solution architect engineer
  - Internet of things engineer (e.g. Building automation, smart metering, power distribution systems)
  - Autonomous driving engineer
  - 3D printing engineer (e.g. additive manufacturing, etc)
  - Cyber and physical systems engineer
- Telecommunications Engineering
  - Cyber security

A high-level summary of the Electrical engineering work is shown in Table 1:

Table 1: Electrical engineering work

Characteristics	Types of work	Functions
• Theoretical experimental investigation and solving of problems • Analysis and design solutions to meet specific objectives • Application of knowledge and engineering technology, based on mathematics, basic sciences, information technology as well as specialist and contextual knowledge • Management of engineering works • Addressing the safety and environmental consequences and other impacts of engineering work	• Grid, hybrid and off-grid bulk power systems in the area of generation, transmission and distribution, including temporary and permanent back up power supplies • Bulk telecommunication systems in the area of transport to access technologies • End use of electricity in powering various utility services, such as water, sanitation, transportation and public lighting • End use of electricity in any other economic activity	• Feasibility and conceptual studies • Project definition and planning • Advising, reporting and auditing • design and development of electrical apparatus. • Manufacture and construction, • Operation and maintenance of materials, components, plant and systems for generating, transmitting, distributing and utilizing electrical energy, electronic devices, apparatus and

- Exercising judgment and taking responsibility for engineering work
- Conducting research and developing new or improved theories and methods related to electrical engineering
- Advising and designing systems which generate, transmit and distribute electrical power
- Supervising, controlling, developing and monitoring the operation and maintenance of electrical generation, transmission and distribution systems
- Conducting research and developing new or improved theories and methods
- related to electronics engineering;
- advising on and designing electronic devices or components, circuits, semiconductors and systems;
- supervising, controlling, developing and monitoring the operation and maintenance of electronic equipment and systems
- establishing control standards and procedures to ensure efficient functioning and safety of electronic systems and equipment;
- designing electronic circuits and components for use in fields such as aeronautical guidance and propulsion control, acoustics or instruments and control;
- developing apparatus and procedures to test electronic components, circuits and systems;
- designing, specifying and implementing Control and Instrumentation of plant and processes;
- designing, specifying, control and monitoring of equipment for fire and safety in plant and factories; such as mining, industry and commerce
- Electrical engineering opinions
- Electronic Fire Alarms systems
- Fire Suppression Systems
- Emergency Evacuation systems
- Communications between the above and control / command / response utilities
- Any other work related to the application and use of electricity

control systems, biomedical and consumer products and process

- Specifying and performing tests, research and development
- specifying Instrumentation, measurement and control of equipment for the monitoring and control of electrical generation, transmission and distribution systems;
- advising on and designing systems for electrical motors, electrical traction and other equipment or electrical domestic appliances;
- specifying electrical installation and application in industrial and other buildings and objects;
- establishing control standards and procedures to monitor performance and safety of electrical generating and distribution systems, motors and equipment;
- determining manufacturing methods for electrical systems as well as the maintenance and repair of existing electrical systems, motors and equipment;
- design and development of electrical apparatus.
- Preparation of tender and / or working drawings;
- Provision of information for the design of services
- Preparation of specifications and schedule of quantities
- Cost estimates, capital and life cycle costs, financial
- implications and works programmes
- Draft tender documentation and tender strategies;

• robotics and process control of manufacturing plant; • advising on and designing telecommunications devices or components, systems, equipment and distribution centres; • supervising, controlling, developing and monitoring the operation and maintenance of telecommunication systems. networks and equipment; • determining manufacturing methods for telecommunication systems as well as the maintenance and repair of existing telecommunication systems, networksand equipment; • planning and designing communications networks based on wired, fibre optical and wireless communication media;		• Advise on contractors and calling for tenders • Procurement and tender adjudication • Contract administration, coordination and construction monitoring; • Management of safety risk and maintenance of electrical engineering solutions; • Communication of the impacts and outcomes; • Education, training and mentoring of engineering personnel

2.2 Risk Response

Risk and impact mitigation must include the probability and impact of all the risks connected with the project. The focus areas of the project must be indicated on a risk matrix. Mitigation must include the time of mitigation and the person who is responsible. Solutions shall include a Plan A and a Plan B. The Risk document must be a live document through the life cycle of a project and must include the following:

- Technical risk
- Environmental risk
- Quality risk
- Commercial risk (Late or wrong deliveries of equipment)
- Schedule risk
- Social risk
- Construction risk

Registered Persons must implement quality and risk management systems covering all aspects of their work, appropriate to the nature of the work and the size of the organisation. Quality and risk management systems must be reviewed on a regular basis. Compliance with the system shall be audited at least annually. Organisations undertaking Engineering Work should consider external certification, such as ISO 9001 and ISO 14001.

