ENSURING THE EXPERTISE TO GROW SOUTH AFRICA

Discipline-Specific Training Guide for Engineering Technicians in Electrical Engineering

R-05-ELE-PN

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DEFINITIONS

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

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

**Voluntary Associations:** Voluntary Associations recognised by ECSA Council in terms of section 36(1) of the Engineering Profession Act, 46 of 2000.

**Mentor:** A person willing to spend his/her time and expertise to guide the development of another person.

**Dublin Accord:** An ECSA agreement for the international recognition of Engineering Technicians qualifications and competencies.

**R-01-POL:** Registration policy in professional categories.

**R-02-PN:** Competency standard for registration as professional technician.

**R-04-PN:** Training and mentoring guide document.

**R-08-PN:** Guide to competency standard for registration as professional technician.

**R-03-PRO:** The application and assessment process for registration as a candidate or a professional.

**Outcome:** At the *professional* level, it means a statement of the performance that a person must demonstrate in order to be judged competent.

**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 and using mathematical formulation where necessary, that extends knowledge and develops models and methods to support its application, solve problems and provide the knowledge base for engineering specialisations.

**Over-determined problem:** A problem whose requirements are defined in excessive detail, making the required solution impossible to attain in all of its aspects.
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.

Specified Category: A category of registration for persons who must be licensed through the Engineering Profession Act or a combination of the Engineering Profession Act and external legislation as having specific engineering competencies at NQF Level 5 related to an identified need to protect the public safety, health and interest or the environment, in relation to an engineering activity.

Management of engineering works or activities: The coordinated activities required to:

(a) direct and control everything that is constructed or results from construction or manufacturing operations;

(b) operate engineering works safely and in the manner intended;

(c) return engineering works, plant and equipment to an acceptable condition by the renewal, replacement or mending of worn, damaged or decayed parts;

(d) direct and control engineering processes, systems, commissioning, operation and decommissioning of equipment;

(e) maintain engineering works or equipment in a state in which it can perform its required function.

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.

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

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ECSA</td>
<td>Engineering Council of South Africa</td>
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<tr>
<td>AIET</td>
<td>Agreement for International Engineering Technicians</td>
</tr>
<tr>
<td>DSTG</td>
<td>Discipline-Specific Training Guideline</td>
</tr>
<tr>
<td>NDip</td>
<td>National Diploma</td>
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<tr>
<td>Dip Eng Tech</td>
<td>Diploma in Engineering Technology</td>
</tr>
<tr>
<td>AdvCert</td>
<td>Advanced Certificate</td>
</tr>
<tr>
<td>C&amp;U</td>
<td>Commitment and Undertaking</td>
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<td>VA</td>
<td>Voluntary Association</td>
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<td>NEC</td>
<td>New Engineering Contract</td>
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<td>JBCE</td>
<td>The Joint Building Contracts Committee</td>
</tr>
<tr>
<td>GCC</td>
<td>General Conditions of Contracts for Construction</td>
</tr>
<tr>
<td>TER</td>
<td>Training and Experience Report</td>
</tr>
<tr>
<td>TES</td>
<td>Training and Experience Summary</td>
</tr>
</tbody>
</table>
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: Document defining the ECSA registration system

1. PURPOSE OF THIS DOCUMENT

This guideline provides information about the requirements for registration as professional engineering technician with the ECSA. All persons applying for registration as Professional Engineering Technicians are expected to demonstrate the competencies specified in registration policy document R-02-PN at the prescribed level, irrespective of the sub-
discipline specific within electrical engineering, through work performed by the applicant at the prescribed level of responsibility.

This document supplements the generic Training and Mentoring Guide R-04-P and the Guide to the Competency Standards for Professional Engineering Technicians, document R-08-PN.

In document R-04-P, key focus should be drawn to the following sections:

- Duration of training and period working at level required for registration
- Principles of planning training and experience
- Progression of training programme
- Documenting training and experience
- Demonstrating responsibility.

Document R-08-PN provides a high-level, outcome-by-outcome understanding of the competency standards that form an essential basis for this Discipline-Specific Training Guide (DSTG). This training guide and documents R-04-P and R-08-PN are subordinate to the Policy on Registration (document R-01-POL), the Competency Standard (document R-02-PN) and the application process definition (document R-03-PRO). This guide further presents information that is relevant to all candidate engineering technicians practising in a variety of sub-electrical engineering disciplines.

1. AUDIENCE

This DSTG is directed to candidates and their supervisors and mentors in the discipline of electrical and electronic engineering. The guide is intended to support a programme of training and experience incorporating good practice elements. The guide applies to persons who wish to be registered as a professional engineering technician with ECSA. Mature applicants for registration may apply the guide retrospectively to identify possible gaps in their development.
This guide applies to persons who have:

- completed the education requirements by obtaining an accredited National Dip (Engineering), Dip (Eng Tech), Adv Cert (Engineering) type qualification, or a Dublin-Accord Recognised qualification or through evaluation/assessment;
- registered as Candidate Engineering Technicians; and/or
- embarked on a process of acceptable training under a registered Commitment and Undertaking (C&U) with a Mentor guiding the professional development process at each stage.

2. PERSONS NOT REGISTERED AS CANDIDATES OR NOT BEING TRAINED UNDER C&U

Irrespective of the development path followed, all applicants for registration must present the same evidence of competence and be assessed against the same standards. Application for registration as a Professional Engineering Technician is permitted without being registered as a candidate technician and without training through a C&U candidacy programme. Mentorship and adequate supervision are, however, key factors in effective development to attain the level required for registration.

If the employer of the trainee does not offer C&U, the trainee must establish the level of mentorship and supervision that the employer is able to provide. In the absence of an internal mentor, the services of an external mentor should be secured. The Voluntary Association (VA) for the discipline may be consulted for assistance in locating an external mentor. A mentor must keep abreast of all stages of the development process.

This guide is written for the recent graduate who is training and gaining experience towards registration. Mature applicants for registration may apply the guide retrospectively to identify possible gaps in their development. Applicants who have not enjoyed mentorship are advised to request an experienced mentor (internal or external) to act as an application adviser while they prepare their application for registration.
3. ORGANISING FRAMEWORK FOR OCCUPATIONS

Electrical engineering technicians form a collective group of engineers who conduct research and design, advise, plan and direct the construction and operation of electronic, electrical and telecommunication systems, computer and software systems, components, motors and equipment. Electrical engineering technicians organise and establish control systems to monitor the performance and safety of electrical and electronic components, assemblies and systems. Electrical engineering technicians perform some of the following well-defined functions: the planning, design, construction, operation and maintenance of materials, components, plants and systems for generating, transmitting, distributing and utilising electrical energy.

