ECSA

ENGINEERING COUNCIL OF SOUTH AFRICA

An Effective Regulator Assuring Engineering Excellence

Discipline-specific Training Guide for Registration as a Professional Engineer, Technologist, and Technician in Civil Engineering

R-05-CIV-PE/PT/PN

REVISION 0: 17 April 2024

ENGINEERING COUNCIL OF SOUTH AFRICA
Tel: 011 6079500 | Fax: 011 6229295
Email: engineer@ecsa.co.za | Website: www.ecsa.co.za

TABLE OF CONTENTS

DEFINITIONS

Applicant: A person applying to the ECSA for registration in any of the categories according to Section 18 of the Engineering Profession Act, No. 46 of 2000

Broadly defined engineering problems: Composed of many inter-related conditions and requiring underpinning methods, procedures, and technical judgement to create a solution within a set of originally broadly defined circumstances

Commitment and Undertaking (C&U): An agreement entered into between an employer and the 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.

Continuing professional development: The systematic maintenance, improvement, and broadening of knowledge and skills and the development of personal qualities necessary for the execution of professional and engineering duties throughout the career of an engineering practitioner

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, to solve problems, and to provide the knowledge base for engineering specialisations

Ill-posed problem: A problem whose requirements are not fully defined or may be defined erroneously by the requesting party

Integrated performance: The 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.

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

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

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

Practise 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 an applicant

Well-defined engineering problems: Problems composed of inter-related conditions and requiring underpinning methods, procedures, and techniques to create a solution within a set of originally well-defined circumstances.

ABBREVIATIONS

BEng (Tech)	Bachelor of Engineering in Technology
BIFSA	Building Industries Federation South Africa
BSc (Eng)	Bachelor of Science in Engineering
BTech (Eng)	Bachelor of Technology in Engineering
CIDB	Construction Industry Development Board
CESA	Consulting Engineers South Africa
CPD	Continuing Professional Development
C&U	Commitment and Undertaking
DoR	Degree of responsibility
DSTG	Discipline-Specific Training Guide
IDoEW	Identification of Engineering Work
IPD	Initial Professional Development
NDip	National Diploma
PD	Professional Development
PE	Professional Engineer
PGDip	Postgraduate Diploma
PN	Professional Engineering Technician
PT	Professional Engineering Technologist
SAFCEC	South African Federation of Civil Engineering Contractors
SAICE	South African Institution of Civil Engineering
SOEs	State-owned enterprises
TER	Training and Experience Report
TES	Training and Experience Summary

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 and provide the framework for all engineering disciplines and registration categories recognised by ECSA.

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.

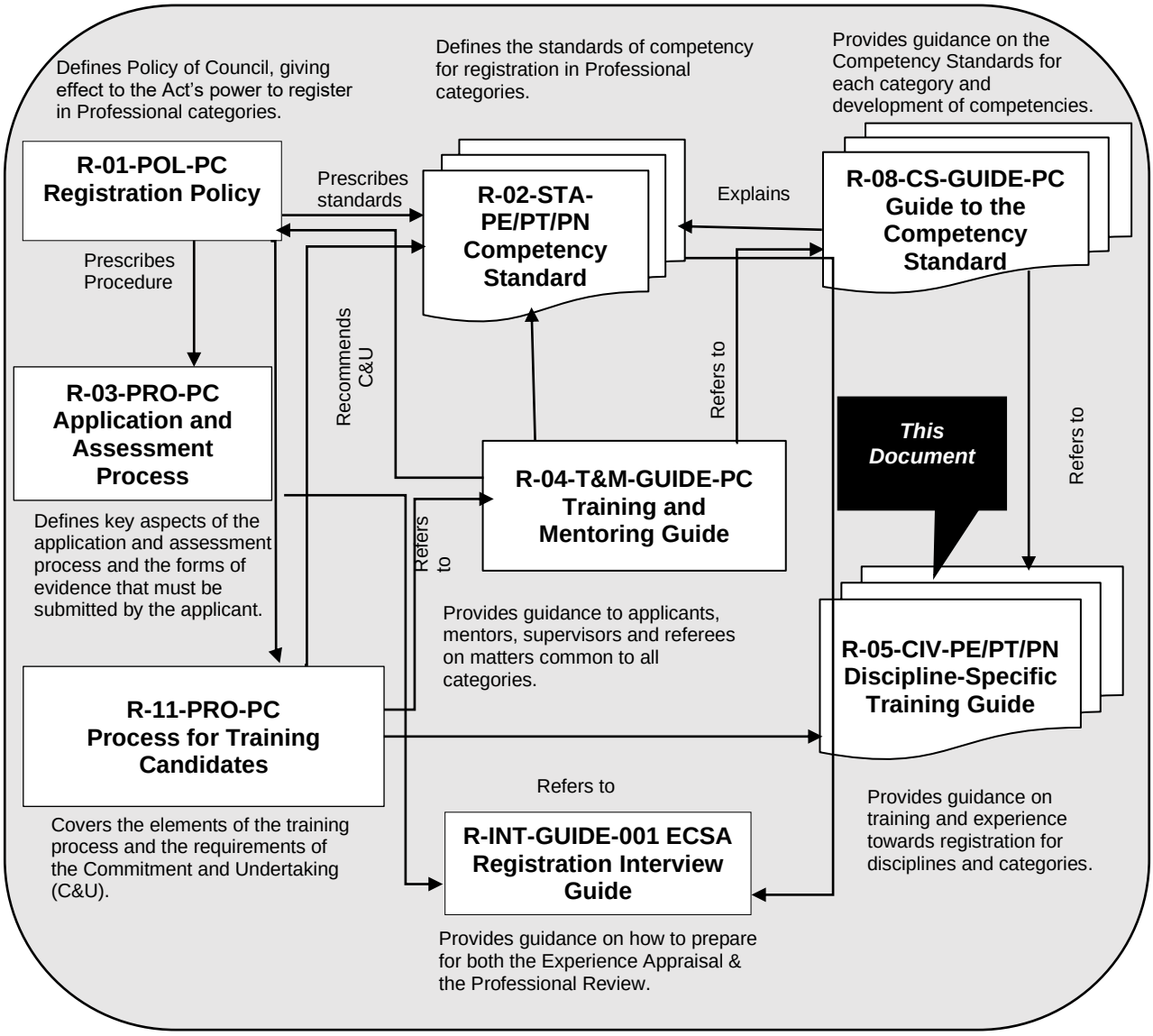

Figure 1: Documents defining the ECSA registration system

1. PURPOSE OF THIS DOCUMENT

This document provides a discipline-specific training guideline, outcome-by-outcome, for applicant Civil 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 Civil Engineering. 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-CIV**: Code of Practice for the Performance of Civil 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

Civil Engineers, Technologists and/or Technicians form a collective group of engineers who plan, design, organise and oversee the construction, operation, maintenance and management of civil engineering infrastructure.

- **Structural systems:** These include buildings, dams, bridges, roads, highways, runways, harbours and railways.
- **Geotechnical systems:** These include township services, earthworks, excavations, soil conservation and geotechnical processes.
- **Transportation systems:** These include the roads, railway, airport runways and all the combination of elements and their interactions, which produce the demand for travel within a given area.
- **Hydraulic engineering systems:** These include water resources and supply, pipelines, canals, water treatment, storm water and drainage, sewer systems, sanitation waste disposal and coastal engineering.

Typical tasks that Civil Engineers**,** Technologists and/or Technicians may undertake include the following:

- Conducting research and developing new or improved theories and methods related to civil engineering.
- Advising on and designing infrastructures such as bridges, dams, harbours, roads, airports, stadiums, railways, canals, pipelines, treatment works, waste-disposal and flood-control systems and residential, commercial, industrial and other large buildings.
- Determining and specifying construction methods, materials and quality standards and directing construction work.
- Establishing control systems to ensure efficient functioning of infrastructure as well as safety and environmental protection.
- Organising and directing maintenance and repair of existing civil engineering infrastructure.
- Analysing the behaviour of soil and rock when placed under pressure by proposed structures and designing structural foundations.
- Analysing the stability of structures and testing the behaviour and durability of materials used in their construction.
- Managing finances which involves preparing the budget, control line items in the budget and proper financial control.
- Executing the design elements according to the specifications and approved construction drawings during the construction stage

Practising Civil Engineers**,** Technologists and/or Technicians generally concentrate in one or more of the following areas:

- Structural Engineering
- Geotechnical Engineering
- Transportation Engineering
- Roads Engineering
- Materials Science Engineering
- Coastal Engineering
- Municipal and Urban Engineering
- Forensic Engineering
- Environmental Engineering
- Construction and Management Engineering

- Railway Engineering
- Site development and Planning
- Surveying Water Engineering.

More specialised fields may be in Transportation and Urban Planning, Biosystems Engineering, GIS, Costal or Marine Engineering and Land-use Management.

The standards are differentiated for Professional Engineers, Professional Engineering Technologists and/or Professional Engineering Technicians by the insertion of level descriptors. These level descriptors are defined for the three professional categories in the Competency Standards defined in documents **R-02-STA-PE/PT/PN**. The applicant for registration should be familiar with the requirements of the applicable standards for the category.