2.3 Implementation & Commissioning

Project Engineers must install, test and commission the necessary equipment or system for the desired result with compliance to appropriate standards and regulations. This process must include all actions taken during construction (quality). This can refer to a project quality plan.

3. ELECTRICAL ENGINEERING COMPETENCIES

3.1 Work Within Area of Competency

Electrical engineering practitioners, depending on the tertiary education, training and experience, category of registration and recognition by the profession, function at one of two distinct levels as indicated in **Table 2**.

Electrical engineering practitioners shall perform duties within the professional category limitations specified in the Identification of Engineering Work (Government Gazette No. 44333).

Table 2: Competence levels of electrical engineering practice

Level	Designation	Typical characteristic of the practitioner	Risk associated with work done
1	Candidate	Person who has a tertiary education qualification in electrical engineering and works under supervision and mentorship of person(s) who meet the requirements stated in document R-04-T&M-GUIDE-PC/SC	Low risk
2	Registered professional in Electrical engineering	Person registered with the Engineering Council of South Africa as a Professional Engineer or Professional Engineering Technologist or Professional Engineering Technician in the electrical engineering discipline as stated in document R-05-ELE-PN/PT/PE	Medium to High risk

It is accepted that due to the varying nature of an electrical engineering service, rigid boundaries are not applicable, but the experienced electrical engineering practitioner would recognise the appropriate competence level required.

3.2 Category of Work for Competency

The level of practitioner assuming responsibility for electrical work is linked to the category of risk as defined in **Table 3**.

Table 3: Categories of risk

Category of electrical work	Level of risk	Illustrative nature of electrical engineering work
1	Low	Simple electrical engineering solutions with low electrical safety and serviceability performance requirements where the analysis requires a simple application of design rules or direct interpretation of reference guidelines
2	Medium	Electrical engineering solutions with moderate to challenging electrical safety and serviceability performance requirements where the design approach involves either a process of: • reasoning and calculation based on the application of standards, or • reasoning, calculation and consideration of accepted analytical principles, based on a combination of deductions from available information, research and data, appropriate testing and service experience
3	High	Electrical engineering solutions with challenging electrical safety and serviceability performance requirements that require specialist skills, recognised expertise or knowledge beyond that required for category 2

3.3 Levels of Competency

The levels of competence required for electrical engineering practitioners and a career path to achieving these levels (see also **Annexure A**) is indicated in **Figure 1**.