The field of Electrical Engineering encompasses electronic devices, apparatus and control systems for industrial systems together with biomedical devices, robotics and consumer products. Computing, communication and software for critical applications, instrumentation and control of processes are addressed through the application of electrical, electromagnetic and information engineering sciences. Electrical engineering technicians generally practise in specialised areas or operate in a broadly defined application of systems. Specialised areas in which engineering technicians may practice include:

- Electrical Power Engineering
- Electronics Engineering
- Telecommunications Engineering
- Control Engineering
- Control and Instrumentation Engineering
- Instrumentation Engineering
- Computer and Software Engineering.

Engineering technicians also practice in combinations of the above specialties as well as in areas involving other disciplines, for example Mechatronics Engineering – involving robotic, prosthesis and process control.
3.1 Electrical power engineering

Electrical Power Engineering is a subfield of Electrical Engineering that deals with the generation, transmission, distribution and utilisation of electric power and the electrical apparatus connected to such systems. Much of this field is concerned with the problems regarding three-phase AC power, transformation in large-scale power transmission and distribution across the modern world.

A significant fraction of the field is concerned with the conversion of AC and DC power and the development of specialised power systems such as those used in aircraft and for electric railway networks. Power Engineering draws the bulk of its theoretical base from Electrical Engineering. Power Engineering covers electrical power-system components, generators, motors and equipment, electrical engineering materials and the development and processing of products.

**Electrical Power Engineering Technicians** assist in conducting research and advise on, design and direct the construction and operation of electrical systems, components, motors and equipment, advise on and direct their functioning, maintenance and repair and study and advice on well-defined technological aspects of electrical engineering materials, products and processes.

Practicing Electrical Power Engineering Technicians may concentrate on one or more of the following areas such as mining, plant and factories, power generation, power transmission, power distribution, power systems protection, metering, illumination, railway signalling, signalling and communications, control and instrumentation, product sales, power electronics, electrical drives, energy management, infrastructure maintenance, construction projects, lecturing, etc. Typical tasks that an Electrical Power Engineering Technician may undertake include:

- conducting well-defined research and development of new or improved theories and methods related to Electrical Power Engineering;
- advising on and designing well-defined aspects of power stations and systems that generate, transmit and distribute electrical power;
• specifying well-defined aspects of instrumentation, measurement and control of equipment for the monitoring and control of electrical generation, transmission and distribution systems;
• supervising, controlling, developing and monitoring aspects of the operation and maintenance of electrical generation, transmission and distribution systems;
• advising on and designing well-defined aspects of systems for electrical motors, electrical traction and other equipment or electrical domestic appliances;
• specifying standard electrical installation and application in industrial and other buildings and objects;
• implementing and improving control standards and procedures to monitor performance and safety of electrical generating and distribution systems, motors and equipment;
• implementing and improving manufacturing methods for electrical systems as well as the maintenance and repair of existing electrical systems, motors and equipment.

3.2 Electronics engineering

Electronics Engineering is an Electrical Engineering discipline that utilises non-linear and active electrical components (e.g. semiconductor devices, especially transistors, diodes and integrated circuits) to design electronic circuits, devices, microprocessors, microcontrollers and other systems. The discipline also designs passive electrical components, usually based on printed circuit boards.

**Electronics Engineering Technicians** assist in conducting research and advice on design and direct the construction, maintenance and repair of electronic systems and study and advice on well-defined technological aspects of electronic engineering materials products or processes. Practising Electronics Engineering Technicians may concentrate on one or more of the following areas such as communications (army), mechatronics, designer, information, SCADA, control, instrumentation, television, bio-medical, clinical, fire and safety, rail network control, aircraft electronic systems, electronic warfare, etc. Typical tasks that an Electronics Engineering Technician may undertake include:

• conducting well-defined research and developing new or improved theories and methods related to Electronics Engineering;
• advising on and designing well-defined electronic devices or components, circuits, semiconductors and systems;
• specifying well-defined aspects of production or installation methods, materials and quality standards, and directing well-defined production or installation work of electronic products and systems supervising, controlling, developing and monitoring aspects of the operation and maintenance of electronic equipment and systems;
• implementing and improving control standards and procedures to ensure efficient functioning and safety of electronic systems and equipment;
• organising and directing maintenance and repair of existing electronic systems and equipment;
• designing well-defined electronic circuits and components for use in fields such as aerospace, guidance and propulsion control, acoustics or instruments and control;
• determining well-defined manufacturing methods for electronic systems as well as the maintenance and repair of existing electronic systems and equipment;
• assist in doing research and advising on radar, telemetry and remote-control systems, microwaves and other electronic equipment;
• assist in designing and developing signal processing algorithms and implementing these through appropriate choice of hardware and software;
• developing well-defined apparatus and procedures to test electronic components, circuits and systems;
• designing, specifying and implementing well-defined control and instrumentation of plant and processes;
• designing, specifying, controlling and monitoring well-defined equipment for fire and safety in plant and factories;
• well-defined robotics and process control of manufacturing plant;
• assisting with energy efficiency PV.

3.3 Telecommunications engineering

Telecommunications Engineering deals with the transmission of information across a channel such as a co-axial cable, optical fibre or free space. Transmissions across free space require information to be encoded in a carrier wave in order to shift the information to a carrier frequency suitable for transmission. This is known as modulation. Popular analogue
Modulation techniques include amplitude modulation and frequency modulation. The choice of modulation affects the cost and performance of a system and the engineer must balance these two factors carefully.

**Telecommunications Engineering Technicians** assist in conducting research and giving advice on, design and directing the construction, maintenance and repair of telecommunication systems and equipment. They study and advise on well-defined technological aspects of telecommunication engineering, materials products or processes. Plans, designs and monitors well-defined telecommunications networks and associated broadcasting equipment. Practising Telecommunications Engineering Technicians may concentrate on one or more of the following areas such as broadcasting, digital signal processing design, communications, fibre optics, radio frequency design, radar, radio, radio and telecommunications, mobile radio, satellite transmission, signal processing systems, communications consulting, communications specialist (ICT), telecommunications consulting, telecommunications network planning, telecommunications specialist, microwave, etc. Typical tasks that a Telecommunication Engineering Technician may undertake include:

- conducting well-defined research and developing new or improved theories and methods related to Telecommunications Engineering;
- advising on and designing well-defined telecommunications devices or components, systems, equipment and distribution centres;
- specifying well-defined aspects of production or installation methods, materials, quality and safety standards and directing production or installation work of telecommunications products and systems;
- supervising, controlling, developing and monitoring aspects of the operation and maintenance of telecommunication systems, networks and equipment;
- determining well-defined manufacturing methods for telecommunication systems as well as the maintenance and repair of existing telecommunication systems, networks and equipment;
- organising and directing maintenance and repair of existing telecommunication systems, networks and equipment;
- assisting in doing research and advising on telecommunications equipment;
• planning and designing well-defined communications networks based on wired, fibre optical and wireless communication media;
• assist in the design and development of signal processing algorithms and implementing these through appropriate choice of hardware and software;
• designing well-defined telecommunications networks and radio and television distribution systems including both cable and over the air..

