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SOUTH AFRICA

Discipline-Specific Training Guide for Candidate Engineering Technicians in Agricultural Engineering

R-05-AGR-PN

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

ECSA

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DEFINITIONS

Engineering science: A body of knowledge that is based on the natural sciences and uses 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

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

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

Integrated performance: An overall satisfactory outcome of an activity requires several outcomes to be satisfactorily attained. For example, a design 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

Management of engineering works or activities: The co-ordinated activities that are required

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

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

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

(iv) to direct and control the engineering processes, systems, commissioning, operation and decommissioning of equipment; and

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

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

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

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

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

Specified Category: A category of registration for persons registered through the Engineering Profession Act or through a combination of the Engineering Profession Act and external legislation having specific engineering competencies at NQF Level 5 regarding an identified need to protect the public safety, health and interest and the environment in the performance of an engineering activity

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.

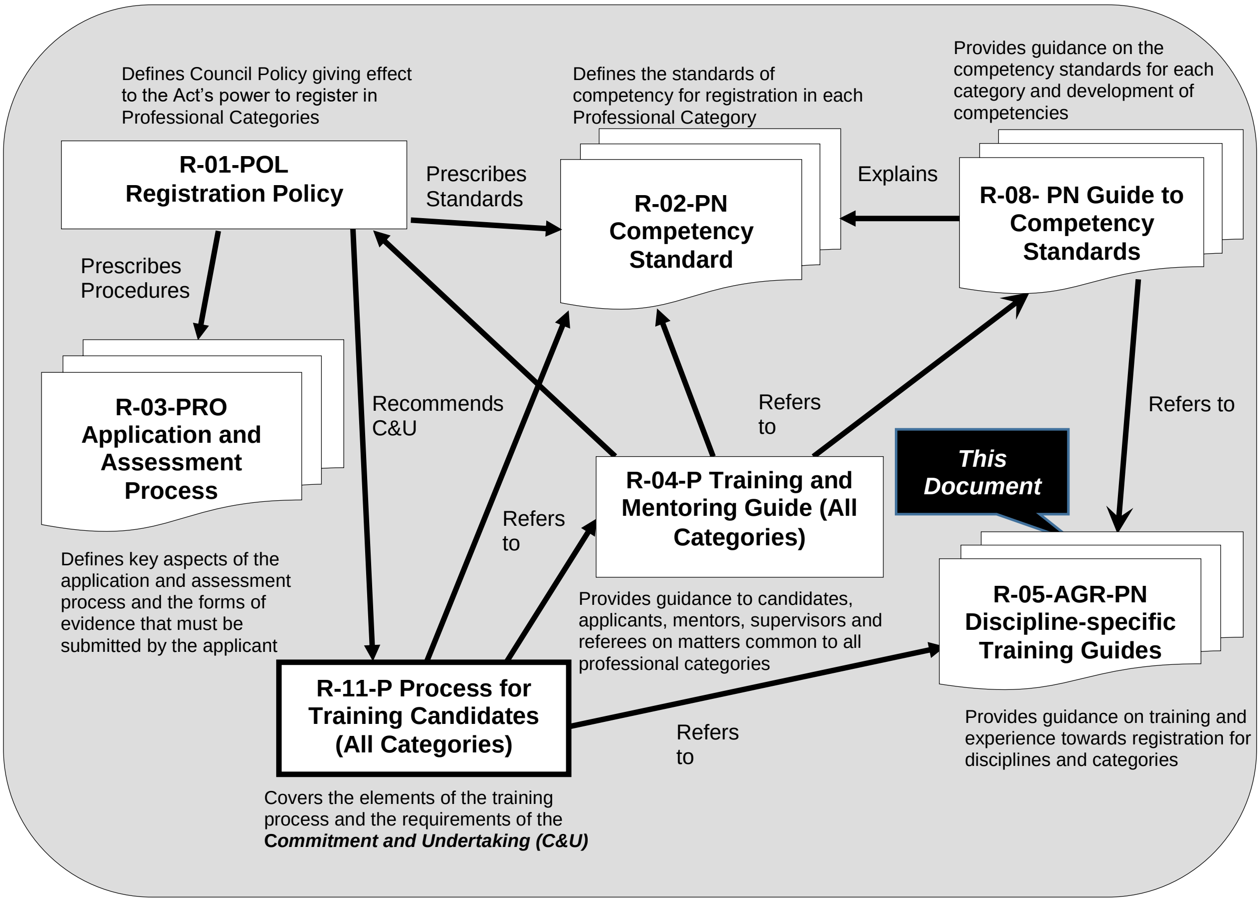

Figure 1: Documents defining the ECSA Registration System

1. PURPOSE OF THIS DOCUMENT

All persons applying for registration as a Professional Technician are expected to demonstrate the competencies specified in document **R-02-PN** at the prescribed level through work performed at the required level of responsibility, irrespective of the discipline.

This document supplements the generic *Training and Mentoring Guide* (document **R-04-P**) and *the Guide to the Competency Standards for Professional Engineering Technicians* (document

R-08-PN).

In document **R-04-P**, attention is drawn to the following sections:

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

The second document **R-08-PN** provides both a high-level and outcome-by-outcome understanding of the competency standards as an essential basis for this discipline-specific guide. This guide and documents **R-04-P** and **R-08-PN** are subordinate to the Policy on Registration (document **R-01-POL**), the Competency Standard (document **R-02-PN**) and the application process definition (document **R-03-PRO**).

2. AUDIENCE

This guide is directed towards candidates and their supervisors and mentors in the discipline of Agricultural Engineering. The guide is intended to support a programme of training and experience that incorporates good practice elements.

This guide applies to persons who have

- completed the educational requirements in Agricultural Engineering by obtaining an accredited Dip (Engineering), Dip (Eng Tech), Adv Cert (Engineering) type qualification, or by obtaining a Dublin Accord recognised qualification, or through evaluation/assessment,
- registered as a Candidate Engineering Technician;
- embarked on a process of acceptable training, preferably under a registered Commitment and Undertaking (C&U) with a mentor guiding the professional development process at each stage; and
- followed a programme of training and experience that incorporates the good practice elements described in this guide.

3. PERSONS NOT REGISTERED AS CANDIDATES OR NOT BEING TRAINED UNDER COMMITMENT AND UNDERTAKING (C&U)

Irrespective of the development path followed, all applicants for registration must present the same evidence of competence and be assessed against the same standards. Application for registration as a Professional Engineering Technician is permitted without being registered as a Candidate Engineering Technician and is also permitted without training under a C&U. Mentorship and adequate supervision are, however, key factors in effective development to the level required for registration. A C&U is an agreement between the company and the ECSA indicating that the company is committed to mentorship and supervision.

If the trainee's employer has not committed to a C&U, the trainee should establish the level of mentorship and supervision that the employer is able to provide. In the absence of an internal mentor, the services of an external mentor should be secured. The Voluntary Association for the discipline should be consulted for assistance in locating an external mentor. A mentor should be in place at all stages of the development process.

