ENSURING THE EXPERTISE TO GROW SOUTH AFRICA

Discipline-Specific Training Guideline for Candidate Engineering Technicians in Chemical Engineering

R-05-CHE-PN

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QM-TEM-001 Rev 0 – ECSA Policy/Procedure
DEFINITIONS

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

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

Ill-posed problem means problems whose requirements are not fully defined or may be defined erroneously by the requesting party.

Integrated performance means that 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 means a measure of performance demands at which outcomes must be demonstrated.

Management of engineering works or activities means the co-ordinated activities required to:
(i) direct and control everything that is constructed or results from construction or manufacturing operations;
(ii) operate engineering works safely and in the manner intended;
(iii) return engineering works, plant and equipment to an acceptable condition by the renewal, replacement or mending of worn, damaged or decayed parts;
(iv) direct and control engineering processes, systems, commissioning, operation and decommissioning of equipment;
(v) maintaining engineering works or equipment in a state in which it can perform its required function.

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

Outcome at the professional level means a statement of the performance that a person must demonstrate in order to be judged competent.
Practice area means 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 means 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 means a category of registration for persons who must be registered through the Engineering Profession Act or a combination of the Engineering Profession Act and external legislation as having specific engineering competencies at NQF Level 5 related to an identified need to protect the public safety, health and interest or the environment, in relation to an engineering activity.
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](image)

1. PURPOSE OF THIS DOCUMENT

All persons applying for registration as Professional Engineering Technicians are expected to demonstrate the competencies specified in document R-02-PN at the prescribed level, irrespective of the trainee’s discipline, through work performed by the applicant at the prescribed level of responsibility.

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

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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 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, as well as documents **R-04-P** and **R-08-PN**, are subordinate to the Policy on Registration, document **R-01-POL**, the Competency Standard (**R-02-PN**) and the application process definition (**R-03-PRO**).

### 2. AUDIENCE

This guide is directed to candidates, their supervisors and mentors in the discipline of Chemical Engineering. The Guide is intended to support a programme of training and experience incorporating good practice elements.

This guide applies to persons who have:

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

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

All applicants for registration must present the same evidence of competence and be assessed against the same standards, irrespective of the development path followed. Application for
registration as a Professional Engineering Technician is permitted without being registered as a Candidate Engineering Technician or without training under a C&U provided that the applicant demonstrates the requisite competence. Mentorship and adequate supervision are however key factors in effective development to the level required for registration. A C&U indicates that the company is committed to mentorship and supervision.

If the trainee’s employer has no C&U, the trainee should establish the level of mentorship and supervision 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 a suitable external mentor. A mentor should be up-to-date at all stages of the development process.

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

Applicants who have not been through mentorship programme are advised to request an experienced mentor (internal or external) to act as an application adviser while they prepare their application for registration. This guide may be applied in the case of a person moving into a candidacy programme at a later stage that is at a level below that required 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 OCCUPATIONS

Chemical Engineering

Chemical Engineering Technicians get involved in the planning, design, development, construction, operation and maintenance of industrial-scale machines and plants processes to convert raw and recycled materials to products through chemical and physical processes using engineering science such as thermodynamics, fluid mechanics, separation technology, chemical reaction kinetics, process control and design, reactor designs, mass and heat transfer processes as well as other...
engineering topics. Chemical engineering is very broad scientifically and technically like all engineers requires application of math, physics, and economics to solve technical problems through designs and invent new processes.

Typical tasks that a Chemical Engineering Technicians may undertake include the following but not limited to:

- Conducting research, advising on and developing well-defined commercial-scale processes to produce substances and items such as petroleum derivatives, chemicals, food and drink products, pulp and paper, pharmaceuticals or synthetic materials such as polymers and plastics, cement, water treatment, energy as well as minerals processing.
- Specifying well-defined chemical production methods, equipment, materials and quality standards and ensuring that they conform to specifications and accepted industry practices and standards.
- Establishing well-defined control standards and procedures to ensure safety of production operations and safety of workers operating equipment or working in close proximity to on-going chemical reactions or processes.
- Designing well-defined chemical plant and equipment and devising well-defined processes for manufacturing chemicals and other products while meeting targeted efficiencies.
- Performing well-defined tests throughout stages of production to determine degree of control over process variables including composition, temperature, density, specific gravity and pressure.
- Participate in developing operating guidelines or work instructions to be employed during design and operating phases (including start-up, shutdown and emergency)
- Preparing estimates of production costs (capex, opex and lifecycle) and production progress reports for management
- Performing laboratory studies of steps in manufacture of new products and testing proposed process(es) in small scale operation such as a pilot plant
- Plant operation and/or management
- Participate in optimising of processes and products for improvement of prescribe performance indices such as profitability, sustainability, energy, environmental and carbon efficiency.
- Develop well-defined process control philosophies and/or advanced process control (APC) systems.
- Evaluate social, environmental, statutory and legal considerations.
5. NATURE AND ORGANISATION OF THE INDUSTRY