3.4 Computer and software engineering

Computer Engineering emphasises solving problems relating to digital hardware and at the hardware-software interface, while Software Engineering deals with building and maintaining software systems. Computer and software engineering technicians assist in conducting research and advising on, design and directing the construction, maintenance and repair of computer-based systems, software and equipment. They study and advise on the well-defined technological aspects of computer-based systems, software, products or processes. They assist in performing system analysis on computer-based system requirements, software and the specification of the systems required.

They plan, design and monitor well-defined computer-based systems, software, networks and associated communication equipment. Practising Computer Engineering Technicians may concentrate on one or more of the following areas: computer hardware, computer systems analysis, computer systems design, computer communication specialisation, computer network design, computer network sales, software systems, etc.

Typical tasks that a Computer Engineering Technician may undertake include:

• conducting well-defined research and developing new or improved theories and methods related to Computer and Software Engineering;
• advising on and designing well-defined computer-based systems or components, systems equipment, software and distribution centres;
• specifying well-defined production or installation methods, materials, quality and safety standards and directing production or installation work of computer-based products, software and systems;
• supervising, controlling, developing and monitoring the operation and maintenance of computer-based systems, software, networks and equipment;
organising and directing the maintenance and repair of existing computer-based systems, programs and equipment;

- assisting in doing research and advising on computer-based equipment and software;

- planning and designing well-defined computer-based communications networks based on wired, fibre optical and wireless communication media and ultra-high-speed data networks;

- analysing systems, designing and developing well-defined computer-based systems and implementing these through appropriate choice of hardware and managing the development of the necessary software;

- determining well-defined manufacturing methods for computer-based systems as well as the maintenance and repair of existing computer-based systems, networks and equipment.

### 3.5 Alternative sources of energy engineering

Alternative sources of engineering maximise the energy potential of clean energy sources including wind, solar, geothermal, biofuel and hydropower. Alternative Sources of Energy Technicians conduct research, advise on design and direct the construction, maintenance and repair of renewable energy sources such as wind, solar and wave at the well-defined level.

Practising Alternative Energy Technicians may concentrate on one or more of the following areas: computer engineering, control and instrumentation engineering, energy management engineering, electrical design engineering, electrical power generation engineering, electromechanical engineering, computer system engineering, computer system design engineering, computer communication engineering, computer network design engineering, computer network sales engineering, software engineering, systems engineering.

Typical tasks that an Alternative Energy Technician may undertake include:

- conducting research and developing new or improved theories and methods relating to Alternative Energy Engineering;

- advising on and designing computer-based systems, components, systems equipment, software and distribution centres;
• specifying production and installation methods, materials and quality and safety standards;
• directing production and installation work of computer-based products, software and systems;
• supervising, controlling, developing and monitoring the operation and maintenance of alternative energy systems, software, networks and equipment;
• organising and directing the maintenance and repair of existing computer-based systems, program and equipment;
• researching and advising on alternative energy equipment and software;
• planning and designing computer-based communication networks based on wired, fibre optic and wireless communication media and ultra-high-speed data networks;
• performing system analyses together with designing and developing complex computer-based systems.

4. NATURE AND ORGANISATION OF THE INDUSTRY

Engineering technicians may be employed in both the private and public sectors. In the private sector, Engineering Technicians would mostly be involved in consulting, contracting, or in supplier or manufacturing organisations. Engineering consultants are responsible for planning, designing, documenting, and supervising the construction of projects on behalf of their clients. Engineering contractors are responsible for project implementation, and activities include planning, construction, and labour and resource management. Those working in supply or manufacturing companies could be involved in research and development and would be involved in production, supply and quality control.

The public sector is responsible for service delivery and is usually the client, though in some departments, design and construction is also carried out. Engineering technicians are required at all levels of the public sector, including at national, provincial and local government level, in state owned enterprises (SOEs) and in public utilities. The public sector largely handles planning, specifying, overseeing implementation, operations and maintenance of infrastructure.

An extension of the public sector would include tertiary academic institutions and research organisations. Depending on the department or organisation where the candidate is
Employed, there may be situations where the opportunities in-house are insufficiently diverse to develop all the competencies required in all the groups noted in document R-02-PN. For example, the opportunity to develop problem solving competence (including design or developing solutions) and for managing engineering activities (including implementing or constructing solutions) may not both be available to the candidate. In such cases, employers are encouraged to put a secondment system in place.

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 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.

4.1 Investigation

Applicants are expected to be exposed to the technical investigation of equipment, plant and product failure. The intent is for the applicant to be able to define the engineering problem and to investigate and analyse well-defined engineering problems. Ultimately, the applicant must be able to demonstrate different options for the development of a solution. Electrical Engineering Technicians assist in the design of products, generating plants, power networks and systems must be able to demonstrate their ability to investigate a product or equipment failure.

4.2 Research and development

Research and development constitute the first stage of development of a potential new service, process or product or the first stages to improve existing services, processes or products. Research and Development Technicians are responsible for assisting a researcher or research team with product development or improvement projects. Technicians are in charge of gathering data, keeping accurate records and making sure records are filed correctly.

Sometimes research projects are abandoned or deferred for different reasons, and this may leave the research technicians in a dilemma. If the project is cancelled or placed on hold...
before the engineering technicians have completed the research cycle, the candidate or the applicant is unlikely to meet all the competency minimum standards for registration as a Professional Engineering Technician. It is strongly recommended that Candidate Engineering Technicians practising in the specialised area of research and development continually engage with their employers and become involved in more than one project to minimise the risk of spending time on a project that risks being cancelled.

4.3 Process or product design

This is a process of originating and developing a plan for a product, service or process which can then be implemented. Process design typically uses a number of tools including flowcharting, process simulation software and scale models. Process design can be the design of new facilities or the modification or expansion of existing facilities. The design starts after the conceptual level and ultimately ends in the form of fabrication and construction plans. Organisations often introduce processes to standardise their designs and operations for efficiency purposes. Engineering Technicians operating in the manufacturing industries and coal/nuclear generating plants are expected to understand the process design of their plant.

4.4 Risk and impact

Technical risk is a major factor to be considered in the acquisition of 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 does not perform as anticipated. Failure to identify or properly manage this risk results 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. This will prevent issues from occurring without warning and drastically decrease the effort required in alleviating sudden infrastructure or system problems. Candidate Technicians must familiarise themselves with the organisational risk
policies and standards. These risks may be identified or demonstrated in building services, product development or research and development related projects.

4.5 Engineering project management

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

- Research and development to develop new products or systems, solve a system problem or due to obsolescence.
- System or product design to develop a new system or product, to solve a system or product problem, to achieve a particular desired result, or to select equipment for a particular purpose.
- 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.

