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Discipline Specific Training Guide for Registration as a Professional Engineer, Technologist and Technician in Electrical Engineering

R-05-ELE-PE/PT/PN

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ECSA

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INTRODUCTION

All persons applying for registration as a Professional Engineer, Technologist and Technicians are expected to demonstrate the competencies specified in document **R-02-STA-PE/PT/PN** through work performed at the prescribed level of responsibility, irrespective of the candidate's discipline.

Training and Mentoring Guide for Professional Categories (document **R-04-T&M-GUIDE-PC**) provides key aspects of training, which are:

- duration of training and length of time working at level required for registration
- principles of planning, training and experience
- progression of training programme
- documenting training and experience
- demonstrating responsibility.

It is therefore important to standardise the framework for all engineering disciplines to ensure that all ECSA registration categories are aligned.

DEFINITIONS

Applicant: A person applying to the ECSA for registration in any of the category as per section 18 of the Engineering Professions Act 46 of 2000.

Commitment and Undertaking: An agreement entered into between an employer and ECSA under which the employer commits to the training of candidates to the standard required for registration in an identified Professional Category. A C&U may be entered into for one or more of the Professional Categories.

Competency Assessment: A summative assessment of an applicant's competence against the prescribed standard based on evidence from the applicant's work and other assessments that include a Professional Review.

Competency Standard: Statement of competency required for a defined purpose.

Engineering problem: A problematic situation that is amenable to analysis and solution using engineering sciences and methods.

Engineering science: A body of knowledge based on the natural sciences that uses mathematical formulation where necessary, which extends knowledge and develops models and methods to support its application, to solve problems and provide the knowledge base for engineering specialisations.

Ill-posed problem: Problems for which the requirements are not fully defined or may be defined erroneously by the requesting party.

Integrated performance: An overall satisfactory outcome of an activity requires several outcomes to be satisfactorily attained. For example, a design requires analysis, synthesis, analysis of impacts, checking of regulatory conformance and judgement in decisions.

Level descriptor: A measure of performance demands at which outcomes must be demonstrated.

Mentor: A professionally registered person who guides the competency development of a candidate in an appropriate category.

Outcome: A statement of the performance that a person must demonstrate to be judged competent at the professional level.

Practice area: A generally recognised or distinctive area of knowledge and expertise developed by an engineering practitioner by virtue of the path of education, training and experience followed.

Range statement: The required extent of or limitations on expected performance stated in terms of situations and circumstances in which outcomes are to be demonstrated.

Supervisor: A person who oversees and controls engineering work performed by a candidate.

ABBREVIATIONS

BEng	Bachelor of Engineering
BSc Eng	Bachelor of Science in Engineering
BTech (Eng)	Bachelor of Technology in Engineering
B Eng (Tech)	Bachelor of Engineering in Technology
DSTG	Discipline-specific Training Guide
CPD	Continuing Professional Development
C&U	Commitment and Undertaking
ICASA	Independent Communications Authority of South Africa
IEA	International Engineering Alliance
ECSA	Engineering Council of South Africa
ICT	Information Computer Technology
JBCC	Joint Building Contract Committee
MEng	Master of Engineering
NDip	National Diploma
NEC	New Engineering Contract
NRS	National Rationalised Specifications
PE	Professional Engineer
PGDip	Postgraduate Diploma
PN	Professional Engineering Technician
PT	Professional Engineering Technologist
SABS	South African Bureau of Standards
SANS	South African National Standard

TERs	Training and Experience Reports
TES	Training and Experience Summary
VA	Voluntary Associations
VIP	Value Improved Practices

BACKGROUND

The illustration below defines the documents that comprise the Engineering Council of South Africa (ECSA) system for registration in professional categories. The illustration also locates the current document.

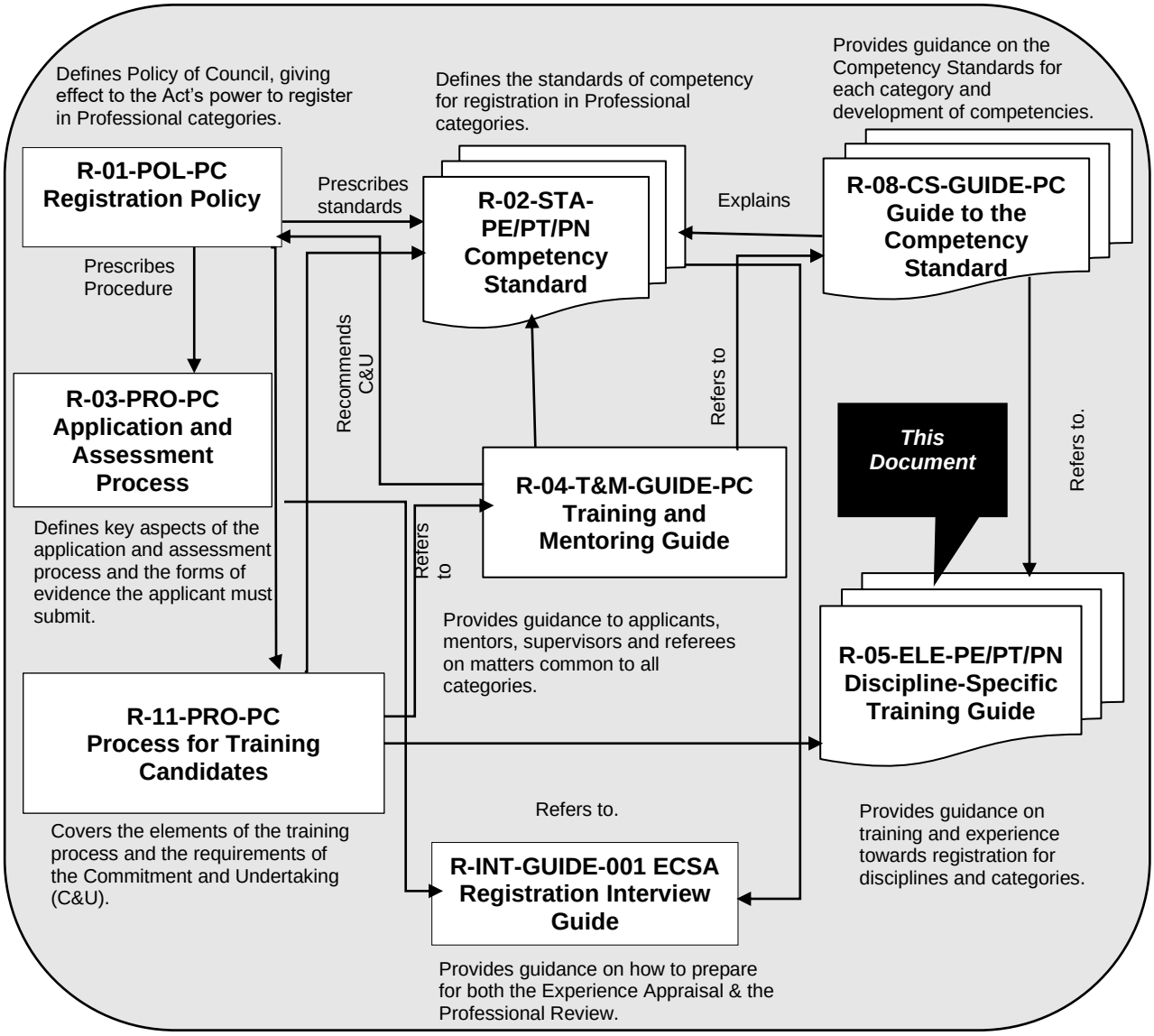

Figure 1: Documents defining the ECSA registration system

1. PURPOSE OF THIS DOCUMENT

This document provides a discipline-specific training guideline, outcome-by-outcome, for candidate Electrical Engineers, Technologists and Technicians or any other person who intends to register as a Professional with ECSA in the respective discipline.