This guide is written for the recent graduate who is training and gaining experience towards registration. Mature applicants for registration may apply the guide retrospectively to identify possible gaps in their development.

Any applicants who have not enjoyed mentorship are advised to request an experienced mentor (internal or external) to act as an application adviser while they prepare their application for registration.

Applicant who does not hold NDip Engineering may apply under alternative route and complete additional form (Educational Development Report) by considering number of years of experience as well as well-defined engineering activities undertaken during this period and experience at the responsible level.

4. ORGANISING FRAMEWORK FOR OCCUPATION

Agricultural Engineering Technician (Organising Framework for Occupation (OFO) 214905)

The expertise of Agricultural Engineering Technicians who have unique skills to connect the living world of plants, soil, water and animals with the technology of engineering (i.e. systems, structures and machines) are required to ensure sustainable environments with adequate water supplies and suitable energy and food production structures and processing systems. Agricultural Engineering Technicians thus operate at the interfaces between engineering science and practice, agricultural production and processing and rural environmental management and must be aware of the factors that are important in agricultural production and processing and environmental sustainability. This is promoted by including introductory agricultural courses in the tertiary education of the Agricultural Engineering Technician. Candidates who have diplomas in engineering specialities other than agriculture must show that they have attained this knowledge through practical experience in at least one of the many diverse areas of sustainable agricultural production and processing if they are to be registered as Agricultural Engineering Technicians.

An Agricultural Engineering Technician plans, performs and supervises well-defined engineering work related to the development and/or improvement of infrastructure; machinery and processes for agricultural production; post-harvest handling and processing of agricultural produce; and similar engineering processes in associated environmental and biological contexts. This may include the use and development of agricultural land, the environment, infrastructure (buildings, roads, river crossings, dams, irrigation systems, electrification, etc.), machines, equipment and processes.

Due to the multi-disciplinary nature of Agricultural Engineering, practicing Agricultural Engineering Technicians generally concentrate on one or more of the following areas:

- Agricultural Energy Engineering
- Agricultural Renewable Energy Engineering
- Agricultural Product Processing Engineering
- Agricultural Structures and Facilities Engineering
- Agricultural Waste Handling and Management
- Aquaculture Engineering
- Mechanisation Engineering
- Irrigation Engineering
- Hydrology and Agricultural Water Use
- Natural Resources Engineering Management
- Food Engineering
- Environmental Engineering
- Rural Infrastructure Engineering

Potential fields of work for the Agricultural Engineering Technician include the following:

- Advising on and/or conducting well-defined research and developing new or improved theories and methods related to Agricultural Engineering (i.e. soil and water; power and machinery; processing and handling of agricultural /biological products; structures and the environment; biological systems; and energy, particularly renewable energy)
- Designing, managing and/or advising on well-defined technology for food, fibre and energy production systems
- Designing, sizing, selecting and managing agricultural machinery, implements and equipment for field operations (e.g. for soil preparation, planting, harvesting, storage and transport of produce)
- Testing and evaluating new agricultural machinery and equipment and using precision agriculture technologies (e.g. GIS, GPS) to ensure optimal and sustainable agricultural production systems that consider the environment
- Designing and operating transportation systems to move produce from fields to storage facilities, factories and consumers
- Designing and managing well-defined irrigation systems to irrigate plants efficiently in order to obtain optimal yield per unit of water applied and designing and installing drainage systems for land conservation and optimal crop production
- Designing and managing well-defined agricultural and rural water resource systems through designing dams, canals, boreholes, extraction works and pipe networks that will supply water to agriculture and humans
- Assessing the availability of water resources in order to meet the water demands in a highly variable South African climate
- Managing water resources by reconciling demands for water with available supply and designing well-defined soil and water conservation systems to control runoff, thus minimising erosion and maximising agricultural production and thereby sustaining the environment by curtailing the negative impacts of agricultural practices
- Designing and operating well-defined agricultural structures and infrastructure (e.g. farm buildings, farm roads, minor river crossings and bridges, animal-handling facilities, agricultural waste handling and management facilities, spray races and dips)
- Designing and managing well-defined food processing and storage systems in order to add value to raw products by using technology to preserve and process food and animal feed

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- Designing and managing structures to ensure that products are safe for human consumption (e.g. cold stores, pack houses, factories and plants for agricultural produce value addition, cooling, heating, dehydration and pasteurisation facilities, grain handling, storage and silo facilities, fish processing plants, abattoirs and marketing structures)
- Designing and managing well-defined and intensive animal and plant production structures and control systems with possible controlled environments for optimal plant production (e.g. greenhouses) and animal production (e.g. housing structures, broiler units, dairy plants, milking parlours)
- Using renewable sources of energy through the design and development of well-defined technology to grow and utilise sustainable sources of energy (e.g. hydro, bio-fuel, solar, wind) and the processing of agricultural products and biomass into bio- energy (e.g. anaerobic digesters)
- Designing, managing and advising on well-defined power and energy systems for agricultural production, including the design, sizing, selection and management of agricultural machinery and equipment (e.g. engines, motors, pumps, fans, pipes) in addition to the testing and evaluation of new agricultural machinery and equipment
- Determining and specifying construction methods, materials and quality standards in addition to directing construction work
- Establishing control systems to ensure efficient functioning of infrastructure and safety and environmental protection
- Organising and directing the operation, maintenance and repair of agricultural production structures and facilities
- Analysing the stability of structures, machinery and implements and testing the behaviour and durability of the materials used in their construction.

5. NATURE AND ORGANISATION OF THE INDUSTRY

The close association of Agricultural Engineering with biological and environmental systems requires specific attention to risk and impact mitigation and requires the Candidate Engineering Technician to develop a good working knowledge of specific laws and regulations. These include the following:

- Atmospheric Pollution Prevention Act, No. 45 of 1965
- Conservation of Agricultural Resources Act, No. 43 of 1983 (CARA)

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- Land reform legislature
- Land Use Planning Ordinance, No. 15 of 1985 (LUPO)
- National Environmental Management Act, No. 107 of 1998
- National Environmental Management Biodiversity Act, No. 10 of 2004
- National Environmental Management Waste Act, No. 59 of 2008
- National Water Act, No. 36 of 1998
- Occupational Health and Safety Act, No. 85 of 1993 (OHS)

Candidate Engineering Technicians should ensure that the work they engage in during the training period is relevant to their progression towards registration and gradually increases their degree of responsibility. Candidate Engineering Technicians should also ensure that they gain experience in all the typical tasks throughout the lifecycle of Agricultural Engineering projects, specifically practical site work and engineering design. The tasks in the engineering project lifecycle are elaborated upon in "**appendices A** and **B**: **Training Elements** and **Training Elements Scope"**. These tasks involve

- solving well-defined engineering problems using engineering and contextual knowledge;
- planning, implementing and operating engineering projects, systems, products and processes;
- mitigating risk and impact; and
- managing engineering activities.