Candidate Electrical Technicians are not expected to change their places of employment to acquire all the skills in the project life cycle as listed above. It is expected that Candidate Technicians or persons wishing to register with ECSA as a Professional Technicians must get involved and get experience in all generic engineering competencies of problem solving, implementation, operation, risk and impact mitigation and management of engineering activities.

4.6 Implementation/Commissioning

In the commissioning of equipment or systems, the Candidate Engineering Technician or person willing to register as a professional technician must demonstrate an understanding of the engineering concepts utilised in the system:

(a) How the equipment functions;

(b) The reason the equipment was acquired; and

(c) Risk impacts associated with these engineering concepts have in the business.
4.7 Operations and maintenance

In the maintenance environment, the Candidate Engineering Technician or persons willing to register as a professional technician must demonstrate:

(a) the engineering and financial implications involved;

(b) why the equipment is maintained at the prescribed intervals; and

(c) what tests have to be done to verify the proper functioning of the equipment before re-commissioning.

5. DEVELOPING COMPETENCY: DOCUMENT R-08-PN

5.1 Contextual knowledge

Candidates are expected to be aware of the engineering profession, the VAs applicable to their area of speciality, their functions and services rendered to their members.

5.2 Functions performed

Candidates/applicants must demonstrate that during their training period, they have mastered the competencies defined in document R-08-PN to a satisfactory level. From the reports submitted as part of the application for registration (i.e. Training and Experience Reports [TERs] and the Engineering Report [ER]), candidates should demonstrate that the 11 Outcomes have been met.

It is very useful to measure the progression of candidates’ competency by using the degree of responsibility as shown in Table 1 below. The degree of responsibility shows the gradual increase in responsibility to which Candidate Technicians are exposed during their professional training. The aim is to get the applicant/candidate at responsibility level E prior to registering for professional registration.
Table 1: Degree of responsibility

<table>
<thead>
<tr>
<th>Level</th>
<th>Nature of work</th>
<th>Responsibility</th>
<th>Level of support</th>
</tr>
</thead>
<tbody>
<tr>
<td>B:</td>
<td>The candidate/applicant performs specific processes, under close supervision.</td>
<td>Limited responsibility for work output.</td>
<td>Supervisor/Mentor coaches, offers feedback.</td>
</tr>
<tr>
<td>C:</td>
<td>The candidate/applicant performs specific processes as directed with limited supervision.</td>
<td>Full responsibility for supervised work.</td>
<td>Supervisor progressively reduces support but monitors outputs.</td>
</tr>
<tr>
<td>D:</td>
<td>The candidate/applicant performs specific work with detailed approval of work outputs.</td>
<td>Full responsibility to supervisor for quality of work.</td>
<td>Applicant/candidate articulates own reasoning and compares it with that of supervisor.</td>
</tr>
<tr>
<td>E:</td>
<td>The candidate/applicant works in team without supervision, recommends work outputs; responsible but not accountable.</td>
<td>Level of responsibility to supervisor is appropriated to a registered person.</td>
<td>Applicant/candidate takes on problem solving without support, at most limited guidance</td>
</tr>
</tbody>
</table>

Appendix A has been developed against the Degree of Responsibility scale. Activities should be selected to ensure that the Candidate reaches the required level of competency and responsibility. It should be noted that for an applicant to be registered as Professional Engineering Technician, each outcome should meet the responsibility level as indicated in Appendix A.

5.3 Statutory and regulatory requirements

Candidate Engineering Technicians or persons willing to register as a professional engineering technician with ECSA are expected to have a working knowledge of the following regulations and Acts and how this 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 (OHS Act);
• Building Regulations – National Building Regulations and Building Standards Act, 103 of 1977, as amended by Act 49 of 1995;
• Machinery and Works Regulations;
• Labour Relations Act, 66 of 1995;
• National Environmental Management Act, 107 of 1998;
• Industry Specific Work Instructions – Mine Health and Safety Act, 29 of 1996;
• The Public Financial Management Act, 1 of 1999;
• Public Service Regulations, 2001, as amended;
• Industry Specific Work Instructions and specifications; and
• SANS applicable specifications.

Candidates or applicants are expected to have basic knowledge of any other regulations, Acts and by-laws not listed above which may also be pertinent to a Candidate’s work environment.

5.4 Desirable formal learning activities

The following list of structured learning activities is by no means extensive and is purely a sample of some useful courses:

• Project management
• Conditions of contract\value engineering – NEC, JBCE etc.
• Standard specifications
• Preparation of specifications
• Negotiation skills
• Engineering finance
• Risk analysis quality systems
• Occupation health and safety
• Discipline specific courses quality systems
• Energy efficiency
• Electrical tariffs
6. PROGRAMME STRUCTURE AND SEQUENCING

6.1 Best practice

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 assigned to the Candidate by the employer. It is suggested that Candidates/Applicants work with their mentors to determine appropriate projects to gain exposure to elements of the asset life cycle. 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 the Candidate progresses through the levels of work capability described in document R-04-P to ensure that by the end of the training period, the Candidate exhibits Responsibility Level E and is able to perform individually and as a team member at the level of problem-solving and engineering activity required for registration. The nature of work, degrees of responsibility and level of support are in Table 1 above as per R-04-P and in Appendix A below.

6.2 Orientation requirements

Most companies have a set programme of orientation designed to last for a specific period; this may include:

- Introduction to Company;
- Company Safety Regulations;
- Company Code of Conduct;
- Company Staff Code and Regulations;
- Typical functions and activities in company;
- Hands-on experience and orientation in each of the major company divisions.

### 6.3 Activities undertaken under training

Table 2 below shows different activities that the Candidates or applicants undertake during progression through different responsibility levels.