This document must be read in conjunction with the following:

- *Policy on Registration in Professional Categories* (document **R-01-POL-PC**)
- *Processing of Applications for Registration of Candidates and Professionals* (document **R-03-PRO-PC**).
- *Training and Mentoring Guide for Professional Categories* (document **R-04-TM-GUIDE-PC**)

2. AUDIENCE

The Discipline-specific Training Guide (DSTG) is directed towards applicants, including their supervisors and mentors in the discipline of Electrical Engineering, which comprises Electrical Power Engineering, Electronic Engineering, Telecommunications Engineering and Alternative Energy Engineering, such as Renewables and Energy Efficiency.

These specialist areas are further defined as:

- **Electrical Power Engineering** encompasses electrical systems, components, motors and equipment, as well as electrical engineering materials, products and processes.
- **Electronic Engineering** covers electronic systems and electronic engineering materials, products and processes.
- **Telecommunications Engineering** encompasses the design, construction and management of systems that carry out the transmission, processing and storage of information as electrical or optical signals and the control services based on this capability.
- **Alternative Energy Engineering** encompasses the design, construction and management of systems that carry out the generation, transmission and processing of alternative sources of electrical energy, such as renewables as well as management thereof.

The guide is intended to support the applicants training programme in gaining experience through incorporating elements of good practice also indicated in the **R-02-COP-ELE**: Code of Practice for the Performance of Electrical Engineering Work.

The guide applies to persons who:

(a) have registered with ECSA as a Candidate Engineer, Technologist or Technician

(b) hold an ECSA accredited qualification or acceptable combination of accredited qualifications prescribed for the category

(c) through ECSA educational qualification evaluation or assessment, have met the minimum educational in a specific category

(d) have qualifications recognised by the Washington, Sidney and Dublin Accords where ECSA is a signatory thereof

(e) hold a qualification or combination of qualifications recognised under an international academic agreement relevant to the category; or

(f) hold a qualification or combination of qualifications that have been determined on a case-by-case evaluation to satisfy criteria for substantial equivalence to an accredited qualification for the category by virtue of:

- the qualifications being awarded in a jurisdiction, or a quality assurance system by ECSA; or
- examination of detailed documentation on the qualifications reflecting substantial equivalence.

2.1 Persons registered with ECSA as a candidate

Candidate engineering practitioner refers to persons registered with ECSA after completing the relevant engineering undergraduate programme accredited or substantially assessed to be equivalent by ECSA. The training and development can be done under a Commitment & Undertaking (C&U) candidacy programme as per document **R-11-PRO-PC** or through the training academies programme as outlined in document **A-01-POL**.

The training under C&U or training academies is structured to align with the ECSA standard competency outcomes for the benefit of the candidate. The professional mentor, supervisors,

coach and the candidate must ensure that the training covers all developmental aspects aligned with the competency outcomes required for registration as a professional.

2.2 Persons not registered with ECSA as a candidate

Regardless of the training development path followed by any individual, all persons wishing to register with ECSA must present the same evidence of having met the ECSA-prescribed competency standard when assessed. Application for registration as a professional in a specific category is accepted without being registered as a candidate Engineer, Technologist or Technician, or without training through a C&U candidacy programme or through training academies. However, mentorship and adequate supervision are critical in ensuring effective development towards achieving the competencies required for professional registration.

If the trainee's employer does not offer C&U, the trainee must establish the level of mentorship and supervision the employer is able to provide and in the absence of an internal mentor, the services of an external mentor should be secured. The discipline specific Voluntary Association (VA) recognised by ECSA may be consulted to assist the trainee with an external mentor. A mentor must be familiar with of all expected stages of the training development process as well as ECSA's registration requirements.

It should be noted that the DSTG is intended to assist graduates who are still gaining work experience and knowledge towards professional registration. Experienced persons wishing to register as a professional may apply this guide retrospectively to identify possible gaps in their respective training and development.

Document **R-08-CS-GUIDE-PE/PT/PN** adequately describes what is expected of individuals whose formative developments have not followed conventional paths, for example, academics, researchers and specialists.

3. TYPE OF ENGINEERING WORK

Electrical engineering practitioners perform functions like investigating plant failures, planning, design and construction of plant, operation and maintenance of plant and materials, urban and rural development reticulation, commissioning of electrical networks and plants, as well as electrical reticulation of buildings. The field of Electrical Engineering also encompasses electronic

devices, apparatus and instrumentation and control of processes for industrial systems together with biomedical devices, robotics and consumer products. New technologies in Electrical Engineering have introduced new categories as follows:

- Big Data Engineering Practitioner
- Biometrics Engineering Practitioner
- Solution Architect Engineering Practitioner
- Internet of Things Engineering Practitioner
- Energy Efficiency Engineering Practitioner
- Renewables Engineering Practitioner
- Intelligent Transport Driving Engineering Practitioner
- Autonomous Driving Engineering Practitioner
- 3D Printing Engineering Practitioner
- Cyber Security and Physical Systems Engineering Practitioner.

Electrical engineering practitioners must have a strong understanding of mathematics, physics and data science, as well as excellent problem-solving skills and attention to detail. They work in a variety of industries, including telecommunications, power generation and distribution, electronics, building services and manufacturing, among others. The education, training and experience will determine the category in which a candidate can register and what type of engineering problems they can solve. These practitioners can register in one of the categories within the electrical engineering discipline.

- Professional Engineer – solves complex engineering problems and performs complex engineering activities.
- Professional Engineering Technologist – solves broadly defined engineering problems and performs broadly defined engineering activities.
- Professional Engineering Technician – solves well-defined engineering problems and performs well-defined engineering activities.

The characteristics and details of each level descriptor can be found in the competency standard for registration **R-02-STA-PE/PT/PN** that defines the competencies required for each category.