The Candidate Engineering Technician can develop further insight into the typical stages involved in the implementation of engineering projects by studying the 'Guideline Scope of Services and Tariff of Fees for Persons Registered' in terms of the Engineering Profession Act, No.46 of 2000. (See Engineering Council of South Africa, Board Notice No. 208 of 2011 in the *Government Gazette*, No.34875 of 20 December 2011).

The six stages for implementation of normal services in an engineering project are as follows:

- **Stage 1:** Inception (including assessment of needs and resources)
- **Stage 2:** Concept and Viability (often called Preliminary Design)
- **Stage 3:** Design Development (also termed Detail Design)
- **Stage 4:** Documentation and Procurement (development of tender documentation such as

drawings, specifications, quantities and tenders/contracts together with procurement that includes the tendering process)

- **Stage 5:** Contract Administration and Inspection (requiring adequate first-hand, practical experience by the Candidate Engineering Technician in site work such as fabrication, construction, manufacturing, installation, construction administration and inspection)
- **Stage 6:** Close-Out (project close-out and handover, including commissioning, operating documentation and as-built plans).

For continuing projects in an operational environment, the Agricultural Technician may be responsible for project management such as ongoing operation and maintenance, asset management and renewal and optimisation in addition to

- post-implementation / operation / management;
- shut-down, preventative maintenance;
- ongoing optimisation;
- repair, refurbishment, upgrading; and
- decommissioning, safe disposal / re-use / recycling.

Both practical experience in site work (Stage 5) and engineering design (stages 2 and 3) are essential in the training of an Agricultural Engineering Technician. It should be noted that design is not restricted to physical infrastructure and artefacts but may include the production of new processes and operating systems.

Agricultural Engineering encompasses a diverse range of fields, and it would be unrealistic to expect Candidate Engineering Technicians to achieve exposure to the full range of fields during their training period, or even throughout their career. However, it is important that Candidate Engineering Technicians

- are exposed to and demonstrate a good understanding of the context within which they are applying their knowledge, skills and engineering judgement;
- gain experience across the full spectrum of tasks in the typical lifecycle of engineering projects; and
- are familiar with the statutory requirements related to their field of operation.

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6. DEVELOPING COMPETENCY: ELABORATING ON SECTIONS IN THE GUIDE REGARDING COMPETENCY STANDARDS (DOCUMENT R-08-PN)

Candidate Engineering Technicians can demonstrate competency in their field by compiling a portfolio of evidence structured according to the eleven outcomes mentioned in document **R-02-PN** and further described in document **R-08-PN**. The eleven outcomes are organised into five groups (Groups A–E), which are explained below:

<u>Group A: Knowledge-based problem-solving (this should be a strong focus)</u>

The Candidate Engineering Technician may develop and demonstrate competency in outcomes 1, 2 and 3 by providing evidence of well-defined problem identification and analysis that successfully interprets a diversity of factors affecting possible engineering solutions in farming, rural development or agro-industrial contexts. Examples of evidence for competency include identification, evaluation, selection, design and implementation of suitable engineering solutions (may include infrastructure and/or processes) and the application of engineering and non-engineering knowledge and insight to achieve workable solutions.

<u>Group B: Management and Communication</u>

Evidence for competency of the Candidate Engineering Technician in outcomes 4 and 5 (management and communication in Agricultural Engineering) can include examples of planning and organising and human resource management, plus funds, machinery, methods and materials in site work and Agricultural Engineering office contexts. Also included is professional and effective communication with farmers, rural communities, contractors, persons engaged in the agro-industry, relevant government departments, clients and peers.

<u>Group C: Identifying and mitigating the impacts of engineering activity</u>

Examples demonstrating competency in Outcome 6 (identifying and mitigating the impacts of Agricultural Engineering activity) include the responsible development, utilisation and protection of natural resources related to agriculture, including water, soil, biodiversity and air quality. Competency may further include mitigation of non-regulated impacts such as disturbances to social and economic stability through ill-considered engineering developments, particularly in remote rural areas.

Evidence of competency in Outcome 7 may include examples of human, animal and plant health protection in farming and agro-industrial contexts and compliance with relevant regulatory requirements in the design of engineering solutions.

Group D: Judgement and responsibility

For outcomes 8, 9 and 10, Candidate Engineering Technicians should demonstrate that they are willing and able to take responsibility for well-defined decisions in addition to being competent in judgement and exhibiting responsible conduct in accordance with the ECSA Code of Conduct.

Group E: Independent learning

Towards the achievement of Outcome 11, the Candidate Engineering Technician should develop the ability and habit of independent and lifelong learning. Using the Continuous Professional Development (CPD) guidance documentation available on the ECSA website, candidates should provide evidence of relevant CPD activities completed during the training period.

6.1 Contextual knowledge

By nature, work in the Agricultural Engineering sector is very closely integrated with biological systems and the natural environment. Thus, the Engineering Technician requires a thorough understanding of the people and the circumstances when devising a suitable Agricultural Engineering solution. Circumstances may vary from ultramodern, agro-industrial factories and complex, multi-faceted, commercial farming enterprises to robust, pro-poor, rural food security systems within complex, multi-user social structures.

The strong contextual nature of Agricultural Engineering solutions holds specific implications for the training of the Candidate Engineering Technician. It is strongly recommended that the Candidate Engineering Technician also acquires first-hand exposure and experience of the non-engineering context (farms, rural communities, agri-businesses) within which Agricultural Engineering solutions need to be relevant. Adequate first-hand exposure will enable Candidate Technicians to:

- understand that they are working with the uncertainties of economy, climate, social contexts and farming environments;
- understand, respect and be able to collaborate with related disciplines in a well-defined environment, including chemical suppliers and specialists in crops, soils, food science and health in addition to various environmental aspects; and

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- appreciate the economic realities in agriculture, including low margins, resource-poor communities and the socio-economic impacts of and on engineering interventions.

6.2 Functions performed, statutory and regulatory requirements and desired formal learning

The following practical and formal learning activities/objectives are recommended for inclusion in the training period for the Candidate Engineering Technician in Agricultural Engineering:

- Gaining practical exposure to non-engineering skills and underlying background experience in farming, rural development and/or agro-industry contexts. It is strongly advised that if possible, the Candidate Agricultural Engineering Technician works in a farming or agro-industrial environment for three months to a year upon graduation;
- Acquiring the habit of CPD in functions related to the discipline;
- Networking and becoming acquainted with peers and related disciplines;
- Developing targeted soft skills to act effectively while considering social realities and management contexts;
- Attending industry-related conferences / presentations / seminars / workshops, including those regarding IT-software applications relevant to the discipline;
- Project planning and management;
- Engineering management; and
- Entrepreneurship and business management.

7. PROGRAMME STRUCTURE AND SEQUENCING

7.1 Best-practice programmes

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

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

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The training programme should be such that the candidate progresses through the levels of work capability as described in document **R-04-P** so that by the end of the training period, the candidate exhibits a Level E degree of responsibility and is able to perform individually and as a team member at the level of problem-solving and engineering activity that is required for registration.