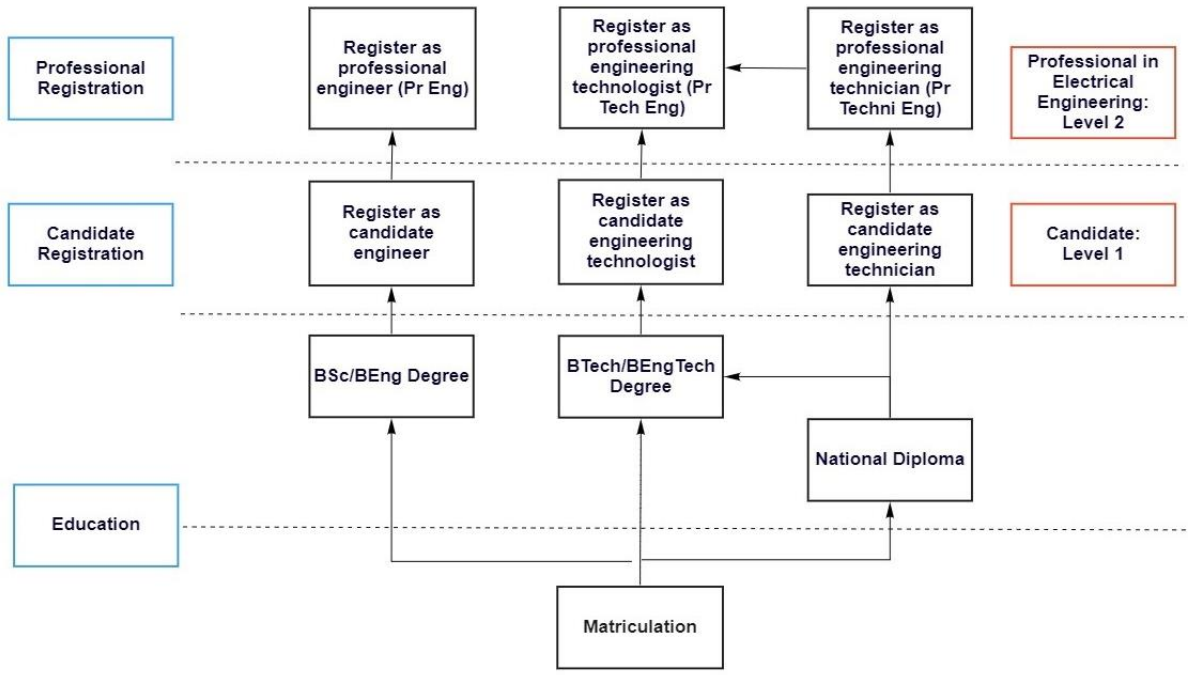

Figure 1: Levels of competence required to practice electrical engineering

3.4 Competencies required for identified critical electrical engineering systems

The following electrical engineering systems are designated as critical electrical engineering systems, thus, those that may have high risk and high consequences on public, health and environment.

3.4.1 Power systems – bulk generation, bulk transmission and distribution, end-use; back-up systems.

3.4.2 Telecommunications – electronic communication networks and systems, broadcast technologies

3.4.3 Utilities – emphasize water services, health systems, transportation

The functions (as per Table 1) associated with the activities in clauses 3.4.1, 3.4.2 and 3.4.3 shall only be approved/certified/supervised by Registered Persons who possess expanded competencies for the critical electrical engineering systems.

3.4.4 General electrical competencies

Every electrical installation has inherent risk. As a result, all electrical engineering work that is not indicated in 3.4.1, 3.4.2 and 3.4.3 shall be supervised by a registered practitioner.

3.5 Misrepresentation of Competence

Electrical engineering practitioners shall execute electrical engineering work in accordance with the provisions of the ECSA's Code of Conduct. In particular, they shall conduct work within their area of competence.

3.6 Development of Knowledge, Skill and Expertise

Electrical engineering practitioners shall continue to develop knowledge, skill and expertise in accordance with ECSA's Standard for Continuing Professional Development (**ECPD-01-STA**).

4. ELECTRICAL ENGINEERING GOOD PRACTICE

4.1 Design Requirements

The design of electrical engineering solutions shall be performed by, or under the direction, control and supervision of a Registered Person who needs to accept responsibility for the design. The full scope of the client requirements shall be agreed and documented as part of the design package and alternative solutions considered. The selected solution shall clearly demonstrate meeting of client requirements in a safe, effective and cost-efficient way to ensure adherence to reliability, availability, maintainability and safety requirements.

4.2 Design Process

The engineering design process is a series of steps to be followed by engineers in creating functional products and processes and solving problems. These steps include the following:

- Define the problem
- Research the problem and specify requirements
- Develop possible/alternative solutions
- Evaluate and choose best solution
- Develop and Prototype solution
- Test and Evaluate Solution
- Communicate Results (and redesign if needed)

A typical final design package when the correct design process is followed shall include design calculations (including simulations), drawings, test procedures and results, and other relevant technical documentation such as User Requirements and Specifications.

The design standards, specifications and related publications used in a design shall be communicated and agreed with the client. All designs shall conform to relevant Acts, design codes and regulations.

4.2.1 Design calculations and simulations

Formal calculations shall be prepared for all electrical engineering solutions. Calculations shall be recorded on calculation sheets or downloaded from a computer simulation tool to form part of a design report. For manual analysis, all analysis calculations shall be shown together with the results of the analysis, e.g. node voltage, load current or fault level.

General information or data to be indicated on calculations and simulations includes:

- Name of client or owner.
- Project title.
- Title of electrical engineering design under consideration.
- Name of person who carried out the calculations and date undertaken.