4. DEVELOPING ENGINEERING COMPETENCIES

Professional Engineers, Professional Engineering Technologists and Professional Engineering Technicians may be employed in both the private and the public sector. Typically, in the private sector, they would be involved in consulting or contracting, or in supplier or manufacturing organisations. Consultants are responsible for planning, designing, documenting and supervising the construction and/or operation of projects on behalf of their clients. Contractors are responsible for project implementation, and activities, including planning, construction, 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 are also carried out. Professional Engineers, Professional Engineering Technologists and Professional Engineering Technicians are required at all levels of the public sector, including at national, provincial and local government level, state-owned enterprises (SOEs) and public utilities. The public sector largely handles planning, specifying, overseeing implementation, operations and maintenance of infrastructure.

An extension of the public sector includes tertiary academic institutions and research organisations.

Depending on where the candidate is employed, there may be situations where opportunities in-house are insufficiently diverse to develop all the competencies required in both Groups A and B,

noted in document **R-02-STA-PE/PT/PN**. For example, the opportunity to develop problem-solving competence (including design or developing solutions) and to manage 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 fairly common practice that where an organisation is unable to provide training in certain areas, secondments are arranged with other organisations, so the candidate is able to develop all the competencies required for registration.

These secondments are usually reciprocal, so both employers and their respective employees get the mutual benefit from the other party. Secondments between consultants and contractors, and between the public and private sector should be possible.

4.1 Training for registration as a Professional Engineer

4.1.1 Outcome 1: Define, investigate and analyse complex engineering problems (Responsibility level E)

The definition, investigation and analysis of complex engineering problems is typified by:

- defining the engineering problems and procedures for solving the problems
- investigating and evaluating pertinent information and identifying systems and sub-systems of complex problems, including collecting, organising and evaluating information from all applicable sources including in-situ investigations where appropriate
- analysing relevant assumptions, inputs and required outputs of a complex engineering problem.

To evaluate and analyse the engineering problem the applicants should:

- identifies and formulates the problem, which leads to an agreed definition of the problem to be addressed
- collects, organises and evaluates information
- uses conceptualisation, abstraction and modelling
- identifies and justifies assumptions, limitations, constraints and premises
- uses both mathematical and non-mathematical analytical methods
- evaluates the results of the analysis, using judgement

- expresses understanding of the results emerging from the analysis.

4.1.2 Outcome 2: Design or develop solutions to complex engineering problems (Responsibility levels C and D)

Designing or developing solutions to complex engineering problems based on engineering knowledge is at the centre of other engineering activities such as planning, research, development and technology transfer, quality assurance, risk analysis, domain-specific project management, managing engineering processes, safe work practices, environmental protection, sustainability analysis and systems engineering.

An example approach for the candidate is given below:

- analyses the requirements for the design/planning/solution and draws up a detailed requirements specification
- synthesises a range of potential solutions to the problem or a range of approaches to developing a solution that is consistent with assumptions, premises, limitations and constraints
- evaluates the potential approaches against the requirements and include cost and impacts outside the requirements
- presents reasoned arguments and a proposal for the preferred option
- fully develops the design of the selected option
- evaluates the resulting solution
- produces design documentation for review and implementation.

4.1.3 Outcome 3: Comprehend and apply advanced and local knowledge of the widely applied principles underpinning good practice that is specific to the jurisdiction in which the Engineer practices. (Responsibility Level E)

During this stage, applicants demonstrate how they comprehended and applied advanced and local knowledge of the widely applied principles underpinning good practice that are specific to the jurisdiction in which the engineer practices.

The application of engineering knowledge as an outcome is normally demonstrated during design, investigation or operations. The applicant:

- displays mastery in the understanding of engineering principles, practices and technologies in the practice area
- applies general and underpinning engineering knowledge to support analysis and to provide insight
- uses an analytical approach based on fundamentals and first principles in building models as required
- displays working knowledge of areas that interact with the practice area
- applies related financial, statutory, safety, and management knowledge
- calculates at theoretical level confirming the correct application and utilisation of equipment, materials, and systems
- understands complex procedures and techniques that must be based on fundamental mathematical, scientific, and engineering knowledge, as part of personal contribution within the engineering team
- displays the ability to manage the resources within legal and financial constraints.

4.1.4 Outcome 4: Manage part or all of one or more complex engineering activities (Responsibility Level D)

During this stage, applicants develop competence in managing part or all of one or more complex engineering activities which can be displayed by:

- managing self, people, work priorities, processes, and resources when performing complex engineering activities
- planning, organising, leading and controlling complex engineering activities
- managing contracts and other agreements and the ability to establish and maintain professional and business relationships
- resources management, availability and controlled by a work breakdown structure and scheduling to meet deadlines. Quality, safety and environment management are important aspects
- the basic elements of management must be applied to complex engineering work.

In line with the progression of levels of engineering work and the degree of responsibility (DoR) defined in document **R-04-T&M-GUIDE-PC**, the applicant uses various phases of activities that assist in developing the ability to plan, organise, lead and control. The applicant must be able to

perform these functions alone and in a team. Conducting engineering work alone or in a team requires planning and organising to attain the required technical outcomes. Participation and contribution as a team member and as a leader give the opportunity to demonstrate leadership and the ability to control on a limited scale.

4.1.5 Outcome 5: Communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of engineering activities. (Responsibility Level C)

During this stage, applicants should demonstrate competence in how to communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of engineering activities. Communication with respect to complex engineering problems relates to the technical aspects and the wider impacts of professional work. The applicant should develop the ability to:

- write clear, concise, and effective technical, legal, and editorially correct documentation
- issue clear and concise instructions and/or guidance, being cognisant of the audience and various skill levels
- execute oral presentations using structure, style, language, visual aids, and supporting documents appropriate to the audience and the purpose.

Moreover, the applicants should display effective communication which can be demonstrated by the ability to write clear, concise, and effective reports that are technically, legally and editorially correct using a structure and style that meets communication objectives and user/audience requirements.

4.1.6 Outcome 6: Recognise the reasonably foreseeable economic, social, cultural, and environmental effects of complex engineering activities seeking to achieve sustainability. (Responsibility Level B)

During this stage, applicants demonstrate the ability to recognise the reasonably foreseeable economic, social, cultural, and environmental effects of complex engineering activities, while seeking to achieve sustainability.

Furthermore, the applicants should develop the ability to identify interested and affected parties and their expectations with regard to technical, social, cultural and environmental effects, and be able to put in measures to mitigate the negative effects of complex engineering activities.

The applicants should be allowed to study, analyse, and recommend measures for:

- social/cultural impacts
- community/political considerations
- environmental impact
- sustainability analysis
- regulatory conditions
- potential ethical dilemmas.

4.1.7 Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons during all complex engineering activities. (Responsibility Level E)

During this stage, applicants should develop the ability to meet all legal and regulatory requirements and protect the health and safety of persons during all complex engineering activities. applicants are expected to have a working knowledge of the following Acts:

- Engineering Profession Act, 46 of 2000, its Rules, specifically the Code of Conduct
- Occupational Health and Safety Act, 85 of 1993 and its relevant regulations pertaining to the industry, as amended by Act 181 of 1993
- Construction Regulations

Moreover, depending on their area of practice, applicants should have a working knowledge of the following Acts but not limited to these Acts:

- National Building Regulations and Building Standards Act, 103 of 1977, as amended by Act 49 of 1995
- Environment Conservation Act, 73 of 1989, as amended by Act 52 of 1994 and Act 50 of 2003
- Water Services Act, 108 of 1997, as amended by Act 30 of 2004
- National Water Act, 36 of 1998, as amended by Act 45 of 1999.

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.

4.1.8 Outcome 8: Conduct engineering activities ethically (Responsibility Level E)

During this stage, applicants are expected to conduct engineering activities ethically. The applicants should be capable of handling ethical issues and adopts a systematic approach to resolve ethical issues, which is typified by:

- identifying the central ethical problem
- identifying affected parties and their interests
- searching for possible solutions to the dilemma
- evaluating each solution using the interests of those involved and according to suitable priorities
- selecting and justifying the solution that most appropriately resolves the dilemma.

The applicants are expected to have knowledge and compliance with the ECSA Code of Conduct for registered persons and be able to identify ethical problems and affected parties, and a systematic approach to resolving the issues while executing complex engineering activity.

4.1.9 Outcome 9: Exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of complex engineering activities. (Responsibility Level E)

During this stage, applicants demonstrate the ability to exercise sound judgement by evaluating the outcomes, impacts, and alternatives in the course of complex engineering activities. Judgement is expected in considering the interactions among conflicting technical, engineering, social or other issues and their far-reaching impact on affected parties in making recommendations.

The indication that a candidate/applicant exhibits engineering judgement is typically demonstrated by the following:

- considering several factors, some of which may be ill-defined or unknown
- considering the interdependence, interactions and relative importance of factors
- foreseeing consequences of actions

- evaluating a situation in the absence of full evidence.
- drawing on experience and knowledge.