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

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

Examples are as follows:

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

Recognition of prior engineering training outside the realm of the ECSA training requirements guide should be used to determine the level of responsibility at which a late entrant or one who has changed employment should join the candidacy programme. The onus is placed on the trainee applicants to provide verifiable evidence that the engineering work in which they were involved in the past indeed meets the requirements of the degree of responsibilities contained in this discipline-specific training guide (DSTG).

7.2 Realities

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The ECSA states that the minimum period for the Candidacy Phase is three years. The likelihood, however, is that the period of training will be longer. This time frame is determined by the availability of opportunities and the exposure to various functions in the actual work environment.

Irrespective of the route followed, the overriding consideration is that the applicant must provide evidence of competence against the standard and provide objective evidence of meeting the 11 specified outcomes.

7.3 Generalists, specialists, researchers and academics

Document **R-08-PN** adequately describes what is expected of persons whose formative development has not followed a conventional path (e.g. academics, researchers and specialists) in order for them to register. As stated above, the overriding consideration is that to be registered, a person must provide evidence of competence against the standard. Thus, the onus is on such applicants to provide verifiable evidence that the required degree of responsibility and competence indicated in this DSTG has been met.

7.4 Orientation requirements

The requirements comprise

- introduction to company safety regulations;
- introduction to the company code of conduct;
- introduction to the company staff code and regulations;
- typical functions and activities of the company; and
- hands-on experience and orientation in each of the major company divisions.

7.5 Moving into or changing candidacy training programmes

This guide assumes that the candidate enters a programme after graduation and continues with the programme until ready to submit an application for registration. It also assumes that the candidate is supervised and mentored by persons who meet the requirements indicated in document **R-04-P**. 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:

- The candidate must complete the Training and Experience Summary (TES) and the Training and Experience Reports (TERs) for the previous programme or unstructured experience. In

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the latter case, it is important to reconstruct the experience as accurately as possible. The TERs must be signed off.

- On entering the new programme, the mentor and supervisor should review the candidate's development in view of past experience and opportunities and the requirements of the new programme and should plan at least the next phase of the candidate's programme.

7.6 Multi-disciplinary exposure

Interface management between various disciplines needs to be formalised. Details of signed-off interface documents between different disciplines are essential.

7.7 Degree of responsibility

Candidate Engineering Technicians together with their supervisors and mentors should ensure that their work is structured and sequenced to enable systematic progression towards registration. Progress can be planned and measured using the scales for Degree of Responsibility, engineering activity and engineering problem-solving as described in document **R-04-P: Training and Mentoring Guide** and document **R-08-PN: Guide to the Competency Standard**.

In particular, document **R-04-P**: **Progression throughout the Candidacy Period** refers to the gradual increase in the degree of responsibility that Candidate Engineering Technicians are expected to acquire and exhibit during their engineering training. Specific examples and outcomes appropriate to training in Agricultural Engineering are given below:

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Degree of Responsibility	Nature of work The	Activities/duties to be undertaken during training in Agricultural Engineering
A: Being Exposed	Undergoes induction; observes processes and work of competent practitioners	While working under close supervision of competent, professional and senior colleagues in the firm/organisation, the trainee should • be directed to read the various Acts and regulations that affect the work of a Professional Engineering Technician; • be exposed to the firm or organisation's work environment, including the organisational structure; • read materials about the firm/organisation; • be exposed to the environment and culture of field work and engineering office work; • attend and participate in meetings, including office and field/site meetings, seminars and workshops; • be sensitised about the importance of CPD and attend relevant vocational society meetings; • be exposed and/or trained in the use of the general and specialised computer software packages that are used by the firm/organisation in its delivery of day-to-day work; • be part of a team comprising competent engineering personnel and Candidate Technicians working on engineering projects in a sub-discipline of Agricultural Engineering; • if possible, be attached/exposed to different well-defined projects in the known sub-disciplines of Agricultural Engineering; and • be personally committed to his/her development and training by gaining experience in the full range of engineering activities that are available in the firm/organisation.

B: Assisting	Performs specific processes under close supervision	While working under the close supervision of a professional person, the trainee should • be engaged in well-defined engineering tasks under close supervision of a competent person; • develop and display an appreciation of the numerous resources at the disposal of an Agricultural Engineering Technician; • be engaged in conducting well-defined special studies or research to solve customer service problems; • assist in the selection of outside consultants and contractors; • assist in the preparation and issuance of proposals to consultants and contractors; • be assigned the well-defined responsibilities of assisting/supervising new staff at the 'A – Being Exposed' level and other lower-level technical staff; • assist in the review of bid proposals and in making recommendations and thereafter, forwarding his/her report to the supervising professional; and • be personally committed to his/her development and training by gaining experience of the complete range of well-defined engineering activities that is available in the firm/organisation.

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C: Participating	Performs specific processes as directed with limited supervision	While working under less supervision than at Degree of Responsibility levels A and B, the trainee should • administer assigned well-defined contracts and provide administrative support in the preparation of well-defined construction and maintenance contracts; • participate in the preparation of budgets for assigned well-defined projects, submit budget recommendation and monitor expenditure; • assist in monitoring outside consultants' work and their progress regarding well-defined projects and disbursement of payments; • compile engineering and other relevant data for use by engineering project team members for assigned projects; • participate in minor well-defined engineering design work as directed by a competent person; • be personally committed to his/her development and training by gaining experience of the complete range of engineering activities that is available in the firm/organisation; and • remain committed to CPD.

D: Contributing	Performs specific work with detailed approval of work outputs	While working under minimum supervision, the trainee applies well-defined engineering technology and knowledge of biological sciences to agricultural problems concerned with power and machinery, electrification, structures, soil and water conservation and the processing of agricultural products in order to • develop well-defined criteria for design, manufacture or construction of equipment, structures and facilities; • design and use sensing, measuring and recording devices and instrumentation to study problems such as effects of temperature, humidity and light on plants or animals or to study the relative effectiveness of different methods of applying insecticides; • design and direct the manufacture of well-defined equipment for land tillage and fertilisation, for plant and animal disease control, for insect control and for the harvesting and transport of commodities; • design and supervise the erection of well-defined structures for crop storage, animal shelter and human dwelling, including light, heat, air-conditioning, water supply and waste disposal facilities; • plan and direct construction of well-defined irrigation, drainage and flood-control systems for soil and water conservation; • design and supervise installation of well-defined equipment and instruments used to evaluate and process farm products and to automate group agricultural operations and related farm cooperatives; and • remain committed to CPD. It should be noted that the trainee need not contribute/work in all the above-mentioned areas because the firm/organisation may not be involved in engineering work covering all the Agricultural Engineering sub-disciplines.