- Name of person who reviewed the calculations and date reviewed.
- Project number or calculations file number.
- Calculation sheet number and revision number.
- Software name and version, data file name and location.
- Sketch defining electrical computer model, e.g. node numbers, element numbers, member releases, etc;
- Summary of all computer input, e.g. load cases and load combinations considered; and
- Summary of computer output analysis results, node voltage, load current or fault level.

4.2.2 Design drawings

Design drawings shall show all information required for implementation, application and/or installation and shall be checked prior to issuing. Appropriate requirements such as earthing or protection requirements shall be included. The responsible electrical engineering practitioner shall approve all design drawings of electrical engineering solutions.

General information or data to be indicated includes:

- Name of the responsible electrical engineering practitioner; and
- Name and address of the consulting firm responsible for electrical design.
- All symbols and units used shall be consistent with the symbols used in the particular code of practice or standard being used.

4.2.3 Design Testing

Any tests required for electrical systems design purposes (including Prototype, Functional Tests or FAT where required), shall be stated and communicated to the contractor and or client for execution. Test results and other relevant data shall be filed with the calculations or overall design package.

4.2.4 Design documentation approval and preservation

Approval of designs means that the design is complete and complies with the required standards, specifications and legislation in terms of safe operation, loading adequacy, fault level withstand and that the design is fit for the intended purpose.

Approval of a design drawing/illustrative model means that the drawing/model is complete, that the drawing/model conforms to the design and that the electrical content of the drawing/model is correct.

Irrespective of client requirements regarding the retention of design information, all design drawings, calculations, computer print-outs, test results, test certificates, etc. shall be retained in a form easily retrievable for a period not less than that specified by the Engineering Council of South Africa or relevant legislation. Data shall be stored electronically in a recognised international format.

Should there be a need to review the approved documents, the designer shall adhere to the process implemented to ensure that all changes are done, accepted, and communicated to all relevant parties in good time.

4.3 Quality and Maintenance of designs

4.3.1 Quality of designs

The designer shall take all reasonable steps for quality control, to generally ascertain that the electrical engineering solutions implemented or installed on site comply with the design. This quality control is not limited to the actual site only, but also needs to include any manufacture/ pre-assembly and assembly work completed.

It is recommended that a quality control plan (QCP) be instituted by the contractor and approved by the designer, which provides for not only conforming to all the requirements of the design, but also to the requirements of the codes and or relevant specifications that the contractor is expected to satisfy. The steps shall be signed off by the contractor as having been correctly completed and overviewed by the engineer for important issues.

Should the designer not be satisfied with the arrangements regarding quality control instituted

on site, this shall be raised with the contract manager (if work is external) and, where applicable and necessary, with the client. Should the quality control on site remain unsatisfactory, the designer shall not sign off any work.

The designer, if satisfied that the electrical engineering solutions have been implemented and installed in accordance with the requirements of the design, shall certify that the electrical engineering solutions have been commissioned according to relevant standards and a certification of completed works issued.

4.3.2 Maintenance of designs

Maintenance requirements shall be defined and clarified by designer and client. This refers to both preventative and corrective maintenance types. As per Regulations issued in terms of the Occupational Health and Safety Act, an obligation is placed on all plant owners to ensure that the electrical engineering solutions are safe for continued use and are inspected regularly.

Should there be a risk or hazard identified, relevant parties shall be notified, and recommended actions communicated.

4.4 Obligations to Society

Any electrical engineering work carried out shall adhere to the following:

- Social, environmental and other possible consequences
- Honesty(Truth and objectivity), integrity and fairness without discrimination
- Health, welfare and community safety
- Effects on the natural environment
- Conflicts of interest
- Confidentiality

The engineering work shall adhere to legislation and recognized standards in executing engineering work which include among others the following Acts as amended:

- Engineering Profession Act 46 of 2000
- Occupational Health and Safety Act, 85 of 1993
- National Building Regulations and Building Standards Act, 103 of 1977
- National Environmental Management Act, 107 of 1998
- Employment Equity Act, 55 of 1998.
- Basic Conditions of Employment Act 7 of 2018

All Engineering Work must be carried out in accordance with the norms of the profession. Such norms are generally represented by national and international standards, industry standards, codes of practice and best practice guidelines. An electrical engineering practitioner shall assess any deviation from recognised standards or work beyond the scope of such standards in terms of sound engineering and scientific fundamentals.