#### Table 2: Progression throughout the training period

<table>
<thead>
<tr>
<th>Degree of Responsibility</th>
<th>Activities or duties to be undertaken under training</th>
</tr>
</thead>
</table>
| A: Being Exposed         | - Understand the business environment and the dynamics that shape the business and industries it operates in.  
                           | - Understand the business model, its key conversion processes and critical outcomes.  
                           | - Understand the value added by Electrical Engineering Technicians and by other professions in the business. |
| B: Assisting             | - Develop insight and understanding of the different well-defined processes and systems in the transformation of inputs into goods and services.  
                           | - Develop an appreciation of the numerous resources at the disposal of the Electrical Technician.  
                           | - Obtain experience in the day-to-day operations of the business, to gain insight and understanding of the different broadly defined processes and systems in the transformation of inputs into goods and services, with specific emphasis on productivity and quality measurements. |
| C: Participating         | - Gain first-hand experience of a broad range of broadly defined industrial engineering activities, for example, 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.  
                           | - The problems and limitations of particular well-defined philosophies, methods and techniques should be noted, with emphasis on cost / effort and relative benefit. |
| D: Contributing          | - Involvement in the planning of production, the control of quality and costs of process study and work study and good materials handling and workplace layout, activity-based costing, bench marking, business cases, process re-engineering, maintenance practice and procedures, project management and system specification, all working together in the economic use of people, materials and machines, is of particular |
### Degree of Responsibility

<table>
<thead>
<tr>
<th>Activities or duties to be undertaken under training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific attention should also be given to human aspects concerning communication, interpersonal relationships and teamwork, training and cost analysis, budget control and profit accountability. These should proceed in parallel, applying well-defined industrial engineering techniques and by utilising computers in problem solving.</td>
</tr>
</tbody>
</table>

#### E: Performing

- Assume increasing well-defined technical responsibility and increasingly co-ordinate the work of others.
- Exposure to and development of skill in management areas such as in labour relations, management accounting, business law and general business management which are important to develop a fully rounded industrial engineering technologist.
- Assignments that require well-defined judgment to be made, even when full information is unavailable, leading to a position of professional responsibility is of great value and should be pursued.

### 6.4 Realities

Generally, irrespective of the discipline, it is unlikely that the period of training will be less than three years for candidates with a Dip (Engineering), Dip (Eng Tech), or four years for candidates with an Adv Cert (Engineering), the minimum time required by ECSA. In most cases, it will be longer and would be determined among others by the availability of functions in the actual work situation.

### 6.5 Considerations for generalists, specialists, researchers and academics

Document R-08-PN adequately describes what would be expected of persons whose formative development has not followed a conventional path, for example academics, researchers, and specialists. The overriding consideration is that, irrespective of the route followed, the applicant must provide evidence of competence against the standard.

### 6.6 Moving into or changing candidacy training programmes

This guide assumes that the Candidate enters a programme after graduation and continues with the programme until ready to apply for registration. It also assumes that the Candidate is supervised and mentored by persons who meet the requirements in document R-04-P. In 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 be completed:

- The Candidate must complete the training and experience summary (TES) and training and experience reports (TERs) for the previous programme or unstructured experience. In the latter case, it is important to reconstruct the experience as accurately as possible. The TERs must be signed off by the relevant supervisor.
- On entering a new programme, the mentor and supervisor should review the Candidate’s development in the light of the past experience and opportunities and the requirements of the new programme and plan at least the next phase of the candidate’s programme.
The Discipline-Specific Training Guide (DSTG) for
Candidate Engineering Technician in Electrical Engineering

Revision 2 dated 10 October 2019 and consisting 27 pages reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research, Policy and Standards (RPS).

Business Unit Manager

Executive: RPS

This definitive version of this policy is available on our website.
APPENDIX A: Training elements

Synopsis: Candidate Technicians should achieve specific competencies at the prescribed level during their development towards professional registration and at the same time should accept more responsibility as experience is gained. The outcomes achieved and established during the Candidacy Phase should form the template for all engineering work performed after professional registration regardless of the level of responsibility at any particular stage of the engineering career:

1. Confirm understanding of instructions received and clarify if necessary.
2. Use theoretical training to develop possible solutions; thereafter, selecting the best and presenting to the recipient.
3. Apply theoretical knowledge to justify decisions taken and processes used.
4. Understand role in the work team and plan and schedule work accordingly.
5. Issue complete and clear instructions and report comprehensively on work progress.
6. Be sensitive about the impact of the engineering activity and take action to mitigate this impact.
7. Consider and adhere to legislation applicable to the task and the associated risk identification and management.
8. Adhere strictly to high ethical behavioural standards and to the ECSA Code of Conduct.
9. Display sound judgement by considering all factors, their interrelationship, consequences and evaluation when all evidence is unavailable.
10. Accept responsibility for own work by using theory to support decisions, seeking advice when uncertain and evaluating shortcomings.
11. Become conversant with employer’s training and development programme and develop own lifelong development programme within this framework.

Well-defined engineering work is usually restricted to applying standard procedures, codes and systems (i.e. work that was done before).

Responsibility Levels: A = Being Exposed; B = Assisting; C = Participating; D = Contributing; E = Performing
### Competency Standards for Registration as a Professional Engineering Technician

#### 1. Purpose
This standard defines the competence required for registration as a Professional Engineering Technician. Definitions of terms having particular meaning within this standard are presented in Appendix B.

#### 2. Demonstration of Competence
Competence must be demonstrated within well-defined engineering activities (defined below) by the integrated performance of the outcomes defined in Section 3 at the level defined for each outcome. Required contexts and functions may be specified in the applicable DSTG.

**Level descriptor:** Well-defined engineering activities (WDEA) have several of the following characteristics:

- **a)** Scope of practice area is defined by techniques applied; change is by adopting new techniques into current practice.
- **b)** Practice area is located within a wider, complex context, with well-defined working relationships with other parties and disciplines.

### DSTGs give context to the purpose of the Competency Standards. Professional Technicians operate within the nine disciplines ECSA recognises. Each discipline can be further divided into sub-disciplines and finally, into specific workplaces as demonstrated in Clause 4 of the specific DSTG. DSTGs are used to facilitate experiential development towards ECSA registration and assist in compiling the required portfolio of evidence (specifically the Engineering Report in the application form).

**NOTE:** The training period must be used to develop the competence of the trainee towards achieving the standards presented below at a Responsibility Level E (i.e. Performing). Refer to Section 7.1 of the specific DSTG.

Engineering activities can be approximately divided into:

- 5% Complex (Professional Engineers)
- 5% Broadly Defined (Professional Technologists)
- 10% Well-Defined (Professional Technicians)
- 15% Narrowly Well-Defined (Registered Specified Categories)
- 20% Skilled Workman (Engineering Artisan)
- 55% Unskilled Workman (Artisan Assistant).

The activities can be in-house or contracted out; evidence of integrated performance can be submitted irrespective of the situation.

**Level descriptor:** WDEAs in the various disciplines are characterised by several or all of the following:

- **a)** Scope of practice area does not cover the entire field of the discipline (exposure limited to the sub-discipline and specific workplace). Techniques applied are largely well established and change by adopting new techniques into current practice is the
3. Outcomes to be satisfied

<table>
<thead>
<tr>
<th>Group A: Engineering Problem-Solving</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome 1</strong>: Define, investigate and analyse well-defined engineering problems.</td>
<td><strong>Responsibility Level E</strong></td>
</tr>
</tbody>
</table>

Analysis of an engineering problem means the “separation into parts, possibly with comment and judgement”.