4.1.10 Outcome 10: Be responsible for making decisions on part or all of complex engineering activities. (Responsibility Level E)

During this stage, applicants are responsible for making decisions on part or all of complex engineering activities. Competence in responsible decision-making is typified by:

- systematic gathering of related information and checking of facts and inputs required for the decision-making process
- making the final decision, based on knowledge, past experience and seeking advice on matters falling outside the applicant's education and experience
- recording the decision-making process and the reasons for the final decision
- taking responsibility and being prepared to be held accountable for far-reaching and significant consequences (whether positive or negative).
- continuous self-evaluation to ascertain that the task given is done correctly, on time and within budget

4.1.11 Outcome 11: Undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. (Responsibility Level D)

Professional development involves taking ownership, and independently planning, selecting, undertaking, and recording appropriate activities to extend competence. Applicants undertake sufficient professional development activities to maintain, extend competence, and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. Competence in self-development is typified by:

- explaining awareness and a strategy to independently enhance professional development
- evidence of self-development in chosen and new areas of expertise and personal development
- taking responsibility for one's own development
- reflecting on strengths and weaknesses, recognising needs, and planning
- executing development activities and overcoming obstacles.

4.2 Training for registration as a Professional Engineering Technologist

4.2.1 Outcome 1: Define, investigate and analyse broadly defined engineering problems (Responsibility level E)

During this stage, applicants demonstrate how to establish the level of complexity of the initial problem state, the complexity of the problem path from the initial state and the level of decision-making required and potential consequences. The definition, investigation and analysis of broadly defined engineering problems is typified by:

- performing or contributing to defining broadly defined engineering problems, thus leading to an agreed definition of the problems to be solved
- investigating or contributing to investigating engineering problems, including collecting, organising and evaluating information from all applicable sources, including in-situ investigations where appropriate
- performing or contributing to analysing engineering problems, using conceptualisation, justified assumptions, limitations and evaluation of results.

4.2.2 Outcome 2: Design or develop solutions to broadly defined engineering problems (Responsibility levels C and D)

The applicants should develop the ability to apply mathematical, natural science and engineering knowledge while developing solution to a broadly defined engineering problem that is typified by:

- designing or developing solutions to broadly defined engineering problems using appropriate theory and information technologies, while checking impacts, sustainability and stakeholder views
- systematically synthesising solutions and providing alternatives by analysing designs, correlating with requirements and considering the wide-ranging impacts and costs
- creating detailed specification requirements and designing documentation for implementation to the satisfaction of the client.

Furthermore, applicants perform a creative, systematic analysis of problems at the required level and work systematically to synthesise solutions to the problems and be able to:

- propose potential approaches or alternatives to the solution
- conduct a preliminary synthesis following selected approaches
- evaluate potential solutions against requirements and wider impacts
- present reasoned, economical and contextual engineering arguments and justification for the selected option or preferred solution
- fully develop the selected option or preferred solution
- evaluate the resulting solution
- document the solution for approval and implementation.

4.2.3 Outcome 3: Comprehend and apply advanced and local knowledge of the widely applied principles underpinning good practice that is specific to the jurisdiction in which the Engineer practices. (Responsibility Level E)

During this stage, applicants demonstrate how they comprehend and apply the knowledge embodied in widely accepted and applied engineering procedures, processes, systems and methodologies that is specific to the jurisdiction in which the Engineering Technologist practices. The applicants should develop the ability to analyse and model the engineering materials, components, systems or processes at broadly-defined engineering problems which are typified by:

- state what engineering principles, practices, procedures, methodologies and technologies, including the application of the theory, are applied in the practice area
- indicating a working knowledge of areas of practice that interact with the practice area to underpin teamwork
- demonstrating knowledge and application of engineering standards, codes of practice, legislation, regulations, and finance in the practice area.

The candidate/applicant typically demonstrates the following:

- Displays mastery of understanding current and emerging technologies in the practice area.
- Applies general and underpinning engineering knowledge to support analysis and provide insight into technologist activities.

- Uses an analytical approach as required.
- Displays working knowledge of areas that interact with the practice area.
- Applies related financial, statutory, safety, and management knowledge.

4.2.4 Outcome 4: Manage part or all of one or more broadly defined engineering activities (Responsibility Level D)

During this stage, applicants develop the ability to exercise sound judgement by evaluating the outcomes, impacts, and alternatives in the course of broadly defined engineering activities in line with the Competency Standard, document **R-02-STA-PE/PT/PN**, on the following:

- competency to manage broadly defined engineering activities must be demonstrated
- linked with management is the ability to communicate with those involved in the engineering activities
- managing self, people, work priorities, processes, and resources when performing broadly defined engineering activities
- planning, organising, leading, and controlling broadly defined engineering activities
- managing contracts and other agreements and the ability to establish and maintain professional and business relationships.

4.2.5 Outcome 5: Communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of engineering activities. (Responsibility Level C)

During this stage, applicants are expected to display effective communication which can be demonstrated by the following personal and the work processes:

- reading and evaluating engineering and legal matter relevant to the function of the Professional Engineering Technologist
- receiving instructions and ensuring correct interpretation
- issuing clear instructions to subordinates using appropriate language and communication aids and ensuring that language and other communication barriers are overcome

- undertaking oral presentations using structure, style, language, visual aids and supporting documents appropriate to the audience and purpose.

4.2.6 Outcome 6: Recognise the reasonably foreseeable economic, social, cultural, and environmental effects of broadly defined engineering activities seeking to achieve sustainability. (Responsibility Level B)

The applicants should develop the ability to identify interested and affected parties and their expectations concerning technical, sociocultural, and environmental effects while considering the economics and long-term sustainability of the broadly defined engineering activities and put in measures to mitigate the negative effects. Competence can be demonstrated when the applicants is allowed to study, analyse, and recommend measures for:

- social/cultural impacts
- community/political considerations
- environmental impact
- sustainability analysis
- regulatory conditions
- potential ethical dilemmas.

4.2.7 Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons during all broadly defined engineering activities. (Responsibility Level E)

To demonstrate competency in regulatory aspects, the applicants should develop the ability to meet all legal and regulatory requirements, protect the health and safety of persons during all broadly defined engineering activities and deal with uncertainty and risk applicable. The applicants should be able to

- identify the applicable legal, regulatory, and health and safety requirements for the engineering activity
- identify the risk and apply defined widely accepted risk management strategies
- select safe and sustainable materials, components, processes and systems
- communicate with parties involved in the legal and regulatory aspects.

Applicants are expected to have a working knowledge of the following Acts:

- Engineering Profession Act, 46 of 2000, its Rules, specifically the Code of Conduct
- Occupational Health and Safety Act, 85 of 1993 and its relevant regulations pertaining to the industry, as amended by Act 181 of 1993
- Construction Regulations.

Moreover, depending on their area of practice, applicants should have a working knowledge of the following Acts, but not limited to these Acts:

- National Building Regulations and Building Standards Act, 103 of 1977, as amended by Act 49 of 1995
- Environment Conservation Act, 73 of 1989, as amended by Act 52 of 1994 and Act 50 of 2003
- Water Services Act, 108 of 1997, as amended by Act 30 of 2004
- National Water Act, 36 of 1998, as amended by Act 45 of 1999.

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 Outcome 8: Conduct engineering activities ethically (Responsibility Level E)

The Code of Conduct covers the need to practise ethically and within one's area of competence, work with integrity, respect public interest and the environment, and uphold the dignity of the profession, including one's relationship with fellow professionals. There is also a section on administrative matters that relate to ethical practice. Applicants must study the ECSA Code of Conduct and be aware of its implications in situations that arise in engineering work. Applicants who are capable of handling ethical issues adopt a systematic approach to resolve ethical issues, which is typified by:

- identifying the central ethical problem
- identifying affected parties and their interests
- searching for possible solutions to the dilemma
- evaluating each solution using the interests of those involved and according to suitable priorities
- selecting and justifying the solution that most appropriately resolves the dilemma.

4.2.9 Outcome 9: Exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of broadly defined engineering activities. (Responsibility Level E)

During this stage, applicants develop the ability to exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of broadly defined engineering activitiesThe indication that a candidate/applicant exhibits engineering judgement is typically demonstrated by the following:

- considering several factors, some of which may be ill-defined or unknown
- considering the interdependence, interactions and relative importance of factors
- foreseeing consequences of actions
- evaluating a situation in the absence of full evidence
- drawing on experience and knowledge.

4.2.10 Outcome 10: Be responsible for making decisions on part or all of broadly defined engineering activities. (Responsibility Level E)

During this stage, applicants are responsible for making decisions on part or all of broadly defined engineering activities and should demonstrate responsibility at the required level of degree of responsibility, which is evidenced by:

- demonstrating a professional approach at all times
- indicating due regard to technical, social, environmental, and sustainable development considerations
- seeking advice from a responsible authority on any matter considered to be outside the area of competence
- making decisions and taking responsibility regarding work output.