5. INTERPRETATION AND COMPLIANCE

5.1. Interpretation

The word “shall” indicates a peremptory provision.
The word “should” indicates a provision directive or informative in character, requiring substantial compliance only.
The word “they” in its singular form, or its derivative forms “their/them” are pronouns used for gender neutrality.

5.2 Compliance

Failure to comply with a peremptory provision of this CoP constitutes improper conduct in terms of the Act.
Failure to comply with a directive or informative provision of this CoP may constitute improper conduct in terms of the Act if its consequences are significant.

6. ADMINISTRATION

The Council shall be responsible for the Administration of this code of practice, including its publication, maintenance and distribution.

The Council shall ensure that the Code of Practice and all amendment there to are available on the ECSA Website and shall upon request, provide a copy thereof.

The Council shall take all reasonable steps to introduce the Code of Practice to the general public.

REVISION HISTORY

Revision Number	Revision Date	Revision Details	Approved By
Rev 0 Draft 1	21 September 2021	New Document	RPS & Working Group
Rev 0 Draft 2	24 November 2021	Comments	Code of Practice Steering Committee
Rev 0 Draft 3	14 December 201	Incorporation of received comments	RPS & Working Group
Rev 0 Draft 4	17 January 2022	Review	ERPS
Rev 0 Draft 5	27 January 2022	Revision of Level 3 on Figure: 1	RPS & Working Group
Rev 0 Draft 6	01 February 2022	Recommendation for approval	Code of Practice Steering Committee

The Code of Practice for:

Electrical Engineering

Revision 0 dated 09 February 2022 and consisting of 21 pages has been reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research Policy and Standards **(RPS).**

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Business Unit Manager Date

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Executive: **RPS** Date

This definitive version of this policy is available on our website.

REFERENCES

Engineering Council of South Africa. Rules of Conduct for Registered Persons Engineering Profession Act, 2000. Board Notice 256 of 2013. Government Gazette No. 37123 of 13 December 2013.

Standards Act no, 29 of 1993

Code of practice for registered professional engineers, Board of professional engineers of Queensland, 29 November 2013

Board notice: 21 of 2021, Identification Of Engineering Work Regulations, No 44333, Government Gazette, 26 March 2021

Board notice 20 of 2021, Overarching Code of Practice for the Performance of Engineering Work, No 44333, Government Gazette, 26 March 2021

ECSA Road Map for drafting The Code Of Practice, REVISION 1: 29 January 2019

Framework for development of ECSA Codes Of Practice Revision 1: 29 January 2019

Structural Engineering Code of Practice

Geotechnical Engineering Code of Practice

R-05-ELE: Discipline Specific Training Guide for Registration as a Professional Engineer in Electrical Engineering (Section 6.3)

ECSA professional development model
https://www.ecsa.co.za/prodevelopment/SitePages/Development%20Process.aspx

Competency standard overview (R-08-PE/PT/PN/PCE) (R-02-PE/PT/PN/PCE)

Annexure A: Suggested minimum competence levels to undertake types of electrical work

The suggested minimum competence levels to undertake categories of electrical work are indicated in Table A1.

Table A1: Competence levels required to undertake categories of electrical work

Type	Category of infrastructure (see Table 3)	Competence level (see Table 2)		
		2	3	4
Main and back-up power supply systems (grid, hybrid and off-grid)	3			•
	2	•	•	•
	1	•	•	•
Telecommunication systems	3		•	•
	2	•	•	•
	1	•	•	•
Electrical systems supplying key utilities	3			•
	2		•	•
	1	•	•	•
Electrical systems supplying other systems	3			•
	2		•	•
	1	•	•	•
Electrical systems deployed in explosive environments	3		•	•
	2	•	•	•
	1	•	•	•
	2	•	•	•
	1	•	•	•
Mining electrical engineering solutions	3		•	•
	2	•	•	•
	1	•	•	•
Lifting electrical engineering solutions and operations	3		•	•
	2	•	•	•
	1	•	•	•
	2	•	•	•
	1	•	•	•
Electrical engineering opinions	3		•	•
	2	•	•	•
	1	•	•	•
Temporary electrical engineering solutions	3			•
	2		•	•
	1	•	•	•
	2		•	•
	1	•	•	•

Note 1: Competence Level 1 (candidates) is not shown in Table A1 as such persons are required to work under supervision and control from an appropriately registered person.

Note 2: Registered engineering technicians may not assume responsibility for a category 2 structure as a whole.