5.1 Investigation and Problem Analysis

- Investigation and problem analysis involves the demonstration of the theoretical and practical knowledge to solve problems utilising the well proven analytical techniques and tools. This includes ability to use trouble shooting skills.
- Identification of problems / hazards and analysing the cause(s) of process problems in a systematic manner using applicable models, frameworks / tools.
- Identification of opportunities for improving current operations / plant performance, extending the product range/yield, changing the feed source, during development of new methods for processing, during development of new applications for products, developing new methods/technologies to address shortfalls in currently available methods/technologies or evaluation of processing alternatives.
- Planning and carrying out well-defined experimental investigations in a scientific manner on a laboratory, pilot plant or industrial plant scale.
- Evaluation of well-defined experimental or theoretical results or evaluation of a proposed project (techno-economic evaluation); deriving conclusions in a logical way and formulating recommendations based on these conclusions.
- Motivating research, development or plant modification projects based on technical, economic, safety and environmental considerations.
- Use of troubleshooting methodologies, literature survey, data analysis, root cause analysis tools to identify or analyse well-defined problems.

5.2 Location of training in overall engineering lifecycle and functions performed.

The Chemical Engineering professional will generally work in one of three broadly defined working environments:

- Projects and design
- Operations and maintenance
- Manufacturing and construction
The areas within Chemical Engineering Technicians work follow the conventional stages of the project life cycle:

- Research and development may include planning, market analysis, feasibility studies, product research, engineering design and specifications, software’s, testing, evaluation of engineering models.
- Carry out research engineering by undertaking laboratory experiments, pilot plants and analysing processes during the development of new services or products or improving or existing services, products or plant equipment.
- Utilisation of appropriate tools to simulate design performances.
- Process design to solve a process-related problem, or achieve a particular desired result, or to select equipment for a particular purpose (including conceptualisation, examination of alternatives, trade-off studies, basic and detailed design).
- Plant operation to manufacture the product and make process improvements.

### 5.3 Process Optimisation, Plant and Equipment Design

- Process optimisation involves providing solution to the problem identified; this might be through improving system / equipment operating parameters by proposing modification or installation of new equipment or system. Preparation of a well-defined design basis, process flow sheets, mass and energy balances (can involve simulation and/or computational fluid dynamics).
- Ensuring that the well-defined process optimization or design is in accordance to design specification or plant design bases requirements.
- Preparation of a well-defined design basis, process flow sheets, mass and energy balances (can involve simulation and/or computational fluid dynamics).
- Optimisation of well-defined plant system design; using models (normally computerised) to determine configuration options.
- Selection, design and specification of equipment and service requirements, with reference to the applicable codes and consideration of the suitability of materials used, costs and lifecycle requirements.
- Checking the reliability of data on the properties of materials to be processed or produced, economics, instrumentation, quality control, logistics, safety, spillage / containment management and the effect on the environment.
- Definition and development of well-defined process control and operating philosophies
- Checking of working drawings for suitability with respect to the process, space, accessibility,
maintenance etc.

- Perform cost economic analysis for minimizing cost and maximising throughput and/or efficiency of the plant operation or process.

5.4 Risk Management and Impact Mitigation

- Risk Management process during project management or plant operation or performing any engineering task by considering social, cultural, environmental, legal and regulatory requirements.
- Technologist maybe involved in risk management, identification and analysis within the plant, system or project life cycle.
- Undertaking risk assessments prior to conducting plant test work, installations, or operations.
- Compiling risk assessment plans, risks register, and risk mitigation plans.
- Using the risk analysis tools to undertaken risk impact analysis and develop impact mitigation strategies.
- Consideration of risk attributes or factors during risk assessments such as cost, programme, quality, labour, profitability, logistics, political, social, cultural and environmental, legislation, technology, etc.
- In chemical engineering inherent safety risk ask is thought of during risk response and control processes.
- Compilation of risk management stakeholder and communication plan.

5.5 Process Safety

- Application of process safety management principles which include inherent safety design principles and process safety analysis during plant operation and throughout the project life cycle phases to ensure safe operation and contingency measures.
- Considering plant / equipment design bases and beyond design bases specification and operating parameters.
- Assessing design and condition of safety devices that are used to handle and control the process effluent for a controlled release during accidental undesirable events.
- Consideration of limitation of effect of different types system / equipment failures.
- Consideration of the process safety aspects of plant / projects, which arise from the use of hazardous materials.
- Consideration of process safety when selecting the materials of construction.
Understanding of hazardous material conditions.