E: Performing	Works in team without supervision; recommends work outputs; responsible but not accountable	While working without supervision, the trainee applies well-defined engineering technology and knowledge of biological sciences to agricultural problems concerned with power and machinery, electrification, structures, soil and water conservation and the processing of agricultural products in order to • develop well-defined criteria for the design, manufacture and construction of equipment, structures and facilities; • develop and implement well-defined production, processing and management systems; • design and use sensing, measuring and recording devices and instrumentation to study problems such as effects of temperature, humidity and light on plants and animals and to study the relative effectiveness of different methods of applying insecticides; • design and direct the manufacture of well-defined equipment for land tillage and fertilisation, for plant and animal disease control, for insect control and for the harvesting and transport of commodities; • design and supervise the erection of well-defined structures for crop storage, animal shelter and human dwelling, including light, heat, air-conditioning, water supply and waste disposal facilities; • plan and direct construction of well-defined irrigation, drainage and flood-control systems for soil and water conservation; • design and supervise the installation of well-defined equipment and instruments used to evaluate and process farm products and to automate group agricultural operations and related farm cooperatives; • assume technical responsibility and coordinate the work of juniors; • manage multi-disciplinary, well-defined engineering projects; • exercise well-defined engineering judgement and take responsibility (the output of which must be confirmed by a professional person); and • remain committed to CPD. It should be noted that the trainee need not contribute/work in all the above mentioned areas because the firm/organisation may not be involved in engineering work covering all the Agricultural Engineering sub-disciplines.

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REVISION HISTORY

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Rev 1	17 July 2014		Central Registration Committee
Rev 2	23 May 2019	Approval	RPSC
Rev 2	14 June 2019	Ratification	RPSC

The Discipline-Specific Training Guide (DSTG) for

Registration as a Professional Engineering Technician in Agricultural Engineering

Revision 2 dated 23 May 2019 and consisting 25 pages reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research, Policy and Standards **(RPS)**.

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Business Unit Manager

24/07/2019
Date

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Executive: RPS

26/07/2019
Date

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

APPENDIX A: TRAINING ELEMENTS

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

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

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

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

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Competency Standards for Registration as a Professional Engineering Technician	Explanation and Responsibility Level
1. Purpose This standard defines the competence required for registration as a Professional Engineering Technician. Definitions of terms having particular meaning within this standard are presented in Appendix B.	Discipline-Specific Training Guides (DSTGs) give context to the purpose of the Competency Standards. Professional Technicians operate within the nine disciplines recognised by the ECSA. Each discipline can be further divided into sub-disciplines and finally, into specific workplaces as demonstrated in Clause 4 of the specific DSTG. Discipline-Specific Training Guides are used to facilitate experiential development towards ECSA registration and assist in compiling the required portfolio of evidence (specifically the Engineering Report in the application form). NOTE: The training period must be used to develop the competence of the trainee towards achieving the standards presented below at a Responsibility Level E (i.e. Performing). Refer to Section 7.1 of the specific DSTG.
2. Demonstration of Competence Competence must be demonstrated within ***well-defined engineering activities*** (defined below) by the integrated performance of the outcomes defined in Section 3 at the level defined for each outcome. Required contexts and functions may be specified in the applicable DSTG. **Level Descriptor: *Well-defined engineering activities (WDEA) have*** several of the following characteristics: a) *Scope* of practice area is defined by techniques applied; change is by adopting new techniques into current practice. b) Practice area is located within a wider, complex *context,* with well-defined working relationships with other parties and disciplines. c) Work involves a familiar, defined range of *resources,* including people, money, equipment, materials and technologies. d) Activities require resolution of *interactions* manifested between specific technical factors with limited impact on wider issues. e) Activities are *constrained* by operational context, defined work package, time, finance, infrastructure, resources, facilities, standards and codes, and applicable laws. f) Activities have *risks* and *consequences* that are locally important but are generally not far reaching ***Activities*** include design; planning; investigation and problem resolution; improvement of materials, components, systems and processes; manufacture and construction; engineering operations; maintenance; project management; research; development; and commercialisation.	Engineering activities can be approximately divided into 5% Complex (Professional Engineers) 5% Broadly Defined (Professional Technologists) 10% Well-Defined (Professional Technicians) 15% Narrowly Well-Defined (Registered Specified Categories) 20% Skilled Workman (Engineering Artisan) 55% Unskilled Workman (Artisan Assistant) The activities can be in-house or contracted out; evidence of integrated performance can be submitted irrespective of the situation. **Level Descriptor: *WDEA*** in the various disciplines are characterised by several or all of the following: a) *Scope* of practice area does not cover the entire field of the discipline (exposure limited to the sub-discipline and specific workplace). Techniques applied are largely well established, and change by adopting new techniques into current practice is the exception. b) Practice area varies substantially with unlimited location possibilities, resulting in the additional responsibility of identifying the need for complex and/or *broadly defined* advice to be included in the well-defined working relationships with other parties and disciplines. c) The bulk of the work involves a familiar, defined range of *resources* that includes people, money, equipment, materials and technologies. d) Most of the impacts in the sub-discipline are on wider issues and although occurring frequently, are *well-defined* and can be resolved by following established procedures. 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 design; planning; investigation and problem resolution; improvement of materials, components, systems or processes; engineering operations; maintenance; and project management. For Engineering Technicians, research, development and commercialisation happen more frequently in some disciplines and are seldom encountered in others.

3. Outcomes to be satisfied	Explanation and Responsibility Level
Group A: Engineering Problem-Solving	
Outcome 1: Define, investigate and analyse *well-defined engineering problems*	**Responsibility Level E** Analysis of an engineering problem means the 'separation into parts, possibly with comment and judgement'.
Well-defined engineering problems have the following characteristics: (a) can be solved mainly by practical engineering knowledge underpinned by related theory; *and one or more of:* (b) are largely defined but may require clarification; (c) are discrete, focused tasks within engineering systems; (d) are routine, frequently encountered, may be unfamiliar but in a familiar context; *and one or more of:* (e) can be solved by standardised or prescribed ways; (f) are encompassed by standards, codes and documented procedures; authorisation required to work outside limits; (g) information is concrete and largely complete but requires checking and possible supplementation; (h) involve several issues (few of these impose conflicting constraints) and a limited range of interested and affected parties; *and one or both of:* (i) require practical judgement in the practice area in the evaluation of solutions and consideration of interfaces to other role players; and (j) have consequences that are locally important but not far reaching (wider impacts are dealt with by others).	(a) A practical problem for Engineering Technicians means the problem encountered cannot be solved by artisans because theoretical calculations and engineering decisions are necessary to substantiate the solution proposed. (b) Further investigation to identify the nature of the problem is seldom necessary. (c) The problem is discrete, meaning it is *individually distinct* and easily recognised as part of the larger engineering task, project or operation. (d) It is recognised that the problem occurred in the past or the possibility exists that it may have happened before; it is definitely and possibly occurred in the past therefore it is not a new problem. (e) The problem does not require the development of a new solution (determine how the problem was previously solved). (f) Encompassed means *encircled:* The standards, codes and documented procedures must be obtained to solve the problem, and authorisation from the Engineer or Technologist in charge must be obtained to waive the stipulations. (g) The responsibility lies with the Engineering Technician to check that the information received regarding the problem encountered is correct and is added to as necessary to ensure the correct and complete execution of the work. (h) The problem handled by the Engineering Technician must be limited to well-known matters and preferably requires standardised solutions without possible complications. (i) Practical solutions to problems include knowledge of the skills displayed by Practical Specialists and Engineering Artisans without sacrificing theoretical engineering principles and/or taking shortcuts to satisfy the parties involved. (j) Engineering Technicians must realise that their actions may appear to be of local importance only but may develop into problems for which support from Engineers and Technologists may be needed to deal with the consequences.
Assessment Criteria: A structured analysis of well-defined problems typified by the following performances is expected. 1.1 State how <u>you</u> interpreted the work instruction received, checking with your client or supervisor that your interpretation is correct. 1.2 Describe how <u>you</u> analysed, obtained and evaluated further clarifying information and indicate if the instruction was revised as a result.	To perform an engineering task, an Engineering Technician will typically receive an instruction from a senior person (customer) to perform the task and must 1.1 ensure that the instruction is complete, clear and within his/her capability and that the person who issued the instruction agrees with his/her interpretation; and 1.2 ensure that the instruction and information to do the work is complete and fully understood, including the engineering theory needed to understand the task and to carry out and/or check the calculations and the acceptance criteria. If needed, supplementary information must be gathered, studied and understood.