4. DEVELOPING ENGINEERING COMPETENCIES: DOCUMENT (R-08-CS-GUIDE-PE/PT/PN)

4.1 Training for registration as a Professional Engineer

4.1.1 Define, investigate and analyse complex engineering problems (Responsibility Level E)

As per the ECSA outcomes, engineers are expected to be able to define, investigate and analyse complex engineering problems by identifying systems and sub-systems in resolving complex problems, using data and information technologies where applicable. The complex engineering problem may be defined as a design requirement, an applied research and development requirement or a problematic situation in an existing component, system or process. The investigation and analysis require in-depth fundamental and specialised engineering knowledge, including the collection, organising and evaluation of the information from all applicable sources, including investigation where appropriate. The work typically includes the research, planning, design, manufacturing, commissioning and installation of electronic, electrical and telecommunications complex systems and electrical equipment.

As an example, engineers could conduct research and advise on the design and direct the construction and the operation of electrical systems and components. They would advise on and direct the functioning, maintenance and repair of equipment and study, and advise on technological aspects of electrical engineering materials, products and processes.

The typical tasks may include:

- conducting research and developing new or improved theories and methods relating to the area of speciality
- advising on and designing electronic components or power stations and systems that generate, transmit and distribute electricity
- specifying the instrumentation, measurement and control of equipment for monitoring and control of systems
- supervising, controlling, developing and monitoring the operation and maintenance of electrical systems

- advising on and designing systems for electrical motors, electrical traction and other equipment such as electrical domestic appliances
- specifying electrical installation and application in industrial structures 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 and maintaining and repairing existing electrical systems, motors and equipment
- designing electronic circuits and components for use in fields such as aerospace, guidance and propulsion control, acoustics or instruments and controls
- researching and advising on radar, telemetry and remote-control systems, microwaves and other electronic equipment
- designing and developing signal processing algorithms and implementing these through appropriate choice of hardware and software
- controlling robotics and processes of manufacturing plants
- increasing energy efficiency and management of systems.

4.1.2 Design or develop solutions to complex engineering problems (Responsibility Levels C and D)

The engineering design of the solution to a complex engineering problem includes having a detailed requirements specification that aligns with the design required and having potential solutions or methods to be used to approach and resolve the complex problem. The preferred option or way forward is influenced by factors that best fit the solution, taking into consideration cost, practicability, innovation and impact, if any, outside the requirements.

4.1.3 Contextual knowledge (Responsibility Level E)

Applicant engineers should be able to provide evidence that they comprehend and have mastered the engineering principles and technologies for their practice areas and that they apply first-principle analytical thinking in demonstrating this competency for the associated complex programme. This includes the application of fundamental principles, practices, sounds testable assumptions or previously encountered techniques the candidate has used to solve the problem.

The theoretical knowledge gained from completing an BEng/BSc degrees should also be applied, as well as knowledge of applicable engineering standards, codes of practice, legislation and regulations.

4.1.4 Engineering project management (Responsibility Level D)

The area in which Electrical Engineers work generally follows the conventional stages of the life cycle of the project or product as follows:

- Research and development of new products or systems, advancement of solutions to system problems or system obsolescence.
- System or product design to establish a new system or product, solve system or product problems, achieve a particular desired result or select equipment for a particular purpose.
- Operation, maintenance and support of the system, network or product.
- Project Engineering to install, test and commission the necessary equipment or system to achieve the desired result.
- Decommissioning the system or network.

A schema, presented in **APPENDIX A: TRAINING ELEMENTS**

, indicates the functions in which a candidate should be competent when carrying out the various phases of a project. The functions include:

- solving problems based on engineering and contextual knowledge
- implementing and operating engineering projects, systems, products and processes
- mitigating risk and impact
- managing engineering activities.

These functions are aligned to the overall competency of the outcomes expected from the applicants. In addition, applicants must state the requirement of the project in terms of delivery, refer to the initial production requirements for the project and state whether they obtained results and if not, why they were unsuccessful.

4.1.5 Professional communication (Responsibility Level C)

Other than technical skills, engineers are expected to work on their communication skills to communicate clearly with others in the course of their engineering activities. This entails clearly demonstrating the ability to write clear, concise, effective, technically, legally and editorially correct reports using a structure and style that meets communication objectives and user/audience requirements.

Applicants are also expected to issue clear instructions to subordinates using appropriate language and communication aids, ensuring that language and other communication barriers are overcome. They are also required to make oral presentations using structure, style, language, visual aids and supporting documents appropriate to the audience and purpose.

4.1.6 Impact of engineering activities and risk mitigation (Responsibility Level B)

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 responsible. Solutions should 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:

- technical risk
- environmental risk
- quality risk
- commercial risk (late or wrong deliveries of equipment)
- schedule risk
- social risk
- cultural risk
- construction risk.

4.1.7 Statutory and regulatory requirements (Responsibility Level E)

Applicants are expected to have, as a minimum, a working knowledge of the following regulations and Acts and an understanding of how these legislation affects their working environment:

- Engineering Profession Act, 46 of 2000, including the ECSA rules and Code of Conduct
- Occupation Health and Safety Act, 85 of 1993 as amended by Act 181 of 1993 (latest revision used)
- Wiring Code – SANS 10142
- Building Regulations – National Building Regulations and Building Standards Act, 103 of 1977) as amended by Act 49 of 1995, SANS 10400
- Factory Regulations
- Machinery and Works Regulations
- Labour Relations Act, 66 of 1995
- Environment Conservation Act, 73 of 1989 as amended by Act 52 of 1994 and Act 50 of 2003
- Mine Health and Safety Act, 29 of 1996
- Industry-specific work instructions and specifications
- South African National Standard (SANS) applicable specifications.

Other Acts not listed here may also be pertinent to an applicant's work environment. Applicants are expected to have a basic knowledge of the applicable Acts.

4.1.8 Conduct engineering activities ethically (Responsibility Level E)

Candidates are expected to conduct themselves in an ethical manner, always demonstrating professionalism during the course of their engineering activities. This includes having the ability to identify ethical problems and unethical behaviour, and solutions to such problems. Unethical behaviour may be in the form of fraud, corruption, maladministration or illegal activities.

In addition, applicants should have knowledge of the ECSA Code of Conduct with an understanding of how it relates to their area of practice. Attention to the health and safety of persons, area of competency, truth, integrity and honest behaviour is of paramount importance.

4.1.9 Exercising engineering sound judgement (Responsibility Level E)

Engineers are expected to exercise sound judgement during the course of engineering activities by considering several factors based on consequences they foresee and the regulatory requirements, such as policies and standards.

Applicants are therefore expected to demonstrate this competency by evaluating a situation in the absence of full evidence presented to them. The requirement is that engineers thoroughly investigate, analyse, identify several factors and understand the risks associated with certain decisions.

4.1.10 Responsibility in decision-making (Responsibility Level E)

Having the contextual knowledge and operating on Level E of degree of responsibility affords candidates an opportunity to demonstrate how they were able to make decisions and take on responsibility for significant parts of one or more complex engineering activities. Seeking advice or guidance from the relevant superiors will assist applicants in making informed decisions and assuming responsibility for those decisions.