4.2.11 Outcome 11: Undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. (Responsibility Level D)

During this stage, applicants undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. The emphasis is on the individual's ability to self-develop. This capability has several dimensions:

- taking responsibility for one's own development
- reflecting on strengths and weaknesses, recognising needs and planning
- executing development activities and overcoming obstacles.

All the activities listed below, including combinations thereof, constitute PD and thus, IPD:

- attending courses, seminars, congresses and technical meetings organised by engineering institutions/institutes, universities, other professional bodies and course providers
- actively participating in conferences, serving on technical or professional committees and engaging in working groups
- undertaking structured self-study (i.e., using textbooks with examples)
- studying technical literature (e.g., journals, magazines)
- taking correspondence courses, studying other supervised study packages, and taking in-house courses provided by employers where applicable
- enrolling for formal postgraduate studies (limited credits)
- Writing technical papers or presenting papers or lectures at organised events.

4.3 Training for registration as a Professional Engineering Technician

4.3.1 Outcome 1: Define, investigate and analyse well-defined engineering problems (Responsibility level E)

The definition, investigation and analysis of well-defined engineering problems is typified by:

- interpreting received work instructions from client and supervisor and checking with the client or supervisor that the interpretation is correct

- collecting and organising clarifying data from all applicable sources including in-situ investigations, where appropriate
- analysing, interpreting and evaluating clarifying information to either keep or revise initial instruction.

The well-defined engineering problem may be a design requirement, an applied research and development requirement or a problematic situation in an existing component, system, or process. An example of a schema for systematic analysis is presented below wherein the applicants must develop an ability to:

- interpret the client's demands, leading to an agreed statement of requirements
- clarify the requirements and draws issues and impacts to the client's attention
- identify standards for design aspects and codes and procedures to be followed
- gather information required for problem analysis
- identify acceptance criteria for work product
- verify that the design problem is amenable to solution by his/her techniques
- document functional solution requirements and gain client acceptance.

A similar schema applies to the synthesis phase, wherein the candidate/applicant develop the following abilities:

- identifies and analyses alternative approaches for meeting the problem specification
- seeks advice on aspects of the proposal or design process that fall outside established practices or standards
- plans tasks and selects methods to complete the design process
- carries out design or develops solutions and synthesises tasks
- assembles the complete solution and reviews to check compliance with the client's requirements
- checks solution and impacts of the solution on interested and affected parties
- reviews documented design with the client to obtain formal acceptance

4.3.2 Outcome 2: Design or develop solutions to well-defined engineering problems (Responsibility levels C and D)

During this stage, applicants demonstrate the ability to design or develop solutions to well-defined engineering problems. Applicants perform a creative, systematic analysis of problems at the required level and work systematically to synthesise solutions to the problems and can carry out the following:

- designing or developing solutions to well-defined engineering problems using appropriate theory and information technologies, while checking impacts, sustainability, and stakeholder views
- systematically synthesising solutions and providing alternatives to the work, considering the immediate requirements, impacts and costs
- stating the final solution and ensuring that the client or the supervisor agrees, and providing engineering documentation.

4.3.3 Outcome 3: Comprehend and apply advanced and local knowledge of the widely applied principles underpinning good practice that is specific to the jurisdiction in which the Engineer practices. (Responsibility Level E)

During this stage, applicants develop the ability to comprehend and apply knowledge embodied in established engineering practices that is specific to the jurisdiction in which the Engineering Technician practices. This outcome is normally demonstrated in the course of design, investigation or operations and the applicants must be able to:

- state what engineering principles, practices, procedures, methodologies and technologies, including the application of the theory, are applied in the practice area
- display mastery of established methods, procedures and techniques in the practice area
- apply the knowledge that underpins methods, procedures and techniques to support technician activities
- display working knowledge of areas that interact with the practice area
- demonstrating knowledge and application of engineering standards, codes of practice, legislation, regulations and finance in the practice area
- apply codified knowledge in related areas (i.e., financial, statutory, safety, management)

- use information technology effectively as required in the practice area
- Example: Know and apply ISO9001 or equivalent, SANS, COLTO or other relevant engineering standards.

4.3.4 Outcome 4: Manage part or all of one or more well-defined engineering activities (Responsibility Level D)

During this stage, applicants develop competence on managing part or all of one or more well-defined engineering activities.

Competent engineering practitioners must not only perform technical functions but must also manage engineering activities. Management of well-defined engineering activities is directed at achieving results as a member or leader of a team by planning and harnessing people, resources, processes, systems, money and contracts or agreements. Applicants must be able to:

- manage self, people, work priorities, processes and resources when performing well-defined engineering work
- plan, organise, lead and control well-defined engineering activities
- manage contracts and other agreements and the ability to establish and maintain professional and business relationships.

The progression of levels of engineering work and degrees of responsibility defined in document **R-04-T&M-GUIDE-PC,** namely Being exposed, Assisting, Participating, Contributing and Performing, also apply to the management outcomes and the communication outcome at the stage of applying for registration as a Professional Engineering Technician.

4.3.5 Outcome 5: Communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of engineering activities. (Responsibility Level C)

During this stage, applicants demonstrate competence on how to communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of engineering activities.

applicants are expected to display effective communication, which can be demonstrated by the following personal and work processes:

- writing clear, concise, and effective reports that are technically, legally, and editorially correct using a structure and style that meet communication objectives and user/audience requirements
- reading and evaluating technical and legal matters relevant to the function of the Professional Engineering Technician
- receiving instructions and ensuring correct interpretation
- issuing clear instructions to subordinates using appropriate language and communication aids, thus ensuring that language and other communication barriers are overcome
- making oral presentations using structure, style, language, visual aids, and supporting documents appropriate to the audience and purpose.

4.3.6 Outcome 6: Recognise the reasonably foreseeable economic, social, cultural, and environmental effects of well-defined engineering activities seeking to achieve sustainability. (Responsibility Level B)

During this stage, applicants demonstrate the ability to recognise the reasonably foreseeable economic, social, cultural, and environmental effects of well-defined engineering activities, while seeking to achieve sustainability. Study the impact of activities on the communities or end user

Applicants should be allowed to study, analyse and recommend measures for:

- social/cultural impacts
- community/political considerations
- environmental impact
- sustainability analysis
- regulatory conditions
- potential ethical dilemmas.

The candidate is responsible for knowing and understanding other relevant Acts that are applicable to their area of practice. This list is not exhaustive.

4.3.7 Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons during all well-defined engineering activities. (Responsibility Level E)

During this stage, applicants develop the ability to meet all legal and regulatory requirements and protect the health and safety of persons during all well-defined engineering activities. To demonstrate competency in regulatory aspects, applicants must:

- identify the applicable legal, regulatory, and health and safety requirements for the engineering activity
- identify the risk and apply defined widely accepted risk management strategies
- select safe and sustainable materials, components, processes, and systems
- communicate with parties involved in the legal and regulatory aspects.

Applicants are expected to have a working knowledge of the following Acts:

- Engineering Profession Act, 46 of 2000, its Rules, specifically the Code of Conduct
- Occupational Health and Safety Act, 85 of 1993 and its relevant regulations about the industry, as amended by Act 181 of 1993
- Construction Regulations.

Depending on their area of practice, applicants should have a working knowledge of the following Acts but not limited to these Acts:

- National Building Regulations and Building Standards Act, 103 of 1977, as amended by Act 49 of 1995
- Environment Conservation Act, 73 of 1989, as amended by Act 52 of 1994 and Act 50 of 2003
- Water Services Act, 108 of 1997, as amended by Act 30 of 2004
- National Water Act, 36 of 1998, as amended by Act 45 of 1999.

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 Outcome 8: Conduct engineering activities ethically (Responsibility Level E)

During this stage, applicants are expected to conduct engineering activities ethically. Ethical behaviour involves the comprehension and application of professional ethics, responsibilities, and norms of engineering practice within one's own limits of competence.

Applicants must study the ECSA Code of Conduct and be aware of its implications in situations that arise in engineering work. A candidate or applicant who is capable of handling ethical issues adopts a systematic approach to resolve ethical issues, which is typified by:

- identifying the central ethical problem
- identifying affected parties and their interests
- searching for possible solutions to the dilemma
- evaluating each solution using the interests of those involved and according to suitable priorities
- selecting and justifying the solution that most appropriately resolves the dilemma.

4.3.9 Outcome 9: Exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of well-defined engineering activities. (Responsibility Level E)

Applicants should develop the ability to exercise sound judgement by evaluating the outcomes, impacts, and alternatives in the course of well-defined engineering activities.

Competence can be achieved by developing options and final solutions or approaches that consider impacts, interrelationships with other disciplines, time, cost, and other constraints including the absence of full evidence.

Exhibiting judgement is typically demonstrated by:

- considering a limited number of factors, some of which may not be well-defined
- considering the interdependence, interactions, and relative importance of factors
- foreseeing consequences of actions
- evaluating a situation in the absence of full evidence
- drawing on experience and knowledge.