Range Statement: The problem may be part of a larger engineering activity or may stand alone. The design problem is amenable to solution by established techniques that are practised regularly by the candidate. Outcome 1 is concerned with the understanding of a problem; Outcome 2 is concerned with the solution.	**Please refer to Clause 4 of the specific DSTG.**
Outcome 2: Design or develop solutions to *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 the problem analysis defined in Outcome 1. Working systematically to synthesise a solution to a well-defined problem typified by the following performances is expected. 2.1 Describe how <u>you</u> designed or developed and analysed alternative approaches to do the work. Impacts checked. Calculations attached. 2.2 State your final solution to perform the work – client or supervisor in agreement.	After the task received is fully understood and interpreted, a solution to the problem posed can be developed (designed). To synthesise a solution means 'to combine separate parts, elements, substances, etc. into a whole or into a system'. 2.1 The development (design) of more than one way to solve an engineering task or problem should always be done and include the costing and impact assessment for each alternative. All the alternatives must meet the requirements set out by the instruction received, and <u>the theoretical calculations to support each alternative must be done and submitted as an attachment</u>. 2.2 In some cases, the Engineering Technician will not be able to support proposals with the complete theoretical calculation substantiating every aspect and must, in these cases, refer his/her alternatives to an Engineer or Technologist for scrutiny and support. The alternatives and the recommended alternative must be convincingly detailed to win customer support for the recommended alternative. Selection of alternatives may be based on tenders submitted with alternatives deviating from those specified.
Range Statement: The solution is amenable to established methods, techniques and procedures within the candidate's practice area.	Applying theory to *well-defined engineering* work is done in a way that has been used before. The process was probably developed by Engineers or Technologists in the past and documented in written procedures, specifications, drawings, models, examples, etc. Engineering Technicians must seek approval for any deviation from these established methods.
Outcome 3: Comprehend and apply knowledge embodied in established engineering practices and knowledge specific to the jurisdiction in which he/she practises.	**Responsibility Level E** Comprehend means to understand fully. The jurisdiction in which an Engineering Technician practises is given in **Clause 4 of the specific DSTG**.
Assessment Criteria: This outcome is normally demonstrated in the course of design, investigation or operations. 3.1 State which NDip-level <u>engineering standard procedures and systems you</u> used to execute the work and how NDip-level theory was applied to understand and/or verify these procedures. 3.2 Provide <u>your</u> own NDip-level theoretical calculations and/or reasoning on why the application of this theory is considered correct (actual examples required).	Design work for Engineering Technicians mainly involves utilising and configuring manufactured components. The design work is repetitive and uses an existing design as an example. Engineering Technicians apply existing codes and procedures in their design work. Investigation is on well-defined incidents. Condition monitoring and operations mainly involve controlling, maintaining and improving engineering systems and operations. 3.1 The understanding of well-defined procedures and techniques must be based on fundamental mathematical, scientific and engineering knowledge. Specific procedures and techniques applied to do the work accompanied by the underpinning theory must be given. 3.2 Calculations confirming the correct application and utilisation of equipment listed in Clause 4 of the specific DSTG must be done on practical *well-defined activities*. Reference must be made to standards and procedures used and how these were derived from NDip theory.

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Range Statement: Applicable knowledge includes the following: (a) Technical knowledge that is applicable to the practice area irrespective of location and is supplemented by locally relevant knowledge, for example, established properties of local materials (b) A working knowledge of interacting disciplines and codified knowledge in related areas: financial, statutory, safety, management (c) Jurisdictional knowledge regarding legal and regulatory requirements and prescribed codes of practice	(a) The specific location of a task to be executed is the most important determining factor in the layout design and utilisation of equipment. A combination of educational knowledge and practical experience must be used to substantiate decisions taken and must include a comprehensive study of materials, components and projected customer requirements and expectations. (b) Regardless of having a working knowledge of interacting disciplines, Engineering Technicians must appreciate the importance of working with specialists such as Civil Engineers on structures and roads, Mechanical Engineers on fire protection equipment, Architects on buildings and Electrical Engineers on communication equipment. The codified knowledge in the related areas means working to and understanding the requirements set out by specialists in the areas mentioned. (c) Jurisdictional in this instance means 'having the authority', and Engineering Technicians must adhere to the terms and conditions associated with each task undertaken. The Engineering Technician may be appointed as the 'responsible person' for specific duties in terms of the OHS Act.

Group B: Managing Engineering Activities	Explanation and Responsibility Level
Outcome 4: Manage part or all of one or more *well-defined engineering activities*	**Responsibility Level D** Manage means 'control'.
Assessment Criteria: The display of personal and work process management abilities is expected: 4.1 State how <u>you</u> managed yourself, priorities, processes and resources in carrying out the work (e.g. bar chart). 4.2 Describe <u>your</u> role and contribution in the work team.	In engineering operations and projects, Engineering Technicians will typically be given the responsibility to carry out specific tasks and/or complete projects. 4.1 Resources are usually subdivided based on availability and are controlled by a work-breakdown structure and schedule to meet deadlines. Quality, safety and environmental management are important aspects. 4.2 Depending on the task, the Engineering Technician can be the team leader or a team member and can supervise appointed contractors.
Outcome 5: Communicate clearly with others in the course of his/her *well-defined engineering activities*	**Responsibility Level C**
Assessment Criteria: Demonstration of effective communication. 5.1 State how <u>you</u> presented your point of view and compiled reports after completion of the work. 5.2 State how <u>you</u> compiled and issued instructions to entities working on the same task.	5.1 Refer to the Range Statement for outcomes 4 and 5. Presentation of point of view mainly occurs in meetings and discussions with immediate supervisor. 5.2 Refer to the Range Statement for outcomes 4 and 5.