4.1.11 Professional development (Responsibility Level D)

The following list of formal learning activities is by no means extensive or comprehensive; it is simply a sample of useful courses.

- Project management
- Conditions of Contract / Value Engineering – New Engineering Contract (NEC), Joint Building Contract Committee (JBCC), etc.
- Standards
- Specifications
- Preparation of specifications
- Negotiation skills
- Engineering finance
- Risk analysis
- Quality systems
- Occupational health and safety

- Engineering ethics
- Discipline-specific courses
- Energy efficiency
- Electrical tariffs
- Maintenance engineering
- Environment impacts
- Management
- Report writing
- Planning methods
- System engineering
- Industrial relations
- Public speaking.

Training and courses that do not carry official continuing professional development (CPD) points are also appropriate, such as courses or training offered within the employer organisation or by other organisations.

4.2 Training for registration as a professional engineering technologist

4.2.1 Define, investigate and analyse broadly-defined engineering problems (Responsibility Level E)

Electrical Technologists are involved with broadly defined engineering activities and solve broadly defined engineering problems. It is critical to properly understand the problem and its extent before attempting to solve such a problem. It is therefore critical to define, investigate and analyse broadly defined engineering problems before deciding on solutions.

Defining engineering problems involves identifying an engineering problem to solve and specifying clear goals or criteria that the final product or system must meet. This process must lead to an agreed definition of the problem to be solved.

Applicants are expected to be exposed to the technical investigation process of a network, complex engineering systems, plant or equipment and product failure. The nature of the engineering problem is ill-posed and it requires identification and refinement into the technological

area under investigation. Investigating a broadly defined engineering problem cannot be a desktop exercise as it requires in-depth knowledge and history of the system, other attempted or successful solutions and how far-reaching a solution to the problem may be.

Analysis and the development of solution

Applicants involved in manufacturing and designing products, power generating plants, power networks and systems engineering must be able to demonstrate their ability to investigate a product or equipment failure by applying a systematic approach. This may involve justified assumptions and evaluation of results from investigated information. Applicants willing to be registered as Professional Engineering Technologists should therefore demonstrate an ability to define, investigate and analyse broadly defined engineering problems.

4.2.2 Design or develop solutions to broadly-defined engineering problems (Responsibility Levels C and D)

Engineering design and development of a solution is a critical step as this results in a plant/system or components operating within acceptable engineering and safety parameters. Engineering problems are solved by applying standards, codes and procedures, and justification for operating outside these standards and codes must be provided. Applicants are expected to be able to demonstrate different options for developing a solution. The solution should be supported by engineering principles and concepts. Applicants should strive to solve engineering problems demonstrating a step-by-step approach adhering to proven logic. Applicants should indicate alternatives or approaches towards solving the problem that have been tested against factors that include but are not limited to costs, engineering parameters, sustainability and environmental considerations before a solution is selected. There is always more than one solution to solving a broadly defined engineering problem.

4.2.3 Contextual knowledge (Responsibility Level E)

In solving broadly defined engineering problems, Electrical Engineering Technologists must comprehend and apply knowledge, accepted engineering procedures, systems and methodologies. Applicants should be able to understand and demonstrate that during engineering problem solving, they have:

- applied engineering principles, practices, technologies, including the application of BTech or BEng (Tech) theory in the practice area
- indicated working knowledge of areas of practice that interact with the practice area to underpin teamwork
- applied related knowledge of finance, statutory, safety and management.

4.2.4 Engineering project management (Responsibility Level D)

The practice areas under which Electrical Engineering Technologists work generally follow a conventional project or product development life cycle model, which could be as follows:

- Research and development to develop new products or systems to solve a system problem or a problem due to obsolescence.
- System or product design to develop a new system or product or to solve a system or product problem, to achieve a particular desired result or to select equipment for a particular purpose.
- Project engineering to install, test and commission the necessary equipment or system for the desired result.
- Operation and maintenance of the system or network or support of the product.
- Decommissioning of the system or network.

In relation to the above engineering activities, applicants are expected to display personal and work process management abilities for the following:

- Managing self, people, work priorities, processes and resources in broadly defined engineering work.
- Evident role in planning, organising, leading and controlling broadly defined engineering activities.
- Knowledge of conditions and operation of contractors and their ability.

4.2.5 Professional communication (Responsibility Level C)

Professional communication is a vital skill for Electrical Engineering Technologists to possess since all their decisions will be communicated to different parties. Candidate Technologists communicate the engineering activities to relevant stakeholders, managers and supervisors on the work deliverables.

Effective communication plays vital role in ensuring that the expectations are clearly understood. It is expected that Applicant Electrical Engineering Technologists demonstrate the ability to:

- write clear, concise, effective technical, legal and editorially correct reports
- issue clear instructions to stakeholders using appropriate language and communication skills
- conduct oral presentations using structured style, language and visual aids.

The above capabilities should be demonstrated at **Responsibility level C** (i.e., contributing).

4.2.6 Impact of engineering activities and risk mitigation (Responsibility Level B)

Broadly defined engineering problems always impact the social, environmental and cultural components. Applicants should be able to recognise and address the impact of their broadly defined engineering activities on these components and where there are negative effects, provide mitigating measures.

- Social effects encompass all issues that affect people and their livelihood, directly or indirectly. Engineering activities may have affected people's way of life, political system, health and wellbeing, and personal and property rights.
- Environmental effects include people's environment, namely air and water quality, dust and exposure to noise and adequacy of sanitation as well as large ecosystems. This might include disruption of ecosystems, fauna and flora and increased land temperatures and historical buildings.
- Cultural effects include people's customary beliefs, religion, language and norms, for example ceremonies and customs of a particular group or society.

It is important to note that engineering activities should be based on the correct level descriptor of broadly defined activities.

4.2.7 Statutory and regulatory requirements (Responsibility Level E)

The gazetted Identification of Engineering work (IDoEW) promotes safety and protection of the public and the environment by ensuring that only registered professionals in the different categories of registration, who have demonstrated the required competence and academic qualifications, performed engineering work or took responsibility for engineering work performed per category. Applicants wishing to register with ECSA as Professional Engineering

Technologists are expected to have a working knowledge of the related regulations and acts and be able to demonstrate how this legislation affects their engineering activities at **Responsibility Level E** (performing). The most commonly used engineering regulating standards and Acts for applicants to meet in the course of executing the engineering work are the following:

- Engineering Profession Act, 46 of 2000, including the rules and the ECSA Code of Conduct
- Occupation Health and Safety Act, 85 of 1993 as amended by Act 181 of 1993
- Wiring Code – SANS 10142
- Building Regulations – National Building Regulations and Building Standards Act, 103 of 1977 as amended by Act 49 of 1995
- Factory Regulations – SANS 10400
- Machinery and Works Regulations
- Labour Relations Act, 66 of 1999
- Environment Conservation Act, 73 of 1989 as amended by Act 52 of 1994 and Act 50 of 2003
- Industry Specific Work Instructions – Mine Health and Safety Act. 29 of 1996
- SANS applicable specifications
- Related ICASA licensing requirements.
- Mine Health and Safety Act 29 of 1996 and Regulations.