4.3.10 Outcome 10: Be responsible for making decisions on part or all of well-defined engineering activities. (Responsibility Level E)

During this stage, applicants are responsible for making decisions on part or all of well-defined engineering activities. Candidates must be able to:

- systematic gather related information and check facts and inputs required for the decision-making process
- make the final decision, based on knowledge, past experience and seek advice on matters falling outside the applicant's education and experience
- record the decision-making process and the reasons for the final decision
- take responsibility and be prepared to be held accountable for immediate consequences of own work and evaluating any shortcomings in the output.

Applicants must demonstrate the ability to make decisions on part or all of well-defined engineering activities at the required level of degree of responsibility, which is evidenced by:

- demonstrating a professional approach at all times
- indicating due regard to technical, social, environmental, and sustainable development considerations
- take advice from a responsible authority on any matter considered to be outside one’s area of competence
- evaluate work output, revising as required and taking responsibility for work output.

4.3.11 Outcome 11: Undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. (Responsibility Level D)

During this stage, applicants undertake sufficient professional development activities to maintain and extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. The emphasis is on the individual’s ability to self-develop. This capability has several dimensions:

- taking responsibility for one’s own development
- reflecting on strengths and weaknesses, recognising needs, and planning

- executing development activities and overcoming obstacles.

All the activities listed below, including combinations thereof, constitute PD and thus, IPD:

- attending courses, seminars, congresses and technical meetings organised by engineering institutions/institutes, universities, other professional bodies and course providers
- actively participating in conferences, serving on technical or professional committees and engaging in working groups
- undertaking structured self-study (i.e., using textbooks with examples)
- studying technical literature (e.g., journals, magazines)
- taking correspondence courses, studying other supervised study packages and taking in-house courses provided by employers where applicable
- enrolling for formal postgraduate studies (limited credits)
- writing technical papers or presenting papers or lectures at organised events.

5. FUNCTIONS PERFORMED

5.1 Degrees of responsibility

During development from the graduate level to meeting the competency requirements for registration, candidates progress through levels of work capability until the required level for registration is attained. 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 applicants are exposed during experience and training period.

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	candidates/applicants should be exposed to: • scope of service in line with ECSA - guideline scope of services and tariff of fees • the applicable legal and regulation • managing finance, material and resources

Degree of responsibility	Nature of work	Activities/duties to be undertaken during training
	work of competent practitioners.	• engineering forms of contracts and condition
B: Assisting	The Candidate performs specific processes under close supervision.	• assist in identifying the social, cultural and environmental effects of their engineering activities • assist in developing or design solution within a team. • assist in drawing up terms of reference • operate engineering modelling software • assist with the identification of stakeholders
C: Participating	The Candidate performs specific processes as directed, with limited supervision.	• Should develop or design solutions to engineering problem • Drawing up detailed specifications (construction drawings) • Developing tender documents • Defining the channel of communication • In issuing clear instructions to stakeholders • In technical report writing and oral presentation
D: Contributing	The Candidate performs specific work with detailed approval of work outputs.	• To develop evaluation criteria and methods of analysis while developing and designing a solution • In managing part or all of the engineering activities by managing materials, machines, manpower, methods or money, contracts • Developing the conditions and operation of contractors and the ability to establish and maintain professional and business relationships • Into owns professional development sufficient to maintain and extend his or her competence.
E: Performing	The Candidate works in a team without supervision, recommends work outputs and is responsible but not accountable.	• define, investigate and analyse engineering problems • conduct research and apply the knowledge embodied in widely accepted and applied engineering procedures and processes, systems or methodologies, and those specific to the jurisdiction in which he or she practice • meeting all legal and regulatory requirements and protect the health and safety of persons in the course of his or her engineering activities

Degree of responsibility	Nature of work	Activities/duties to be undertaken during training
		• conduct engineering activities ethically and be conversant and operate in compliance with ECSA's Rules of Conduct for registered persons • exercise sound judgement in the course of engineering activities, sometimes in the absent of full experience • Be responsible for making decisions on part or all of engineering activities using past experience, educational knowledge, and advises received from competent person.

5.2 Candidate's training programme

The training programme for each candidate depends on the work opportunities available for the employer to assign to the a at the time. Best practice programmes are those that address the development of the competencies needed for each candidate to be able to successfully register as a Professional Engineer, Professional Engineering Technologist and Professional Engineering Technician.

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

Depending on the nature of the work undertaken by an employer, it may be possible to develop a training programme that provides opportunities for the applicant to undertake the work functions described in Section 5. In some cases, an employer may only cover some of the functions described in section 5. In such cases, the employer and candidate should make appropriate arrangements as described in section 5 of this document.

It is suggested that candidates/applicants work with their mentors to determine appropriate projects to gain exposure to elements of the asset cycle and ensure their designs are constructive, operable, and designed considering life cycle costing and long-term sustainability.

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

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

Generally, no matter the discipline, it is unlikely that the training period will only be 3 years, the minimum time required by ECSA. Typically, it will be longer and will be determined, among others, by the availability of functions in the actual work situation. There is no ideal training programme structure or a unique sequencing that constitutes best practice.

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 review has included and introduction section the document further indicate type of engineering work that the different categories should undertake Section 4. Developing Competency: Document (R-08-PE/PT/PN) Under Training for Registration as a Professional Engineer, Professional Engineering Technologist, and Professional Engineering Technician has been revised to ensure that each training element is aligned to each outcome, *4.1.1 Investigation & Analysis* The content under this section is aligned with Outcome 1 *4.1.2 Engineering Design & Development of solution* The content under this section is aligned with Outcome 2 *4.1.3 Contextual Knowledge* The content under this section is aligned with Outcome 3 *4.1.4 Engineering Project Management* The content under this section is aligned with Outcome 4 *4.1.5 Professional Communication* The content under this section is aligned with Outcome 5 *4.1.6 Impact of Engineering Activities & Risk Mitigation* The content under this section is aligned with Outcome 6 *4.1.7 Statutory & Regulatory Requirements* The content under this section is aligned with Outcome 7 *4.1.8 Ethics of Engineering* The content under this section is aligned with Outcome 8 *4.1.9 Exercising sound judgment* The content under this section is aligned with Outcome 9 *4.1.10 Responsibility in Decision-making* The content under this section is aligned with Outcome 10 *4.1.11 Professional Development* The content under this section is aligned with Outcome 11	Working group

Revision number	Revision date	Revision details	Approved by
Rev 0 Draft C	19 Dec 2023	Document revised with WG and Registration BU	RI BU, Registration BU and WG
Rev 0 Draft D	12 Mar 2024	Document submitted to the IEA Task Team for alignment to the IEA changes	IEA Review Task Team
Rev 0 Draft E	04 Apr 2024	Reviewed and checked	Executive: RPSC
Rev 0	17 Apr 2024	Approval	RPSC
Rev 0	17 Apr 2024	Added Appendix and changed Header and cover page	RPSC

The Discipline-Specific Training Guide for:

Registration as a Professional Engineer, Technologist and Technician in Civil Engineering

Revision 0 dated 17 April 2024 and consisting of 41 pages reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Regulatory Instruments and International Relations (**ERSIR**).

..... 9/12/2024 .....

Business Unit Manager Date

..... 2024/12/09 .....

Executive: RSIR Date

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

APPENDIX A: TRAINING ELEMENTS

Synopsis: Applicants should achieve specific competencies at the prescribed level during their development towards professional registration, at the same time accepting more and 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 an engineering career:

1. Confirm understanding of instructions received and clarify if necessary.
2. Use theoretical training to develop possible solutions: select the best and present 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 ECSA's Code of Conduct.
9. Display sound judgement by considering all factors, their interrelationship, consequences and evaluation when all evidence is not available.
10. Accept responsibility for own work by using theory to support decisions, seeking advice when uncertain and evaluating shortcomings.
11. Become conversant with your employer's training and development programme and develop your own lifelong development programme within this framework.

Complex, Broadly-defined and Well-defined engineering work is usually characterised by the application of engineering deviating from standard procedures, codes and systems, the deviation verified by research, modelling and/or substantiated design calculations.

Responsibility Levels: A = Being Exposed; B = Assisting; C = Participating; D = Contributing; E = Performing.