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Range Statement for outcomes 4 and 5: Management and communication in *well-defined engineering* involves the following: (a) Planning *well-defined* activities (b) Organising *well-defined* activities (c) Leading *well-defined* activities (d) Controlling *well-defined* activities Communication relates to technical aspects and the wider impacts of professional work. Audience includes peers, other disciplines, clients and stakeholders. Appropriate modes of communication must be selected. The Engineering Technician is expected to perform the communication functions reliably and repeatedly.	(a) Planning means 'the arrangement for doing or using something; considering in advance'. (b) Organising means 'putting into working order; arranging in a system; making preparations for'. (c) Leading means 'guiding the actions and opinions of; influencing; persuading'. (d) Controlling means the 'regulating, restraining, keeping in order; checking'. Engineering Technicians write or participate in writing specifications for the purchase of materials and/or for work to be done; make recommendations on tenders received; place orders and variation orders; write work instructions; report back on work done; draw, correct and revise drawings; compile test reports; use operation and maintenance manuals to write work procedures; write inspection and audit reports; write commissioning reports; prepare and present motivations for new projects; compile budget reports; report on studies done and calculations carried out; report on customer requirements; report on safety incidents and risk analysis; report on equipment failure; report on proposed system improvement and new techniques; report back on cost control; etc.

Group C: Impacts of Engineering Activity	Explanation and Responsibility Level
Outcome 6: Recognise the general foreseeable social, cultural and environmental effects of *well-defined engineering activities*	**Responsibility Level B** Social means 'relating to people living in communities; relations between persons and communities'. Cultural means 'all the arts, beliefs, social institutions, etc. that are characteristic of a community'. Environmental means 'surroundings, circumstances, influences'.
Assessment Criteria: This outcome is normally displayed in the course of the analysis and solution of problems. 6.1 Describe the social, cultural and environmental impact of the engineering activity. 6.2 State how you communicated mitigating measures to affected parties and acquired stakeholder engagement.	6.1 Engineering significantly affects the environment (e.g. servitudes, expropriation of land, excavation of trenches with associated inconvenience, borrow pits, dust and obstruction, street and other crossings, power dips and interruptions, visual and noise pollution, malfunctions, oil and other leaks, electrocution of human beings, detrimental effect on animals and wild life, dangerous rotating and other machines, and demolition of structures). 6.2 Mitigating measures taken may include environmental impact studies, environmental impact management, community involvement and communication, barricading and warning signs, temporary crossings, alternative supplies (ring feeders and bypass roads), press releases and compensation paid.

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Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his/her *well-defined engineering activities*	**Responsibility Level E**
Assessment Criteria: 7.1 List the major laws and regulations applicable to this particular activity and indicate how health and safety matters were handled. 7.2 State how <u>you</u> obtained advice in carrying out risk management for the work and elaborate on the risk management system applied.	7.1 The OHS Act is supplemented by a variety of parliamentary Acts, regulations, local authority by-laws, standards and codes of practice. Places of work may have standard procedures, instructions, drawings, and operation and maintenance manuals available. Depending on the situation (emergency, breakdown, etc.), these documents are consulted before commencing the work and during the activity. 7.2 It is advisable to attend a Risk Management (Assessment) course and to investigate and study the materials, components and systems used in the workplace. The Engineering Technician seeks advice from knowledgeable and experienced specialists if the slightest doubt exists that safety and sustainability cannot be guaranteed.
Range Statement for outcomes 6 and 7: Impacts and regulatory requirements include the following: (a) Impacts to be considered are generally those identified within the established methods, techniques and procedures used in the practice area. (b) Regulatory requirements are prescribed. (c) Prescribed risk management strategies are applied. (d) Effects to be considered and methods used are defined. (e) Safe and sustainable materials, components and systems are prescribed. (f) Persons whose health and safety are to be protected are both inside and outside the workplace.	(a) The impacts will vary substantially with the location of the task (e.g. the impact of laying a cable or pipe in the main street of a town will be entirely different to the impact of construction in a rural area). The methods, techniques and procedures will differ accordingly and are identified and studied by the Engineering Technician before starting the work. (b) The Safety Officer and/or the Responsible Person appointed in accordance with the OHS Act usually confirms or checks that the instructions are in line with regulations. The Engineering Technician is responsible for ensuring that this is done, and if not, for establishing which regulations apply and ensuring adherence. Usually, the people working on site are strictly controlled w.r.t. health and safety, but the Engineering Technician checks that this is done. Tasks and projects are mainly carried out where contact with the public cannot be avoided, and safety measures such as barricading and warning signs must be used and maintained. (c) Risks are mainly associated with elevated structures, subsidence of soil, electrocution of human beings and moving parts on machinery. Risk-management strategies are usually implemented by more senior staff but are understood and applied by the Engineering Technician. (d) Effects associated with risk management are mostly well known if not obvious, and methods used to address these risks are clearly defined. (e) Usually, the components and systems and the safe and sustainable materials are prescribed by Engineers, Technologists or other professional specialists. It is the responsibility of the Engineering Technician to use his/her knowledge and experience to check and interpret what is prescribed and to report if any dispute exists. (f) Health and safety of the staff working on the task or project as well as persons affected by the engineering work should be considered.

Group D: Exercise judgement, take responsibility and act ethically	Explanation and Responsibility Level
Outcome 8: Conduct engineering activities ethically	**Responsibility Level E** Ethics 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 such issues are expected. 8.1 State how you identified the ethical issues in addition to the affected parties and their interests and indicate the actions you took when a problem arose. 8.2 Confirm that you are conversant and in compliance with the ECSA Code of Conduct and why this Code of Conduct is important in your work.	Systematic means 'methodical; based on a system'. 8.1 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 and misrepresentation of facts. 8.2 The ECSA Code of Conduct as per the ECSA website is known and adhered to. Applicable examples given.

Outcome 9: Exercise sound judgement in the course of *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 State the factors applicable to the work and their interrelationship and indicate how you applied the most important factors. 9.2 Describe how you foresaw work consequences and evaluated situations in the absence of full evidence.	9.1 The extent of a project or task given to a junior Engineering Technician is characterised by the limited number of factors and their resulting interdependence. The Engineering Technician will seek advice if educational and/or experiential limitations are exceeded. Examples of the main engineering factors applied must be given. 9.2 Making risky decisions will lead to equipment failure, excessive installation and maintenance cost, damage to persons and property, etc. Give examples.
Range Statement for outcomes 8 and 9: Judgement in decision-making involves (a) accounting for limited risk factors, some of which may be ill-defined; **or** (b) accounting for consequences that are in the immediate work contexts; **or** (c) accounting for an identified set of interested and affected parties with defined needs.	In engineering, approximately 10% of the activities can be classified as *well-defined* and for these, the Engineering Technician uses standard procedures, codes of practice, specifications, etc. Judgement must be displayed to identify any activity that falls outside the *well-defined* range (defined above): (a) Advice is sought when risk factors exceed his/her capability. (b) Consequences outside the immediate work contexts (e.g. long-term) are not normally handled. (c) Interested and affected parties with defined needs outside the *well-defined* parameters are taken into account.