The candidate is expected to have a basic knowledge of the applicable Acts that are applicable to their area of practice. This list is not exhaustive.

4.2.8 Conduct engineering activities ethically (Responsibility Level E)

Applicant Electrical Engineering Technologists are involved in tender evaluations and adjudications, and contract management (e.g., NEC3). Ethical problems such as tender fraud and corruption, bribery payment, favouritism, defamation, fraudulent overtime claims, fraudulent expenses claimed, fraudulent qualifications, misrepresentation of facts and overstating of compensation events may occur. Applicant Electrical Engineering Technologists are expected to identify ethical problems and affected parties, and the best solution to resolve the problem at **Responsibility Level E** (i.e., performing).

Most engineering projects are multi-disciplinary in nature, with many role players performing speciality work that could result in individuals conducting engineering activities that they have no

education, training or competency for. It is imperative that Applicant Electrical Engineering Technologists familiarise themselves with ECSA's Rules of Conduct: Ethics regarding integrity and competency.

4.2.9 Exercising engineering sound judgement (Responsibility Level E)

Taking risky decisions may lead to equipment failure, excessive installation and maintenance costs, and damage to persons and property. Evaluation of engineering solutions may include engineering calculations to substantiate decisions taken and assumptions made. Therefore, judgement exercised by the applicant in arriving at a conclusion within the application of technologies and their interrelationship to other disciplines and technologies is crucial.

The design of new product or equipment has technical risk that needs to be considered in the acquisition of any new technologies. While the application of developmental technology potentially offers significantly enhanced capability over existing systems, it can also lead to excessive delays and cost 'blow-outs'. Furthermore, technical risk could have negative impacts on the project, system or entire infrastructure if the implementation is not successful as anticipated.

In developing engineering solutions, applicants should be able to demonstrate the factors taken into consideration, bearing in mind risk, consequences in technology application and affected parties. Failure to identify or properly manage this risk may result in performance degradation, security breaches, system failures, increased maintenance time and a significant amount of technical debt for the organisation. It is essential to have a reliable analysis solution for technical-risk management to ensure early detection of problems.

Therefore, applicants must familiarise themselves with the organisational risk policies and standards. These risks may be identified or demonstrated under the practice areas, such as research and development, engineering systems design, advisory, planning and directing the construction and operation of electronic, electrical and telecommunication systems, computer and software systems, components, rotating machines, and equipment and building services related projects.

4.2.10 Responsibility in decision-making (Responsibility Level E)

Responsible decision-making includes applying engineering knowledge acquired from accredited engineering programmes. It includes considerations from engineering, social, environmental and sustainable development factors in solving a broadly defined engineering problem. Applicants should be able to demonstrate recognition of social and environmental issues as well as application of relevant academic level knowledge in formulating decisions. The responsibility is mostly allocated within a team environment with an increasing designation as experience is gathered.

Applicant Electrical Engineering Technologists should discharge responsibilities for significant parts of one or more activities taken into consideration relating to the impact of engineering, social, environmental and sustainable development at **Responsibility Level E**. It is important for Applicant Electrical Engineering Technologists to demonstrate how they had sought some advice from a responsible authority on matters outside their area of competence.

4.2.11 Professional development (Responsibility Level D)

Applicants intending to register as Professional Engineering Technologists are expected to undertake independent learning activities sufficient to maintain and extend their competence. The following list of formal learning activities is by no means exhaustive; it is simply a sample of useful courses to assist applicants:

- Project management
- Conditions of Contract\Value Engineering – NEC, JBCC, etc.
- Standard specifications
- Preparation of specifications
- Negotiation skills
- Engineering finance
- Risk analysis and quality systems
- Occupational health and safety
- Discipline specific courses
- Energy efficiency
- Electrical tariffs

- Maintenance engineering
- Environment impacts management
- Technical and business report writing
- Planning methods
- Systems engineering
- Industrial relations
- Business presentation skills/public speaking
- Artificial intelligence
- Internet of things
- Cyber security
- Systems resilience.

Training and courses that do not carry official CPD points are also appropriate, such as courses or training offered within the employer organisation or by other organisations.

4.3 Training for registration as a Professional Engineering Technician

4.3.1 Define, investigate and analyse well-defined engineering problems (Responsibility Level E)

During training, Applicant engineering technician should be exposed to the technical investigation of equipment, plant and product failure. The intent is for applicants to be able to clearly define the engineering problem and investigate and analyse well-defined engineering problems. For engineering technicians to solve well-defined engineering problems, it is imperative to understand the nature of the engineering problem. Inability to understand the engineering problem could lead to incorrect design or development of solutions. Defining an engineering problem requires in-depth knowledge and history of the system, other attempted or successful solutions, and how far-reaching a solution to the problem may be. Investigation of the engineering problem could be in a form of equipment failure in the electrical system, development of new products and provision of services to a greenfield area.

Engineering problems should be thoroughly investigated through site visits, collecting technical information and checking engineering drawings. No investigation can be completed using desktop information only. Sufficient technical and business information about a plant or systems should

be collected, evaluated and analysed for accuracy and reliability. Analysis of the information assists applicants to review the instruction given in the initial engineering problem and assess if the work instruction was well understood. Engineering analysis involves applying scientific analytic principles and processes to reveal the properties and state of the system, device or mechanism under study. Applicants Electrical Engineering Technicians or persons willing to register as Professional Engineering Technicians should be able to demonstrate how well-defined engineering problem/s were defined and investigated.

4.3.2 Design or develop solutions to well-defined engineering problems (Responsibility Level C and D)

Once the analysis of the engineering problem has been established, applicants are expected to either design or develop engineering solutions to resolve well-defined engineering problems. Well-defined engineering problems can be solved in a standardised or prescribed ways. They are encompassed by standards, codes and documented procedures. Electrical Engineering Technicians encounter various engineering problems and should provide solutions to return the plant, system, or subsystem to its normal functioning state. Designing or developing solutions for a well-defined engineering problem normally follow the following steps:

- List possible solutions.
- Evaluate and rank the possible solutions.
- Develop a detailed plan for the most attractive solutions.
- Re-evaluate the plan to check desirability.
- Check the result through calculations.
- Implement the plan.
- Communicate the results.

Applicant Electrical Engineering Technicians should be able to demonstrate the application of calculations and engineering concepts in either designing or developing solutions to a well-defined engineering problem. Engineering norms and standards should be applied in the process of developing well-defined engineering solutions.

4.3.3 Contextual knowledge (Responsibility Level E)

Applicant Electrical Engineering Technicians are required to apply engineering knowledge acquired during the accredited undergraduate programmes to resolve the well-defined engineering problems and subsequently provide solutions to such problems. During training, applicant engineering technicians are expected to be introduced to engineering standards, procedures and different systems used in the process of engineering problem solving. It is imperative that applicant engineering technicians are able to understand and demonstrate application of acceptable engineering theory, engineering standards, engineering procedures, systems and governing laws in solving well-defined engineering problems.