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QM-TEM-001 Rev 0 – ECSA Policy/Procedure
<table>
<thead>
<tr>
<th>Well-defined engineering problems have the following characteristics:</th>
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<tbody>
<tr>
<td>a) can be solved mainly by practical engineering knowledge underpinned by related theory; <strong>and one or more of:</strong></td>
</tr>
<tr>
<td>b) are largely defined but may require clarification;</td>
</tr>
<tr>
<td>c) are discrete, focused tasks within engineering systems;</td>
</tr>
<tr>
<td>d) are routine, frequently encountered, may be unfamiliar but in a familiar context; <strong>and one or more of:</strong></td>
</tr>
<tr>
<td>e) can be solved by standardised or prescribed ways;</td>
</tr>
<tr>
<td>f) are encompassed by standards, codes and documented procedures; authorisation required to work outside limits;</td>
</tr>
<tr>
<td>g) information is concrete and largely complete but requires checking and possible supplementation;</td>
</tr>
<tr>
<td>h) involve several issues (few of these impose conflicting constraints) and a limited range of interested and affected parties; <strong>and one or both of:</strong></td>
</tr>
<tr>
<td>i) require practical judgement in the practice area in the evaluation of solutions and consideration of interfaces to other role players;</td>
</tr>
<tr>
<td>j) have consequences that are locally important but not</td>
</tr>
</tbody>
</table>

| a) A practical problem for Engineering Technicians means the problem encountered cannot be solved by artisans because theoretical calculations and engineering decisions are necessary to substantiate the solution proposed. |
| b) Further investigation to identify the nature of the problem is seldom necessary. |
| c) The problem is discrete, meaning it is individually distinct and easily recognised as part of the larger engineering task, project or operation. |
| d) It is recognised that the problem occurred in the past or the possibility exists that it may have happened before; it is definitely and possibly occurred in the past therefore it is not a new problem. |
| e) The problem does not require the development of a new solution (determine how the problem was previously solved). |
| f) Encompassed means encircled: The standards, codes and documented procedures must be obtained to solve the problem, and authorisation from the Engineer or Technologist in charge must be obtained to waive the stipulations. |
| g) The responsibility lies with the Engineering Technician to check that the information received regarding the problem encountered is correct and is added to as necessary to ensure the correct and complete execution of the work. |
| h) The problem handled by the Engineering Technician must be limited to well-known matters and preferably requires standardised solutions without possible complications. |
| i) Practical solutions to problems include knowledge of the skills displayed by Practical Specialists and Engineering Artisans without sacrificing theoretical engineering principles and/or taking shortcuts to satisfy the parties involved. |
| j) Engineering Technicians must realise that their actions may appear to be of local importance only but may develop into problems for which support from Engineers and Technologists may be needed to deal with the consequences. |
Subject: Discipline-specific Training Guideline for Candidate Engineering Technician in Electrical Engineering

<table>
<thead>
<tr>
<th>Compiler: MB Mtshali</th>
<th>Approving Officer: EL Nxumalo</th>
<th>Next Review Date: 10/10/2023</th>
</tr>
</thead>
</table>

**Assessment criteria:** A structured analysis of well-defined problem typified by the following performances is expected.

1.1 To perform an engineering task, an Engineering Technician will typically receive an instruction from a senior person (customer) to perform the task and must ensure that the instruction is complete, clear and within his/her capability and that the person who issued the instruction agrees with his/her interpretation; and

1.2 Ensure that the instruction and information to do the work is complete and fully understood, including the engineering theory needed to understand the task and to carry out and/or check the calculations and the acceptance criteria. If needed, supplementary information must be gathered, studied and understood.

**Range statement:** The problem may be part of a larger engineering activity or may stand alone. The design problem is amenable to solution by established techniques that are practised regularly by the Candidate. Outcome 1 is concerned with the understanding of a problem; Outcome 2 is concerned with the solution.

**Outcome 2:** Design or develop solutions to well-defined engineering problems.

**Assessment criteria:** This outcome is normally demonstrated after the problem analysis defined in Outcome 1. Working systematically to synthesise a solution to a well-defined problem typified by the following performances is expected.

**Responsibility Levels C and D**

Design means “drawing or outline from which something can be made”.  
Develop means “come or bring into a state in which it is active or visible”.  

After the task received is fully understood and interpreted, a solution to the problem posed can be developed (designed). To synthesise a solution means “to combine separate parts, elements, substances, etc. into a whole or into a system”.  

2.1 The development (design) of more than one way to solve an engineering task or problem should always be done and include the costing and impact assessment for each alternative. All the alternatives must meet the requirements set out by the
2.1 Describe how you designed or developed and analysed alternative approaches to do the work. Impacts checked. Calculations attached.

2.2 State your final solution to perform the work – client instruction received, and the theoretical calculations to support each alternative must be done and submitted as an attachment.

2.2 In some cases, the Engineering Technician will not be able to support proposals with the complete theoretical calculation substantiating every aspect and must, in these cases, refer his/her alternatives to an Engineer or Technologist for scrutiny and support. The alternatives and the recommended alternative must be convincingly detailed to win customer support for the recommended alternative. Selection of alternatives may be based on tenders submitted with alternatives deviating from those specified.

Range statement: The solution is amenable to established methods, techniques and procedures within the candidate’s practice area.

Applying theory to well-defined engineering work is done in a way that has been used before. The process was probably developed by Engineers or Technologists in the past and documented in written procedures, specifications, drawings, models, examples, etc. Engineering Technicians must seek approval for any deviation from these established methods.

Outcome 3: Comprehend and apply knowledge embodied in established engineering practices and knowledge specific to the jurisdiction in which he/she practises.

Responsibility Level E

Comprehend means to understand fully. The jurisdiction in which an Engineering Technician practises is given in Clause 4 of the specific DSTG.

Assessment criteria: This outcome is normally demonstrated in the course of design, investigation or operations.

3.1 State which NDip-level engineering standard procedures and systems you used to execute the work and how NDip-level theory was applied to understand and/or verify these procedures.

3.2 Provide your own NDip-level theoretical calculations and/or reasoning on why the application of this

Design work for Engineering Technicians mainly involves utilising and configuring manufactured components. The design work is repetitive and uses an existing design as an example. Engineering Technicians apply existing codes and procedures in their design work. Investigation is on well-defined incidents. Condition monitoring and operations mainly involve controlling, maintaining and improving engineering systems and operations.

3.1 Understanding of well-defined procedures and techniques must be based on fundamental mathematical, scientific and engineering knowledge. Specific procedures and techniques applied to do the work accompanied by the underpinning theory must
theory is considered correct (actual examples required).

### Range statement: Applicable knowledge includes the following:

- **a) Technical knowledge** that is applicable to the practice area irrespective of location and is supplemented by locally relevant knowledge, for example, established properties of local materials.
- **b) A working knowledge of interacting disciplines and codified knowledge in related areas:** financial, statutory, safety, management.
- **c) Jurisdictional knowledge** regarding legal and regulatory requirements and prescribed codes of practice.