Competency Standards for Registration as a Professional Engineering Technologist	Explanation and Responsibility Level
1. Purpose This standard defines the competence required for registration as a **Professional Engineer, Technologist and Technician**. Definitions of terms having particular meaning within this standard is given in text in relevant section.	DSTGs give context to the purpose of the Competency Standards. The **Engineer, Technologist and Technician** operate within the 12 disciplines ECSA recognises. Each discipline can be further divided into sub-disciplines and finally into specific workplaces as given in section 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 trainee's competence towards achieving the standards below at a Responsibility Level E, i.e., Performing. (Refer to the specific DSTG)
2. Demonstration of competence Competence must be demonstrated within Complex, broadly defined and Well-defined *engineering activities,* defined below, by integrated performance of the outcomes defined at the level defined for each outcome. Required contexts and functions may be specified in the applicable DSTG. **Level Descriptor:** Complex engineering activities (**CEA**), Broadly-defined engineering activities (**BDEA**), and Well-	Engineering activities can be divided into (approximately): 5% Complex (Professional Engineers) 5% Broadly Defined (Professional Engineering Technologists) 10% Well-defined (Professional Engineering Technicians) 15% Narrowly Well-defined (Registered Specified Categories) 20% Skilled Workman (Engineering Artisan) 55% Unskilled Workman (Artisan Assistants) Activities can be in-house or contracted out; evidence of integrated performance can be submitted irrespective of the situation. **Level Descriptor: CEA, *BDEA and WDEA*** in the various disciplines are characterised by several or all of the following:

defined engineering activities (**WDEA**) have several of the following characteristics: a) Scope of practice area is linked to technologies used and changes by adoption of new technology into current practice. b) Practice area is located within a wider, complex context, requires teamwork, and has interfaces with other parties and disciplines. c) Involves a variety of resources, including people, money, equipment, materials and technologies. d) Requires resolution of occasional problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues. e) Are constrained by available technology, time, finance, infrastructure, resources, facilities, standards and codes and applicable laws. f) Have significant risks and consequences in the practice area and in related areas.	a) Scope of practice area does not cover the entire field of the discipline (exposure limited to the sub-discipline and specific workplace). Some technologies used are well established and adoption of new technologies needs investigation and evaluation. b) Practice area varies substantially with unlimited location possibilities and an additional responsibility to identify the need for advice on **CEA, *BDEA and WDEA*** activities and problems. **CEA, *BDEA and WDEA*** activities in the sub-discipline needs interfacing with professional engineers, professional technicians, artisans, architects, financial staff, etc. as part of the team. c) The bulk of the work involves familiar, defined range of resources, including people, money, equipment, materials, but new technologies are investigated and implemented. d) Most of the impacts in the sub discipline are on wider issues, but some arise from conflicting technical and engineering issues that have to be addressed by the application of broadly defined non-standard engineering principles. e) The work packages and associated parameters are constrained by operational context with variations limited to different locations only. (Cannot be covered by standards and codes.) f) Even locally important minor risks can have far reaching consequences.
Activities include but are not limited to design; planning; investigation and problem resolution; improvement of materials, components, systems or processes; manufacture or construction; engineering operations; maintenance; project management; research; development and commercialisation.	**Activities** include but are not limited to design; planning; investigation and problem resolution; improvement of materials, components, systems or processes; engineering operations; maintenance; project management. For **Engineers, Technologists and Technicians**, research, development and commercialisation happen more frequently in some disciplines but are seldom encountered in others.
3. Outcomes to be satisfied:	**Explanation and Responsibility Level**
Group A: Engineering Problem Solving	Please refer to section 4 of the specific DSTG.
Outcome 1:	**Responsibility Level E**

Define, investigate and analyse *Complex, broadly defined and Well-defined,* engineering problems	Analysis of an engineering problem means the 'separation into parts possibly with comment and judgement'. Complex, *Broadly, Well-defined* means: 'not minute or detailed' and 'not kept within narrow limits'.
Complex, Broadly-defined and Well-defined engineering problems have the following characteristics.	
a) They require coherent and detailed engineering knowledge, underpinning the technology area; and one or more of the following:	a) Coherent and detailed engineering knowledge for **Engineer, Technologist and Technician** means the problem encountered cannot be solved without the combination of all the relevant detail including engineering principles applicable to the situation.
b) Are ill-posed, under- or over-specified, require identification and interpretation into the technology area.	b) The nature of the problem is not immediately obvious, and further investigation to identify and interpret the real nature of the problem is necessary.
c) Encompass systems within complex engineering systems;	c) The problem is not easily recognised as part of the larger engineering task, project or operation and may be obscured by the complexity of the larger system.
d) Belong to families of problems which are solved in well-accepted but innovative ways. *and one or more of:*	d) It is recognised that the problem can be classified as ~~a~~ falling within a typical solution requiring innovative adaptation to meet the specific situation.
e) Can be solved by structured analysis techniques	e) Solving the problem needs a step-by-step approach adhering to proven logic.
f) May be partially outside standards and codes; must provide justification to operate outside.	f) The standards, codes and documented procedures must be analysed to determine to what extent they are applicable to solve the problem and justification must be given to operate outside these.
g) Require information from practice area and sources interfacing with practice area that is complex and incomplete.	g) The responsibility lies with the **Engineer, Technologist and Technician** to verify that some information received as part of the problem encountered may remain incomplete and solutions to problems may need justified assumptions.
h) Involve a variety of issues which may impose conflicting constraints: technical, engineering and interested or affected	h) The problem handled by **Engineer, Technologist and Technician** may be solved by alternatives that are unaffordable, detrimental to the environment, socially unacceptable, not maintainable, not

parties. *and one or both of:* i) Require judgement in decision-making in practice area, considering interfaces to other areas. j) Have significant consequences which are important in practice area but may extend more widely.	sustainable, etc; the **Engineer, Technologist and Technician** will have to justify his/her recommendation. i) Practical solutions to problems include knowledge and judgement of the roles displayed by the multi-disciplinary team and impact of own work in the interactive environment. j) **The Engineer, Technologist and Technician** must realise that their actions might seem to be of local importance only but may develop into significant consequences extending beyond their own ability and practice area.
Assessment criteria: A structured analysis of broadly defined problems typified by the following performances is expected: 1.1 Performed or contributed to defining engineering problems leading to an agreed definition of the problems to be solved. 1.2 Performed or contributed to investigating engineering problems including collecting, organising and evaluating information. 1.3 Performed or contributed to analysis of engineering problems using conceptualisation, justified assumptions, limitations and evaluation of results.	To perform an engineering task an **Engineer, Technologist and Technician** will typically receive an instruction from a senior person (customer) to do a specific task, and must: 1.1 Ensure the instruction is complete, clear and within his/her capability and that the person who issued the instruction agrees with his/her interpretation. 1.2 Ensure the engineering problem and related information are segregated from the bulk of the information, investigated and evaluated. 1.3 Ensure that the instruction and information to do the work is fully understood and complete, including engineering theory needed to understand the task and acceptance criteria, and to carry out and/or check calculations. If needed supplementary information must be gathered, studied and understood. Concepts and assumptions must be justified by engineering theory and calculations, if applicable.
3. Outcomes to be satisfied:	**Explanation and Responsibility Level**
Range statement: The problem may be a design requirement, an applied research and development requirement or a problematic situation in an existing component, system or process. The problem is one amenable to solution by technologies known to the Candidate. This outcome is	Please refer to section 4 of the specific DSTG.

concerned with the understanding of a problem: Outcome 2 is concerned with the solution.	
Outcome 2: Design or develop solutions to **Complex, Broadly-defined and Well-defined** engineering problems	**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'.
Assessment criteria: This outcome is normally demonstrated after a problem analysis as defined in Outcome 1. Working systematically to synthesise a solution to a broadly defined problem, typified by the following performances is expected: 2.1 Designed or developed solutions to **Complex, Broadly-defined and Well-defined** engineering problems. 2.2 Systematically synthesised solutions and alternative solutions or approaches to the problem by analysing designs against requirements, including costs and impacts on outside parameters. (requirements). 2.3 Drawing up of detailed specification requirements and design documentation for implementation to the satisfaction of the client.	After the task received is fully understood and interpreted, a solution to the problem posed can be developed (designed). To synthesise a solution is 'the combination of separate parts, elements, substances, etc. into a whole or into a system' by the following: 2.1 The development (design) of more than one way to solve an engineering task or problem should always be done, including the costing and impact assessment for each alternative. All the alternatives must meet the requirements set out by the instruction received, and the theoretical calculations to support each alternative must be done and submitted as an attachment. 2.2 The **Engineer, Technologist and Technician** will in some cases be unable to support proposals with the complete theoretical calculation to substantiate every aspect and must in these cases refer his / her alternatives to an engineer for scrutiny and support. The alternatives and alternative recommended must be convincingly detailed to win customer support for the alternative recommended. Selection of alternatives might be based on tenders submitted with alternatives deviating from those specified. 2.3 The best complete and final solution selected must be followed up with a detailed technical specification, supporting drawings, bill of quantities, etc. for the execution of work to meet customer requirements.
Range Statement: Solutions are those enabled by the technologies in the Candidate's practice area.	Applying theory to do ***Complex, Broadly-defined and Well-defined*** *engineering* work is mostly done in a way that has been used before, probably developed by engineers in the past, and documented in written procedures, specifications, drawings, models, examples, etc. **The Engineer, Technologist and**