Engineering problem-solving of well-defined activities involves justifying the reasoning on why National Diploma theory is applied and, in most cases, requires the engineering technician to perform calculations to justify certain engineering decisions and assumptions.

Applicant Electrical Engineering Technicians are expected to work within prescribed engineering standards and codes in solving engineering problems or to justify operating outside these standards and codes. Engineering technicians may also rely on knowledge from the National Rationalised Specifications (NRS), South African Berea of Standards (SABS), technical standards and specifications to develop solutions to well-defined engineering activities.

4.3.4 Engineering project management (Responsibility Level D)

The areas in which Applicant Electrical Engineering Technicians work generally follow a conventional project or product development life cycle model,

Electrical Technicians may contribute to or participate in a project by managing one or more activities in the project life cycle. The key activities of project management involve time, cost and quality. Applicant Electrical Engineering Technicians should be able to manage their activities to minimise project delays or engineering work activities, either in operations and maintenance or capital projects. Sometimes work priorities need to be tracked using project management software tools to manage project activities' critical path.

Applicant Electrical Engineering Technicians must expose themselves to the tools/software used to manage well-defined engineering activities and understand their role within the team. Applicant

Electrical Engineering Technicians or persons wishing to register with ECSA as a Professional Technicians must particate in and contribute to the work activities in the project life cycle. Applicant Electrical Engineering Technicians are not expected to change their places of employment to acquire all the skills in the project life cycle as listed above.

4.3.5 Professional communication (Responsibility Level C)

While conducting engineering works, Applicant Electrical Engineering Technicians are expected to effectively communicate with their team members, supervisors, clients and contractors. Professional communication is a vital skill for Applicant Electrical Engineering Technicians to possess since all their decisions are communicated to different parties. Professional communication is important for Applicant Electrical Engineering Technicians to run effective meetings, work with people who are not technical, work with other cultures, issue and receive instructions, report on engineering works and share ideas.

The main type of professional communication includes oral, written and graphical techniques, or a combination thereof. During the execution of engineering work activities, Electrical Technicians hold meetings, develop technical reports, develop tender document specification and develop bills of quantity. This should be clear and concise to convey the message to the recipients. Creating presentations using visual aids and supporting documents for the purpose of presenting to colleagues, team members, supervisors or client is an important part of engineering problem solving. Oral and written communication skills are important for effective professional communication.

Applicants should develop effective communications skills during training and be able to demonstrate such skills to be registered as Professional Engineering Technicians.

4.3.6 Impact of engineering activities and risk mitigation (Responsibility Level B)

Performing engineering work always means there will be impact socially, environmentally and culturally. This is because engineering work happens within the environment and are meant to improve services or products but not impact cultural beliefs and norms. Social effects encompass all issues that affect people and their livelihood, directly or indirectly. Engineering activities may have affected people's way of life, political system, health and wellbeing, and personal and property rights.

Environmental effects include people's environment, namely air and water quality, dust and exposure to noise and adequacy of sanitation as well as large ecosystems. This might include disruption of ecosystems, fauna and flora and increased land temperatures and impact on historical buildings.

Cultural effects include people's customary beliefs, religion, language and norms, for example ceremonies and customs of a particular group or society.

Applicants should always remember that these activities are mostly outward looking. Applicants must be able to describe the impact of engineering work on these items and be able to provide mitigation measures to affected parties. Stakeholder engagement is always important in mitigating impacts to a level acceptable to affected parties.

4.3.7 Statutory and regulatory requirements (Responsibility Level E)

Engineering work is performed under various legal and regulatory requirements that ensures the safety of personnel, protection of environment and continued service delivery to the public. Applicant Electrical Engineering Technicians should be familiar with major laws and regulations applicable in their area of operation. Regulations includes standards and specifications that are there to provide safety and ensure continuation of service. Such knowledge ensures that work is done safely and no unnecessary risks are taken during such work.

Applicant should be able to identify such laws and regulations and be able to demonstrate applicability. These include but are not limited to the following:

- Occupational Health and Safety Act, 85 of 1993
- Mine Health and Safety Act, 29 of 1996
- National Environmental Act, 107 of 1990
- Municipal Finance Management Act, 56 of 2003
- Public Finance Management Act, 1 of 1999
- Environment Conservation Act, 73 of 1989
- Labour Relations Act, 66 of 1995
- Municipal by-laws.

Regulations may include but are not limited to:

- Operation regulations for high voltage systems
- Electrical machinery regulations
- Electrical Installation regulations
- SABS standards
- NRS standards
- Industry-specific work Instructions, technical standards and specifications.

The candidate is expected to have a basic knowledge of the applicable Acts that are applicable to their area of practice. This list is not exhaustive.

4.3.8 Conduct engineering activities ethically (Responsibility Level E)

Ethical problems arise during engineering activities, for example using unsustainable material for a solution or contravening other regulations in the process of developing solutions. Other general ethical problems may also arise while performing engineering activities. Engineering practitioners should be able to identify ethical issues arising during engineering activities, identify affected parties and how such issues may affect them. A solution to an ethical problem must take into consideration all affected parties.

Applicant Electrical Engineering Technicians must perform engineering work and make technical decisions while adhering to the ECSA Code of Conduct for registered persons. Engineering work should be performed taking into consideration the following factors:

- Make decisions within the limits of the practitioner's education, training and experience
- Act with integrity and in accordance with the general norms of professional conduct
- Strive to respect the interests of the public and health and safety and minimise environmental impact.

Where the scope of work falls outside the area of expertise, Applicant Electrical Engineering Technicians should seek guidance from relevant parties. Conflict of interest while conducting engineering activities should be avoided/declared so that decisions are made transparently and with the best interests at heart.

4.3.9 Exercising engineering sound judgement (Responsibility Level E)

Sound judgment and decision-making can be defined as one's ability to objectively assess situations or circumstances using all the relevant information and apply past experience to come to a conclusion. Applicant Electrical Engineering Technicians should be able to make judgement towards a sustainable solution after ensuring that all factors, including consideration of other disciplines, have been taken into consideration.

It is essential to have a reliable analysis solution for technical-risk management to ensure early detection of problems. This prevents issues from occurring without warning and drastically decreases the effort required to alleviate sudden infrastructure or system problems. Applicant Electrical Engineering Technicians must familiarise themselves with organisational risk policies and standards. These risks may be identified or demonstrated in building services, product development or research and development related projects. Applicant Electrical Engineering Technicians should strive to acquire experience in all generic engineering competencies of problem-solving implementation, operation, risk and impact mitigation, and management of engineering activities.