- **3.2 Calculations confirming the correct application and utilisation of equipment listed in Clause 4 of the specific DSTG must be done on practical well-defined activities. Reference must be made to standards and procedures used and how these were derived from NDip theory.**

- **a) The specific location of a task to be executed is the most important determining factor in the layout design and utilisation of equipment. A combination of educational knowledge and practical experience must be used to substantiate decisions taken and must include a comprehensive study of materials, components and projected customer requirements and expectations.**

- **b) Regardless of having a working knowledge of interacting disciplines, Engineering Technicians must appreciate the importance of working with specialists such as Civil Engineers on structures and roads, Mechanical Engineers on fire protection equipment, Architects on buildings and Electrical Engineers on communication equipment. The codified knowledge in the related areas means working to and understanding the requirements set out by specialists in the areas mentioned.**

- **c) Jurisdictional in this instance means ‘having the authority’, and Engineering Technicians must adhere to the terms and conditions associated with each task undertaken. The Engineering Technician may be appointed as the ‘responsible person’ for specific duties in terms of the OHS Act.**
Group B: Managing Engineering Activities

<table>
<thead>
<tr>
<th>Outcome 4: Manage part or all of one or more well-defined engineering activities.</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsibility Level D</td>
<td>Manage means “control”.</td>
</tr>
<tr>
<td>Assessment criteria: The display of personal and work process management abilities is expected:</td>
<td></td>
</tr>
<tr>
<td>4.1 State how you managed yourself, priorities, processes and resources in carrying out the work (e.g. bar chart).</td>
<td>In engineering operations and projects, Engineering Technicians will typically be given the responsibility to carry out specific tasks and/or complete projects.</td>
</tr>
<tr>
<td>4.2 Describe your role and contribution in the work team.</td>
<td>4.1 Resources are usually subdivided based on availability and are controlled by a work-breakdown structure and schedule to meet deadlines. Quality, safety and environmental management are important aspects.</td>
</tr>
<tr>
<td>4.2 Depending on the task, the Engineering Technician can be the team leader or a team member and can supervise appointed contractors.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome 5: Communicate clearly with others in the course of his/her well-defined engineering activities.</th>
<th>Responsibility Level C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment criteria: Demonstration of effective communication.</td>
<td>5.1 Refer to the Range Statement for outcomes 4 and 5. Presentation of point of view mainly occurs in meetings and discussions with immediate supervisor.</td>
</tr>
<tr>
<td>5.1 State how you presented your point of view and compiled reports after completion of the work.</td>
<td>5.2 Refer to the Range Statement for outcomes 4 and 5.</td>
</tr>
<tr>
<td>5.2 State how you compiled and issued instructions to entities working on the same task.</td>
<td></td>
</tr>
</tbody>
</table>

**Range statement for outcomes 4 and 5:** Management and communication in well-defined engineering involves the following:

- Planning means ‘the arrangement for doing or using something; considering in advance’.
- Organising means ‘putting into working order; arranging in a system; making preparations for’.
- Leading means ‘guiding the actions and opinions of; influencing; persuading’.
- Controlling means the ‘regulating, restraining, keeping in order; checking’.
c) Leading well-defined activities;

   d) Controlling well-defined activities.

Communication relates to technical aspects and the wider impacts of professional work. Audience includes peers, other disciplines, clients and stakeholders. Appropriate modes of communication must be selected. The Engineering Technician is expected to perform the communication functions reliably and repeatedly.

Engineering Technicians write or participate in writing specifications for the purchase of materials and/or for work to be done; make recommendations on tenders received; place orders and variation orders; write work instructions; report back on work done; draw, correct and revise drawings; compile test reports; use operation and maintenance manuals to write work procedures; write inspection and audit reports; write commissioning reports; prepare and present motivations for new projects; compile budget reports; report on studies done and calculations carried out; report on customer requirements; report on safety incidents and risk analysis; report on equipment failure; report on proposed system improvement and new techniques; report back on cost control; etc.

### Group C: Impacts of Engineering Activity

<table>
<thead>
<tr>
<th>Outcome 6: Recognise the general foreseeable social, cultural and environmental effects of well-defined engineering activities</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Responsibility Level B</strong></td>
</tr>
<tr>
<td></td>
<td>Social means “relating to people living in communities; relations between persons and communities”. Cultural means “all the arts, beliefs, social institutions, etc. that are characteristic of a community”. Environmental means “surroundings, circumstances, influences”.</td>
</tr>
</tbody>
</table>
### Assessment criteria: This outcome is normally displayed in the course of the analysis and solution of problems.

6.1 Describe the social, cultural and environmental impact of the engineering activity.

6.2 State how you communicated mitigating measures to affected parties and acquired stakeholder engagement.

6.1 Engineering significantly affects the environment (e.g. servitudes, expropriation of land, excavation of trenches with associated inconvenience, borrow pits, dust and obstruction, street and other crossings, power dips and interruptions, visual and noise pollution, malfunctions, oil and other leaks, electrocution of human beings, detrimental effect on animals and wild life, dangerous rotating and other machines, and demolition of structures).

6.2 Mitigating measures taken may include environmental impact studies, environmental impact management, community involvement and communication, barricading and warning signs, temporary crossings, alternative supplies (ring feeders and bypass roads), press releases and compensation paid.

### Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his/her well-defined engineering activities

**Responsibility Level E**

#### Assessment criteria:

7.1 List the major laws and regulations applicable to this particular activity and indicate how health and safety matters were handled.

7.2 State how you obtained advice in carrying out risk management for the work and elaborate on the risk management system applied.

7.1 The OHS Act is supplemented by a variety of parliamentary Acts, regulations, local authority by-laws, standards and codes of practice. Places of work may have standard procedures, instructions, drawings, and operation and maintenance manuals available. Depending on the situation (emergency, breakdown, etc.), these documents are consulted before commencing the work and during the activity.