Outcome 10: Be responsible for making decisions on part or all of one or more *well-defined engineering activities*	**Responsibility Level E** Responsible means 'legally or morally liable for carrying out a duty; caring for something or somebody while being in a position where one may be blamed for loss, failure, etc.'
Assessment Criteria: Responsibility is displayed by the following performance: 10.1 Show how you used NDip theoretical calculations to justify decisions taken in carrying out the engineering work. Attach actual calculations. 10.2 State how you sought responsible advice on any matter falling outside your own education and experience. 10.3 Describe how you took responsibility for your own work and evaluated any shortcomings in your output.	10.1 The calculations (e.g. fault levels, load calculations, losses) are done to ensure that the correct material and components are used). 10.2 The Engineering Technician does not operate on tasks at a higher level than *well-defined* and consults professionals at engineer and/or technologist level if elements of the tasks to be done are beyond his/her education and experience (e.g. power system stability). 10.3 The Engineering Technician engages in continuous self-evaluation to ascertain that the task given is done correctly, on time and within budget. Continuous feedback to the originator of the task instruction with corrective action taken if necessary forms an important element.
Range Statement: Responsibility must be discharged for significant parts of one or more *well-defined engineering activities.*	The responsibility is mainly allocated within a team environment and with an increasing designation as experience is gathered.
Note 1: Demonstration of responsibility is under the supervision of a competent engineering practitioner but the Engineering Technician is expected to perform as if he/she is in a responsible position.	

Group E: Initial Professional Development (IPD)	Explanation and Responsibility Level
Outcome 11: Undertake independent learning activities sufficient to maintain and extend his/her competence	**Responsibility Level D**
Assessment Criteria: Self-development is displayed by the following performance: 11.1 Provide the strategy that you independently adopted to enhance professional development (IPD report) 11.2 Be aware of the philosophy of the employer in regard to professional development	11.1 If possible, a specific field of the sub-discipline is chosen, available developmental alternatives are established, a programme is drawn up (in consultation with the employer if costs are involved) and options that are open to expand knowledge into additional fields are investigated. 11.2 Record-keeping must not be left to the employer or any other person. The trainee must manage his/her own training independently, taking the initiative and being in charge of his/her experiential development towards Professional Engineering Technician level. Knowledge of the employer's policy and procedures on training is essential.

Range Statement: Professional development involves the following: (a) Taking ownership of own professional development (b) Planning own professional development strategy (c) Selecting appropriate professional development activities (d) Recording professional development strategy and activities while displaying independent learning ability	(a) This is your professional development, not the development of the organisation for which you are working. (b) In most places of work, training is seldom organised by a training department. The Engineering Technician must manage his/her own experiential development. Engineering Technicians frequently find themselves at a standstill and are left doing repetitive work. If self-development is not self-driven, success is unlikely. (c) Preference must be given to engineering development rather than developing soft skills. (d) Developing a learning culture in the workplace environment of the Engineering Technician is vital to his/her success. Information is readily available, and most senior personnel in the workplace are willing to mentor if approached.

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APPENDIX B: SCOPE OF TRAINING ELEMENTS

	Occupational		Work Experience and Scope
	Tasks	Contexts	
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); covers how things are** (Experience in one or more of these but not all)
1.2.1		(Responsibility levels A, B, C)	Manufacturing / Production
1.2.2			Laboratory and Testing
1.2.3			Project Management
1.2.4			Process Optimisation and Design
1.2.5			Construction
1.2.6			Commissioning
1.2.7			Plant Operations and Maintenance

1.2.8			Plant Decommissioning
1.2.9			Process Safety
1.2.10			Problem Investigation
1.3		**Experience in design and application of design knowledge**	**(Typically 12 to 18 months); focus is on planning, design and application**
1.3.1		(Responsibility levels C and D)	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 and 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**	**Remainder of training period; focus is on projects and project management** (Working in one or more of these but not in all)
1.4.1		(Responsibility Level E)	Plant and Process Design
1.4.2			Process Optimisation

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1.4.3			Manufacture / Production
1.4.4			Construction and Installation
1.4.5			Project Management
1.4.6			Commissioning
1.4.7			Plant Operations and Maintenance
1.4.8			Modifications
1.4.9			Decommissioning
1.4.10			Process Safety
1.4.11			Research and Development

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	(Responsibility Level C)		
2	**Solving problems based on engineering and contextual knowledge**		
2.1		Conceptualisation of well-defined engineering problems	
2.1.1			Receive brief
2.1.2			Interpret client's requirements
2.1.3			Gather information required for problem analysis
2.1.4			Participate in developing preliminary solutions
2.2		Design or development processes for well-defined engineering problems	
2.2.1			Identify and analyse alternative approaches for design / solution / development processes
2.2.2			Develop documentation for implementing well-defined engineering solutions
3	**Implementing projects or operating engineering systems or processes**		
3.1		Planning processes for Implementation or Operations	
3.1.1			Develop business and stakeholder relationships
3.1.2			Determine scope and generate plan
3.2		Organising processes for Implementation or Operations	
3.2.1			Manage resources
3.2.2			Optimise resources and processes
3.3		Controlling processes for Implementation or Operations	
3.3.1			Monitor progress and delivery
3.3.2			Monitor quality

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3.4		Close-out processes for Implementation or Operations	
3.4.1			Commission processes
3.4.2			Develop of operational documentation
3.4.3			Handover processes
3.5		Maintenance and repair processes	
3.5.1			Plan and scheduling for maintenance
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	
4.1.1			Impact assessments
4.1.2			Risk assessments
4.1.3			Mitigation plans
4.2		Regulatory compliance processes	
4.2.1			Health and Safety
4.2.2			Legal and regulatory
5	Managing Engineering Activities		
5.1		Self-Management Processes	
5.1.1			Manage own activities

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5.1.2			Communicate effectively
5.2		Team Environment	
5.2.1			Participate in and contribute to team planning activities
5.2.2			Manage people
5.3		Professional communication and relationships	
5.3.1			Establish and maintain professional and business relationships
5.3.2			Communicate effectively
5.4		Exercising judgement and taking responsibility	
5.4.1			Practise ethically
5.4.2			Exercise sound judgement in the course of well-defined engineering activities
5.4.3			Be responsible for decision-making on part or all of well-defined engineering activities
5.5		Competency development	
5.5.1			Plan own development strategy
5.5.2			Construct Initial Professional Development record

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