4.3.10 Responsibility in decision-making (Responsibility Level E)

Responsible decision-making includes applying engineering knowledge acquired from accredited engineering programmes. It includes using relevant calculations to justify why certain solutions are chosen to solve well-defined engineering problems. Where an Applicant Electrical Engineering Technicians does not have the required knowledge, it is responsible to ask for advice from relevant authority or those who have the information. This could be on matters within the Electrical Engineering discipline or other disciplines but impacting the work of the Applicant Electrical Engineering Technicians. Any decisions taken should be evaluated for shortcomings to ensure no surprises at the end of the project/ activity.

4.3.11 Professional development (Responsibility Level D)

Professional development refers to continuing education and career training after a person has entered the workforce to assist in developing new skills, broadening of knowledge, stay up to date on current trends, technologies and advance their career. A registered Professional Engineering

Technician is required to maintain and extend the level of competency through CPD activities to maintain registration.

When applying for registration, applicants should provide evidence of initial professional development (IPD) that has been attained during the training period. These activities could include engineering courses, management courses and computer courses. Enrolling towards a post graduate engineering programmes is part of development activities. Candidates must be able to demonstrate professional development by:

- adopting strategy towards own professional development
- selecting appropriate professional development activities
- keeping thorough records of professional development activities
- demonstrating independent learning ability completing development activities.

Applicants training towards registration are not required to satisfy formal CPD requirements.

5. FUNCTIONS PERFORMED

5.1 Degrees of responsibility

Progression throughout the candidacy period presented in document **R-04-T&M-Guide-PC** and below in **Table 1** refers to the gradual increase in the degree of responsibility to which candidate engineers are exposed during professional training. Considering the nature of work, specific examples and outcomes appropriate to training in Electrical Engineering are given in Table 1 presented below:

Table 1: Progression throughout the candidacy period

Degree of responsibility	Nature of work	Activities/duties to be undertaken during training
A: Being exposed	The Candidate undergoes induction and observes processes and work of competent practitioners.	• Understand the business environment and the dynamics that shape the businesses and industries in which they operate. • Understand the business model, its key conversion processes and critical outcomes. • Understand the value added by Electrical Engineering Practitioners and other professionals in the business.

Degree of responsibility	Nature of work	Activities/duties to be undertaken during training
B: Assisting	The Candidate performs specific processes under close supervision.	• Develop insight and understanding of the different processes and systems in transforming inputs into goods and services. • Develop an appreciation of the numerous resources at the disposal of Electrical Engineering practitioners. • Obtain experience in the day-to-day operations of the business to gain insight and understanding of the different processes and systems involved in transforming inputs into goods and services, with specific emphasis on productivity and quality measurements.
C: Participating	The Candidate performs specific processes as directed, with limited supervision.	• Gain first-hand experience of a broad range of Electrical Engineering activities (e.g., process design and re-engineering, planning and control, work study, value engineering, materials and information management, people management skills, logistics, specialists' inputs, tools and equipment and quality assurance). • Note the problems and limitations of particular philosophies, methods and techniques, with emphasis on cost/effort and relative benefit.
D: Contributing	The Candidate performs specific work with detailed approval of work outputs.	• Be involved in activities such as the planning of production, the control of quality and costs of process study and work study, good material handling and workplace layout, activity-based costing, benchmarking, business cases, process re-engineering, maintenance practice and procedures, project management and system specification. Of particular importance is the collective working of such activities in the economic use of people, materials and machines. • Give specific attention to human aspects concerning communication, interpersonal relationships and teamwork, training and cost analysis, budget control and profit accountability. These should proceed in parallel, applying Electrical Engineering techniques and utilising computers in problem-solving.
E: Performing	The Candidate works in a team without supervision, recommends work outputs and is	• Assume escalating technical responsibility and increasingly co-ordinate the work of others. • Gain exposure to and develop skills in management areas such as labour relations, management accounting, business law and general business management. This is

Degree of responsibility	Nature of work	Activities/duties to be undertaken during training
	responsible but not accountable.	important for developing well-rounded Engineering Practitioners. • Seek assignments that require judgement, even if full information is unavailable. This leads to a position of professional responsibility, which is of great value and should be pursued.

Special considerations in the discipline, sub-discipline or specialty must be given to the competencies specified in the following groups:

- Knowledge-based problem-solving (this should be a strong focus)
- Management and communication
- Identifying and mitigating the impacts of engineering activity
- Judgement and responsibility
- Independent learning.

It is useful to measure the progression of a candidate's competency using the Degree of Responsibility, the Problem-Solving and the Engineering Activity scales as specified in document **R-02-STA-PE/PT/PN**.

APPENDIX A: TRAINING ELEMENTS

below has been developed against the Degree of Responsibility Scale. Activities should be selected to ensure candidates reach the required level of competency and responsibility.

It should be noted that candidates working at **Responsibility Level E** carry responsibility equivalent to that of a registered person **except** that the candidate's supervisor is accountable for the candidate's recommendations and decisions.

5.2 Candidates training programme

There is no ideal training programme structure or unique sequencing that constitutes best practice. The training programme for each candidate depends on the available work opportunities the employer assigns to the candidate at the time.

It is suggested that applicants work with their mentors to determine appropriate projects to gain exposure to elements of the asset life cycle. In addition, applicants need to ensure that their designs are constructible, operable and designed considering life cycle costing and long-term sustainability. A regular reporting structure with suitable recording of evidence of achievement against the competency outcomes and responsibility needs to be in place.

The training programme should be such that candidates progress through the levels of work capability (described in document **R-04-T&M-GUIDE-PC**) to ensure that by the end of the training period, applicants exhibit Responsibility Level E and are able to perform individually and as a team member at the level of problem-solving and engineering activity required for registration.

Value improved practices (VIPs) are out-of-the-ordinary practices used to improve cost, schedule, and/or reliability of capital construction projects. VIPs are:

- used primarily during front-end-loading
- formal, documented practices involving a repeatable work process
- predominantly facilitated by specialists from outside the project team.

Examples of VIPs include the following:

- Technology selection
- Process simplification
- Classes of facility quality
- Waste minimisation
- Energy optimisation
- Process reliability modelling
- Customisation of standards and specifications
- Predictive maintenance
- Design to capacity
- Value engineering
- Constructability.

The DSTG assumes that applicants enter a programme after graduation and continue with the programme until they are ready to apply for professional registration. The guide also assumes

that applicants are supervised and mentored by persons who meet the requirements stated in document **R-04-T&M-GUIDE-PC**. In the case of a person changing from one candidacy programme to another or moving into a candidacy programme from a less structured environment, it is essential that the following steps are completed:

- Applicants must complete the Training and Experience Summary (TES) and the Training and Experience Reports (TERs) for the previous programme or the unstructured experience. Regarding the latter, it is important to reconstruct the experience as accurately as possible. The TERs must be signed off by the relevant supervisor or mentor.
- On entering the new programme, the mentor and supervisor should review a applicant's development while being mindful of the past experience and the opportunities and requirements of the new programme. At minimum, the mentor and supervisor should plan the next phase of the applicant's programme.