7.2 It is advisable to attend a Risk Management (assessment) course and to investigate and study the materials, components and systems used in the workplace. The Engineering Technician seeks advice from knowledgeable and experienced specialists if the slightest doubt exists that safety and sustainability cannot be guaranteed.
Range Statement for outcomes 6 and 7: Impacts and regulatory requirements include the following:

a) Impacts to be considered are generally those identified within the established methods, techniques and procedures used in the practice area.
b) Regulatory requirements are prescribed.
c) Prescribed risk management strategies are applied.
d) Effects to be considered and methods used are defined.
e) Safe and sustainable materials, components and systems are prescribed.
f) Persons whose health and safety are to be protected are both inside and outside the workplace.

a) The impacts will vary substantially with the location of the task (e.g. the impact of laying a cable or pipe in the main street of a town will be entirely different to the impact of construction in a rural area). The methods, techniques and procedures will differ accordingly and are identified and studied by the Engineering Technician before starting the work.
b) The Safety Officer and/or the Responsible Person appointed in accordance with the OHS Act usually confirms or checks that the instructions are in line with regulations. The Engineering Technician is responsible for ensuring this is done, and if not, for establishing which regulations apply and ensuring adherence. Usually, the people working on site are strictly controlled w.r.t. health and safety, but the Engineering Technician checks that this is done. Tasks and projects are mainly carried out where contact with the public cannot be avoided, and safety measures such as barricading, and warning signs must be used and maintained.
c) Risks are mainly associated with elevated structures, subsidence of soil, electrocution of human beings and moving parts on machinery. Risk-management strategies are usually implemented by more senior staff but are understood and applied by the Engineering Technician.
d) Effects associated with risk management are mostly well known if not obvious, and methods used to address these risks are clearly defined.
e) Usually, the components and systems and the safe and sustainable materials are prescribed by Engineers, Technologists or other professional specialists. It is the responsibility of the Engineering Technician to use his/her knowledge and experience to check and interpret what is prescribed and to report if any dispute exists.
f) Health and safety of the staff working on the task or project as well as persons affected by the engineering work should be considered.
### Group D: Exercise judgement, take responsibility and act ethically

<table>
<thead>
<tr>
<th>Outcome 8: Conduct engineering activities ethically</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
</table>
| **Responsibility Level E**                        | Ethi
city means “science of morals; moral soundness”.
1.1 Moral means “moral habits; standards of behaviour; principles of right and wrong”.

**Assessment criteria:** Sensitivity to ethical issues and the adoption of a systematic approach to resolving such issues are expected.

8.1 State how you identified the ethical issues in addition to the affected parties and their interests and indicate the actions you took when a problem arose.

8.2 Confirm that you are conversant and in compliance with the ECSA Code of Conduct and why this Code of Conduct is important in your work.

<table>
<thead>
<tr>
<th>Outcome 9: Exercise sound judgement in the course of well-defined engineering activities</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
</table>
| **Responsibility Level E**                                                            | Judgement means “good sense; ability to judge”.

**Assessment criteria:** Judgement is displayed by the following performance:

9.1 The extent of a project or task given to a junior Engineering Technician is characterised by the limited number of factors and their resulting interdependence. The Engineering Technician will seek advice if educational and/or experiential limitations are exceeded. Examples of the main engineering factors applied must be given.
### Range Statement for outcomes 8 and 9: Judgement in decision-making involves:

<p>| | |</p>
<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>a)</td>
<td>accounting for limited risk factors, some of which may be ill-defined;</td>
</tr>
<tr>
<td>b)</td>
<td>accounting for consequences that are in the immediate work contexts; or</td>
</tr>
<tr>
<td>c)</td>
<td>accounting for an identified set of interested and affected parties with defined needs.</td>
</tr>
</tbody>
</table>

### In engineering, approximately 10% of the activities can be classified as well-defined and for these, the Engineering Technician uses standard procedures, codes of practice, specifications, etc. Judgement must be displayed to identify any activity that falls outside the well-defined range (defined above):

<p>| | |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Advice is sought when risk factors exceed his/her capability.</td>
</tr>
<tr>
<td>b)</td>
<td>Consequences outside the immediate work contexts (e.g. long-term) are not normally handled.</td>
</tr>
<tr>
<td>c)</td>
<td>Interested and affected parties with defined needs outside the well-defined parameters are taken into account.</td>
</tr>
</tbody>
</table>

### Outcome 10: Be responsible for making decisions on part or all of one or more well-defined engineering activities.

**Responsibility Level E**

Responsible means “legally or morally liable for carrying out a duty; caring for something or somebody while being in a position where one may be blamed for loss, failure, etc.”

**Assessment criteria:** Responsibility is displayed by the following performance:

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>10.1</td>
<td>Show how you used NDip theoretical calculations to justify decisions taken in carrying out the engineering work. Attach actual calculations.</td>
</tr>
<tr>
<td>10.2</td>
<td>State how you sought responsible advice on any matter falling outside your own education and</td>
</tr>
</tbody>
</table>

<p>| | |</p>
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<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1</td>
<td>The calculations (e.g. fault levels, load calculations, losses) are done to ensure that the correct material and components are used.</td>
</tr>
</tbody>
</table>
| 10.2 | The Engineering Technician does not operate on tasks at a higher level than well-defined and consults professionals at engineer and/or technologist level if elements of the tasks to be done are beyond his/her education and experience (e.g. power system
### 10.3 Describe how you took responsibility for your own work and evaluated any shortcomings in your output.

**Range statement:** Responsibility must be discharged for significant parts of one or more well-defined engineering activities.

**Note 1:** Demonstration of responsibility is under the supervision of a competent engineering practitioner, but the Engineering Technician is expected to perform as if he/she is in a responsible position.

10.3 The Engineering Technician engages in continuous self-evaluation to ascertain that the task given is done correctly, on time and within budget. Continuous feedback to the originator of the task instruction with corrective action taken if necessary forms an important element.

The responsibility is mainly allocated within a team environment and with an increasing designation as experience is gathered.
<table>
<thead>
<tr>
<th>Group E: Initial Professional Development (IPD)</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome 11:</strong> Undertake independent learning activities sufficient to maintain and extend his/her competence.</td>
<td><strong>Responsibility Level D</strong></td>
</tr>
</tbody>
</table>
| **Assessment criteria:** Self-development is displayed by the following performance:  
  11.1 Provide the strategy that you independently adopted to enhance professional development (IPD report)  
  11.2 Be aware of the philosophy of the employer in regard to professional development |  
  11.1 If possible, a specific field of the sub-discipline is chosen, available developmental alternatives are established, a programme is drawn up (in consultation with the employer if costs are involved) and options that are open to expand knowledge into additional fields are investigated.  
  11.2 Record-keeping must not be left to the employer or any other person. The trainee must manage his/her own training independently, taking the initiative and being in charge of his/her experiential development towards Professional Engineering Technician level. Knowledge of the employer's policy and procedures on training is essential. |
| **Range statement:** Professional development involves the following:  
  a) Taking ownership of own professional development.  
  b) Planning own professional development strategy.  
  c) Selecting appropriate professional development activities.  
  d) Recording professional development strategy and activities while displaying independent learning ability. |  
  a) This is your professional development, not the development of the organisation for which you are working.  
  b) In most places of work, training is seldom organised by a training department. The Engineering Technician must manage his/her own experiential development. Engineering Technicians frequently find themselves at a standstill and are left doing repetitive work. If self-development is not self-driven, success is unlikely.  
  c) Preference must be given to engineering development rather than developing soft skills.  
  d) Developing a learning culture in the workplace environment of the Engineering Technician is vital to his/her success. Information is readily available, and most senior personnel in the workplace are willing to mentor if approached. |