	Technician must seek approval for any deviation from these established methods but must also initiate and/or participate in the development and revision of these norms.
Outcome 3: Comprehend and apply the knowledge embodied in widely accepted and applied engineering procedures, processes, systems or methodologies and those specific to the jurisdiction in which he/she practices.	**Responsibility Level E** Comprehend means 'to understand fully'. The jurisdiction in which an **Engineer, Technologist and Technician** practices is given in section 4 of the specific DSTG.
Assessment criteria: This outcome is normally demonstrated in the course of design, investigation or operations. 3.1 Apply engineering principles, practices, technologies, including the application of, B Eng, BTech or B Eng (Tech) and N Dip, theory in the practice area. 3.2 Indicate working knowledge of areas of practice that interact with practice area to underpin teamwork. 3.3 Apply related knowledge of finance, statutory, safety and management.	Design work for **Engineer, Technologist and Technician** is based on B Eng, BTech, N Dip, theory and is mostly the utilisation and configuration of manufactured components and selected materials and associated novel einineering., **Engineer, Technologist and Technician** develop and apply codes and procedures in their design work. Investigation would be on broadly defined incidents and condition monitoring, and operations mostly on developing and improving engineering systems and operations. 3.1 Calculations at B Eng, BTech or B Eng (Tech) and/or NDip, theoretical level confirming the correct application and utilisation of equipment, materials and systems listed in section 4 of the specific DSTG must be done on broadly defined activities. 3.2 The understanding of **complex, broadly defined, well defined,** procedures and techniques must be based on fundamental mathematical, scientific and engineering knowledge, as part of personal contribution within the engineering team. 3.3 The ability to manage the resources within legal and financial constraints must be evident.
Range Statement: Applicable knowledge includes: a) Technological knowledge that is well-established and applicable to the practice area irrespective of location, supplemented by locally relevant knowledge, for example,	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 including a comprehensive study of systems, materials,

established properties of local materials. Emerging technologies are adopted from formulations of others.	components and projected customer requirements and expectations. New ideas, materials, components and systems must be investigated, evaluated and applied accompanied by complex theoretical motivation.
b) A working knowledge of interacting disciplines (engineering and other) to underpin teamwork.	b) In spite of having a working knowledge of interacting disciplines, **Engineer, Technologist and Technician** take responsibility for the multidisciplinary team of specialists like Civil Engineers on structures and roads, Mechanical Engineers on fire protection equipment, architects on buildings, Electrical Engineers on communication equipment, etc.
c) Jurisdictional knowledge includes legal and regulatory requirements as well as locally relevant codes of practice. As required for practice area, a selection of law of contract, health and safety, environmental, intellectual property, contract administration, quality management, risk management, maintenance management, regulation, project and construction management.	c) Jurisdictional in this instance means 'having the authority', and **Engineer, Technologist and Technician** must be aware of and decide on the relevant requirements applicable to each specific project that he/she is responsible for. They are usually appointed as the 'responsible person' for specific projects in terms of the OHS Act.
Group B: Managing Engineering Activities	**Explanation and Responsibility Level**
Outcome 4: Manage part or all of one or more ***Complex, Broadly-defined and Well-defined*** engineering activities.	**Responsibility Level D** Manage means 'control'.
Assessment criteria: The Candidate is expected to display personal and work process management abilities: 4.1 Managed self, people, work priorities, processes and resources in broadly defined engineering work. 4.2 Role in planning, organising, leading and controlling broadly defined engineering activities evident. 4.3 Knowledge of conditions and operation of contractors and the ability.	In Engineering operations **Engineer, Technologist and Technician** are typically given the responsibility to carry out projects. 4.1 Resources are usually subdivided based on availability and controlled by a work breakdown structure and scheduling to meet deadlines. Quality, safety and environment management are important aspects. 4.2 The basic elements of managements must be applied to broadly defined engineering work. 4.3 Depending on the project, **Engineer, Technologist and Technician** can be the team leader, a team member, or can supervise appointed contractors. To achieve this, maintenance of relationships is important and must be demonstrated.

Outcome 5: Communicate clearly with others in the course of his/her broadly defined engineering activities.	**Responsibility Level C**
Assessment criteria: Demonstrates effective communication by: 5.1 Ability to write clear, concise, effective technical, legal and editorially correct reports shown. 5.2 Ability to issue clear instructions to stakeholders using appropriate language and communication skills evident. 5.3 Oral presentations made using structure, style, language, visual aids	Refer to Range Statement for Outcome 4 and 5 below. Presentation of point of view mostly occurs in meetings and discussions with immediate supervisor.
Range Statement for Outcomes 4 and 5: Management and communication in ***Complex, Broadly-defined and Well-defined*** *engineering* involves: a) Planning ***Complex, Broadly-defined and Well-defined*** activities b) Organising ***Complex, Broadly-defined and Well-defined*** activities c) Leading ***Complex, Broadly-defined and Well-defined*** activities d) Controlling ***Complex, Broadly-defined and Well-defined*** activities.	a) Planning means 'the arrangement for doing or using something, considered in advance' b) Organising means 'put into working order, arrange in a system, make preparations for' c) Leading means to 'guide the actions and opinions of, influence, persuade' d) Controlling means the 'means of regulating, restraining, keeping in order, check' **The Engineer, Technologist and Technician** write specifications for the purchase of materials and/or work to be done, recommendations on tenders received, place orders and variation orders, write work instructions, report 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 on cost control, etc.
Group C: Impacts of Engineering Activity	**Explanation and Responsibility Level**
Outcome 6: Recognise the foreseeable social, cultural and environmental effects of ***Complex, Broadly-defined and Well-defined*** engineering activities generally	**Responsibility level B** Social means 'people living in communities; of relations between persons and communities'. Cultural means 'all the arts, beliefs, social institutions, etc. characteristic of a community'. Environmental means 'surroundings, circumstances, influences'.
Assessment criteria: This outcome is normally displayed in the course of analysis and solution of problems. The candidate typically shows: 6.1 Ability to identify interested and affected parties and their expectations in regard to interactions between technical, social, cultural and environmental considerations shown. 6.2 Measures taken to mitigate the negative effects of engineering activities evident.	6.1 Engineering impacts heavily on 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 wildlife, dangerous rotating and other machines, demolishing of structures, etc. 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, compensation paid, etc.
Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his/her broadly defined engineering activities.	**Responsibility level E**
Assessment criteria:	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 might have standard procedures, instructions, drawings

7.1 Identified applicable legal and regulatory requirements including health and safety requirements for the engineering activity. 7.2 Circumstances stated where applicant assisted in or demonstrated awareness of the selection of safe and sustainable materials, components and systems and have identified risk and applied risk management strategies.	and operation and maintenance manuals available. These documents, depending on the situation (emergency, breakdown, etc.) are consulted before work is commenced and during the activity. 7.2 It is essential to attend a Risk Management (Assessment) course, and to investigate and study the materials, components and systems used in the workplace. The **Engineer, Technologist and Technician** seeks advice from knowledgeable and experienced specialists if the slightest doubt exist that safety and sustainability cannot be guaranteed.
Range Statement for Outcomes 6 and 7: Impacts and regulatory requirements include the following: a) Requirements include both explicit regulated factors and those that arise in the course of particular work. b) Impacts considered extend over the lifecycle of the project and include the consequences of the technologies applied. c) Effects to be considered include direct and indirect, immediate and long-term related to the technology used. d) Safe and sustainable materials, components and systems.	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 town will be entirely different to construction in a rural area. The methods, techniques or procedures will differ accordingly and may be complex. It is identified and studied by the **Engineer, Technologist and 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 **Engineer, Technologist and Technician** is responsible to see that this is done, and if not, establish which regulations apply, and ensure that they are adhered to. Usually, the people working on site are strictly controlled.W.r.t. health and safety, but the **Engineer, Technologist and Technician** checks that this is done, but may authorise unavoidable deviation after setting conditions for such deviations. Projects are mostly carried out where contact with the public cannot be avoided, and safety measures like barricading and warning signs must be used and maintained. c) Effects associated with risk management are mostly well known if not obvious, and methods used to address, clearly defined. Risks are mostly associated with elevated structures, subsidence of soil, electrocution of human beings and moving parts on machinery. The **Engineer, Technologist and Technician** needs to identify, analyse and manage any long-term risks and develop strategies to solve these by using alternative technologies. d) The safe and sustainable materials, components and systems must be selected and prescribed by the **Engineer, Technologist and Technician** or other professional specialists must be consulted. It is the responsibility of the **Engineer, Technologist and Technician** to use his/her knowledge and experience to confirm that prescriptions by others are correct and safe.

e) Regulatory requirements are explicit for the context in general.	e) Application of regulations associated with the particular aspects of the project must be carefully identified and controlled by the **Engineer, Technologist and Technician**.
Group D: Exercise judgment, take responsibility, and act ethically	**Explanation and Responsibility Level**
Outcome 8: Conduct engineering activities ethically.	**Responsibility level E** Ethically means 'science of morals; moral soundness'. 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 these issues is expected, typified by: 8.1 Conversance and operation in compliance with ECSA's Rules of Conduct for registered persons confirmed 8.2 How ethical problems and affected parties were identified, and the best solution to resolve the problem selected.	Systematic means 'methodical; based on a system'. 8.1 ECSA's Code of Conduct, as per ECSA's website, is known and adhered to. 8.2 Ethical problems that can occur include tender fraud, payment bribery, alcohol abuse, sexual harassment, absenteeism, favouritism, defamation, fraudulent overtime claims, fraudulent expenses claimed, fraudulent qualifications, misrepresentation of facts, etc.
Outcome 9: Exercise sound judgement in the course of ***Complex, Broadly-defined and Well-defined*** engineering activities	**Responsibility level E** Judgement means 'good sense: ability to judge'.
Assessment criteria: Judgement is displayed by the following performance: 9.1 Judgement exercised in arriving at a conclusion within the application of technologies and their interrelationship to other disciplines and technologies.	9.1 The extent of a project given to a junior **Engineer, Technologist and Technician** is characterised by the several broadly defined and a few well-defined factors and their resulting interdependence. He/she will seek advice if educational and/or experiential limitations are exceeded.