6. CONCLUSION

To attain registration as a professional, applicants should be able to meet the educational requirements for the category and demonstrate competency against prescribed standard for the registration category. Demonstrating competency is achieved by meeting requirements for the 11 outcomes. Applicants or persons willing to be registered as professionals must ensure, together with their mentors, that the training provided is geared towards achieving the ECSA competency outcomes. Focusing on one training aspect for the entire duration of training will not assist candidates or applicants to achieve the necessary skills to demonstrate all the standard competency outcomes.

The development of training remains the responsibility of the candidate or applicant to ensure that the training plan being provided covers all aspects of the outcomes. It has been common practice that in situations where a department or organisation is unable to provide training in certain areas, secondments are arranged with other departments or organisations so that the candidate or applicant is able to develop all the competencies required for registration. These secondments are usually reciprocal in nature and benefit the employee as well as the employer. Secondments between consultants and contractors and between the public and private sectors should be possible to allow applicants to acquire the necessary competencies.

REVISION HISTORY

Revision number	Revision date	Revision details	Approved by
Rev 0 Draft A	12 Dec 2023	The DSTG have been merged into one Discipline Specific Training Guide for Registration as a Professional Engineer, Technologist and Technician in Electrical Engineering and to ensure that the DSTG clearly detail how each outcome can be achieved.	RDDR BU
Rev 0 Draft B	13 Dec 2023	The three DSTGs have been reviewed to ensure that the document clearly explains how the candidate can achieve the eleven outcomes. The document now has an introductory section, and new abbreviations have been added under the section for abbreviations. The following additions have been made under section 2, Audience Renewables and Energy Efficiency have been added and the specialist areas are further defined as: • **Electrical Power Engineering -** encompasses electrical systems, components, motors, equipment, and engineering materials, products, and processes. • **Electronic Engineering -** covers electronic systems, electronic engineering materials, products, and processes. • **Telecommunications Engineering -** encompasses the design, construction, and management of systems that transmit, process, and storage information as electrical or optical signals and the control services based on this capability. • **Alternative Energy Engineering -** encompasses the design, construction, and management of systems that carry out the generation, transmission, and processing of alternative sources of electrical energy, such as renewables, as well as management thereof. Under section 3, Type of Engineering work, the following have been added: • Energy Efficiency Engineer • Renewables Engineer Under section 4.1, Training for Registration as a Professional Engineer, Investigation & Analysis, further information has been added to ensure what is expected of the candidate, including a list of what typical tasks may include. Under section 4.2, Training for Registration as a Professional Engineer, Investigation & Analysis, further information has been added to ensure what is expected of the candidate.	Working group

Revision number	Revision date	Revision details	Approved by
Rev 0 Draft C	14 Dec 2023	Document revised with WG and Registration BU	RI BU, Registration BU and WG
Rev 0 Draft D	30 Jan 2024	Reviewed and checked	Executive: RPSC
Rev 0	08 Feb 2024	Approval	RPSC

The Discipline-specific Training Guide for:

Professional Engineer in Electrical Engineering

Revision 0 dated 08 February 2024 and consisting of 39 pages has been reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research Policy and Standards **(RPS).**

..... 09 April 2024.....

Business Unit Manager Date

..... .2024/04/09.....

Executive: **RPS** Date

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

APPENDIX A: TRAINING ELEMENTS

1	**Introduction**
1.1	*Induction programme* (typically 1–5 days)
1.1.1	Company structure
1.1.2	Company policies
1.1.3	Company Code of Conduct
1.1.4	Company safety regulations
1.1.5	Company staff code
1.1.6	Company regulations
1.2	*Exposure to Practical Aspects of Engineering (typically 6–12 months) and covers how things are:* (Responsibility Levels A–B)
Experience in one or more of these sectors but not all:	
1.2.1	Manufacturing
1.2.2	Construction
1.2.3	Erection
1.2.4	Field installation
1.2.5	Testing
1.2.6	Commissioning
1.2.7	Operation
1.2.8	Maintenance
1.2.9	Fault location
1.2.10	Problem investigation
2	**Design or develop solution**
2.1	*Experience in design and application of design knowledge* (typically 12–18 months). *Focus is on planning, design and application* (Responsibility Levels C–D)
In one or more of the above sectors:	
2.1.1	Analysis of data and systems
2.1.2	Planning of networks and systems
2.1.3	System modelling and integration
2.1.4	System design

2.1.5	Network/circuit design
2.1.6	Component/product design
2.1.7	Software design
2.1.8	Research and investigation
2.1.9	Preparation of specifications and associated documentation
2.1.10	Preparation of contract documents and associated documentation
2.1.11	Development of standards
2.1.12	Application of quality systems
2.1.13	Configuration Management
3	**Engineering tasks**
3.1	*Experience in the execution of engineering tasks* (rest of training period). *Focus should be on projects and project management* (Responsibility Level E)
3.1.1	Working in one or more of these sectors but not all
3.1.1.	Design or develop solution
3.1.2	Manufacture
3.1.3	Construction
3.1.4	Erection
3.1.5	Installation
3.1.6	Commissioning
3.1.7	Maintenance
3.1.8	Modifications
3.2	*Organising for implementation of 3.1* (Responsibility Level E)
3.2.1	Manage resources
3.2.2	Optimisation of resources and processes
3.3	*Controlling for implementation or operation of 3.1* (Responsibility Level E)
3.3.1	Monitor progress and delivery
3.3.2	Monitor quality
3.4	*Completion of 3.1* (Responsibility Level E)
3.4.1	Commissioning completion
3.4.2	Documentation completion
3.4.3	Documentation handover

3.5	*Maintenance and repair of 3.1* (Responsibility Level E)
3.5.1	Planning and scheduling maintenance
3.5.2	Monitor quality
3.5.3	Oversee maintenance and repair
4	**Risk and impact mitigation**
4.1	*Impact and risk assessments* (Responsibility Level E)
4.1.1	Risk assessments
4.2	*Regulatory compliance* (Responsibility Level E)
4.2.1	Health and safety
4.2.2	Codes and standards
4.2.3	Legal and regulatory
5	**Managing engineering activities**
5.1	*Self-management* (Responsibility Levels C–D)
5.1.1	Manages own activities
5.1.2	Communicates effectively
5.2	*Team environment* (Responsibility Levels C–D)
5.2.1	Participates in and contributes to team planning activities
5.2.2	Manages people
5.3	*Professional communication and relationships (networking)* (Responsibility Levels C–D)
5.3.1	Establishes and maintains professional and business relationships
5.3.2	Communicates effectively
5.4	*Exercising judgement and taking responsibility* (Responsibility Level E)
5.4.1	Ethical practices
5.4.2	Code of Conduct
5.4.3	Exercises sound judgement in the course of complex engineering activities
5.4.4	Is responsible for decision-making in some or all engineering activities
5.5	*Competency development* (Responsibility Level D)
5.5.1	Plans own development programme
5.5.2	Constructs initial professional development record