9.2 Factors taken into consideration given, bearing in mind, risk, consequences in technology application and affected parties.	9.2 Taking risky decisions will lead to equipment failure, excessive installation and maintenance cost, damage to persons and property, etc. Evaluation includes engineering calculations to substantiate decisions taken and assumptions made.
Range Statement for Outcomes 8 and 9*: Judgement* in decision-making involves: a) taking several risk factors into account; **or** b) significant consequences in technology application and related contexts; **or** c) ranges of interested and affected parties with widely varying needs.	In Engineering, about 5% of engineering activities can be classified as broadly defined where the **Engineer, Technologist and Technician** uses standard procedures, codes of practice, specifications, etc, but develops variations and completely unique standards when needed. Judgement must be displayed to identify any activity falling inside the broadly defined range, as defined above: a) Getting the work done in spite of numerous risk factors needs good judgement and substantiated decision-making. b) Consequences are part of the project e.g., extra cost due to unforeseen conditions, incompetent contractors, long-term environmental damage, etc. c) Interested and affected parties with defined needs that may be in conflict, e.g., need for a service irrespective of environmental damage, local traditions and preferences, etc. needs sound management and judgement.
Outcome 10: Be responsible for making decisions on part or all of all of one or more ***Complex, Broadly-defined and Well-defined*** engineering activities	**Responsibility level E** Responsible means 'legally or morally liable for carrying out a duty; for the care of something or somebody in a position where one may be blamed for loss, failure, etc.'.
Assessment criteria: Responsibility is displayed by the following performance: 10.1 Engineering, social, environment and sustainable development taken into consideration in discharging responsibilities for significant parts of one or more activities. 10.2 Advice sought from a responsible authority on matters outside your area of competence.	10.1 All interrelated factors taken considered are indicative of professional responsibility accepted working on broadly defined activities. 10.2 The **Engineer, Technologist and Technician** does not operate on tasks at a higher level than, complex, broadly defined, well defined and consults professionals at engineer level if elements of the project to be done are beyond his/her education and experience, e.g., power system stability.

10.3 Academic knowledge of at least B Eng, BTech N Dip, level combined with past experience used in formulating decisions.	10.3 This is in the first instance 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 and corrective action, if necessary, forms an important element. The calculations, for example fault levels, load calculations, losses, etc. are done to ensure that the correct material and components are utilised.
Range Statement: Responsibility must be discharged for significant parts of one or more ***Complex, Broadly-defined and Well-defined*** engineering activity.	The responsibility is mostly allocated within a team environment with an increasing designation as experience is gathered.
Note 1: Demonstrating responsibility is under supervision of a competent engineering practitioner but is expected to perform as if he/she is in a responsible position.	
Group E: Initial Professional Development (IPD)	**Explanation and Responsibility Level**
Outcome 11: Undertake independent learning activities sufficient to maintain and extend his or her competence.	**Responsibility level D**
Assessment criteria: Self-development managed typically: 11.1 Strategy independently adopted to enhance professional development evident. 11.2 Awareness of philosophy of employer regarding professional development evident.	11.1 If possible, a specific field of the sub-discipline is chosen, available developmental alternatives established, a programme drawn up (in consultation with employer if costs are involved), and options open to expand knowledge into additional fields investigated. 11.2 Record keeping must not be left to the employer or anybody else. The trainee must manage his/her own training independently, taking initiative and being in charge of experiential development towards **Engineer, Technologist and Technician** engineering**.**
Range Statement: Professional development involves: a) planning own professional development strategy b) selecting appropriate professional development activities	a) In most places of work training is seldom organised by a training department. It is up to the **Engineer, Technologist and Technician** to manage his/her own experiential development. **Engineer, Technologist and Technician** frequently end up in a 'dead-end street' being left behind doing repetitive work. If self-development is not driven by him/herself, success is unlikely. b) Preference must be given to engineering development rather than developing soft skills.

c) recording professional development strategy and activities, while displaying independent learning ability.	c) Developing a learning culture in the workplace environment of the **Engineer, Technologist and Technician** is vital to his/her success

APPENDIX B: TRAINING ELEMENTS

1	Introduction
1.1	Training Induction Programme (Typically, 1 to 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 engineering principles and processes (Typically, 6 to 12 months) and cover how things are: (Responsibility level A, B, C)
(Experience in one or more of these but not all)	
1.2.1	Manufacturing / Production
1.2.2	Laboratory and testing
1.2.3	Project management
1.2.4	Process optimisation and design
1.2.5	Plant operations and maintenance, construction, commissioning and decommissioning
1.2.6	Heat treatment (Use of equipment e.g., furnace, spectrometer)
1.2.7	Mechanical testing of materials
1.2.8	Non-destructive testing of materials
1.2.9	Chemical analysis
1.2.10	Problem investigation & failure investigations
1.3	Experience in design and application of design knowledge (Typically, 12 to 18 months) and would focus on planning, design and application: (Responsibility level C&D)
1.3.1	Analysis of data and systems
1.3.2	Research and investigation
1.3.3	Preparation of specifications and associated documentation
1.3.4	System modelling and integration
1.3.5	System & software designs
1.3.6	Component / Product designs
1.3.7	Preparation of contract documents and associated documentation
1.3.8	Preparation of project management documents

1.3.9	Application of quality systems
1.3.10	Configuration and documentation management (Quality Management Systems)
1.3.11	Development of standards and procedures
1.4	Experience in the execution of engineering tasks Rest of training period, focus should be on projects and project management. (Responsibility level E)
(Working in one or more of these but not in all.)	
1.3.1	Plant & process design
1.3.2	Process optimisation
1.3.3	Manufacture / Production
1.3.4	Construction and installation
1.3.5	Project management
1.3.6	Commissioning
1.3.7	Plant operations and maintenance
1.3.8	Modifications
1.3.9	Decommissioning
1.3.10	Safety standards and processes
1.3.11	Research and development
2	**Solving problems based on engineering and contextual knowledge**
2.1	Conceptualisation of complex engineering problems (Responsibility Level E)
2.1.1	Receive brief
2.1.2	Investigate / evaluate requirements
2.1.3	Develop preliminary solutions
2.1.4	Justify the preliminary design
2.2	Design or development processes for complex engineering problems
2.2.1	Detailed design or development processes
2.2.2	Documentation development for Implementing PE/PT/PN engineering Solutions
3	**Implementing projects or operating engineering systems or processes**
3.1	Planning processes for Implementation or Operations (Responsibility Level E)
3.1.1	Develop business and stakeholder relationships
3.1.2	Scope and plan
3.2	Organising processes for Implementation or Operations (Responsibility Level E)

3.2.1	Manage resources
3.2.1	Optimisation of resources and processes
3.3	Controlling processes for Implementation or Operations (Responsibility Level E)
3.3.1	Monitor progress and delivery
3.3.2	Monitor quality
3.4	Close out Processes for Implementation or Operations (Responsibility Level E)
3.4.1	Commissioning processes
3.4.2	Development of operational documentation
3.4.3	Handover processes
3.5	Maintenance and repair processes (Responsibility Level E)
3.5.1	Maintenance planning and scheduling
3.5.2	Monitor quality
3.5.3	Oversee repairs and/or implement remedial processes
4	**Risk and Impact Mitigation**
4.1	Impact and risk assessments (Responsibility Level E)
4.1.1	Impact assessments
4.1.2	Risk assessments
4.1.3	Mitigation plans
4.2	Regulatory compliance processes (Responsibility Level E)
4.2.1	Health and safety
4.2.2	Legal and regulatory
5	**Managing Engineering Activities**
5.1	Self-Management Processes (Responsibility Levels C–D)
5.1.1	Manage own activities
5.1.2	Communicate effectively
5.2	Team Environment (Responsibility Levels C–D)
5.2.1	Participate in and contribute to team planning activities
5.2.2	Manage people
5.3	Professional communication and relationships*(networking)* (Responsibility Levels C–D)
5.3.1	Establish and maintain 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	Exercise sound judgement in the course of PE/PT/PN engineering activities
5.4.3	Be responsible for decision making on part or all of PE/PT/PN engineering activities
5.5	***Competency development* (Responsibility Level D)**
5.5.1	Plan own development strategy
5.5.2	Construct initial professional development record