- Assessing the environmental impact of process industry activities, and compliance with legal requirements (including requirements for final de-commissioning, shutdown and/or facility closure)
- Use of risk assessment (e.g. quantitative risk analysis) and HAZOP techniques to improve plant design safety.
- Ability to use applicable process safety hazard analysis technique / tool at the specific project life cycle phase.

5.6 Project Management

Project management has a number of phases, stages and gates to be followed to solve industrial problems. Companies uses different project life cycle which include the following: project development; procurement management; contract management; plant construction; commissioning and hand-over; as well as de-commissioning.

Application of the supporting project management process to solve the scientific problem may include:

- Integrated Project Controls: including cost control, estimating (resources, capital, and operating and/or lifecycle costs), planning and scheduling, as well as project risk management.
- Stakeholder Management (i.e. liaison and responsibility for communication and overall control of the engineering team and interfacing with client/legal entities.
- Project Resource management.
- Manage project change and project risk.

5.7 Project Development

- Undertaking project management tasks during all the project development phases including idea / problem analysis / definition need, conceptual design, basic and detailed engineering. The research studies are undertaken as well as feasibility studies to identify select preferred solution and develop the solution.
- Responsibilities of Procurement and contracts management are to consider national treasury rules. There are number of examples that the technologist company may follow for specific project e.g. EPCM – engineering procurement, construction management and commissioning/hand-over.
5.8 Plant Construction, Commissioning and Hand-over

Metallurgical Engineering Technician participates and assists during the following project management processes at well-defined level:

- Plant Construction – site establishment and site management, assembling of plant equipment in accordance to drawings and installation designs.
- Plant commissioning: measurement and analysis of plant performance versus design data; responsibility for acceptable plant performance; elimination of operability and other problems and unacceptable bottlenecks; checking on compliance with safety standards.
- Plant hand-over: including “as-built” documentation, construction punch-out, planning and execution of punch-out and hand-over.
- Undertaken effectiveness reviews after commissioning and hand over to ensure that design was for reliability, maintainability, usability, supportability, reducibility, disposability and affordability.
- Preparation of operating, start up, shutdown and emergency procedures

5.9 Plant Decommissioning

- Assist during the compilation of the decommissioning strategy and safety procedures are followed by understanding the chemical characteristics of the equipment or plant.
- Participate during the compilation of decommissioning strategy and safety procedures are followed by understanding the chemical and physical characteristics of the equipment or plant.
- Participate in compilation of procedures for plant de-commissioning and consolidation for shutdown or closure.
- Participate during the decommissioning phases to ensure safe state of equipment is maintained which include surveillance, inspection, testing and maintenance.
- Ensuring regulatory and statutory application and authorization process is acquired.

5.10 Production / Manufacturing

- Manufacturing or production of the plant equipment of systems which include plant and process design. E.g. heaters, economizers, pumps, scrubbers, distillation columns, reactors, piping, material handling equipment, etc.
- Manufacturing or production of equipment maybe part of plant / equipment design process. Some technologist may find themselves working in industries that only manufacture or produce machinery for the process plants or systems.
• The machinery being produced or manufactured are not limited to transportation and storage of fluids (pumps, tanks), waste management systems, evaporation, drying, ion exchange, solid handling, etc.
• Considering of new or existing plant or system specification and operating parameters from client.
• Application of manufacturing and market measures.

5.11 Plant Operations and Maintenance
• Management of production resources: raw materials, manpower, energy and maintenance.
• Quality control and assurance; monitoring quality and meeting equipment and plant design specifications in accordance to design bases.
• Assist in measurement analysis and evaluation of performance data; on-going plant monitoring and plant optimisation, performance and operating costs.
• Involvement in budgets, cost control, planning and production scheduling.
• Undertaking plant performance analysis may involve problem identification, measurements, modelling and validation of data. Processes involved are not limited to: material balance, energy balance, flow measurements and indications, etc.
• Ensure availability, reliability and operability of the plant or equipment during operation by monitoring and undertaking necessary calculations.
• Understanding different type’s maintenance or repair strategies or practices that must be undertaken per type of equipment specification by identifying physical equipment variables and considering reliability of the equipment.
• Compilation of operating procedures, maintenance bases / lifecycle plans / procedures.
• Broadly defined tools to perform such plant performance analysis and monitoring shall be used.
• Process modification and plant modification maybe suggested as part of plant operations.
• Implementation of maintenance strategy during the plant or equipment decommissioning process.
• Monitor or equipment by considering the following aspects: reliability, maintainability, usability, supportability, reducibility, disposability and affordability.
6. DEVELOPING COMPETENCY: ELABORATING ON SECTIONS IN THE GUIDE TO THE COMPETENCY STANDARDS, DOCUMENT R-08-PN

6.1 Contextual Knowledge
Candidates are expected to be aware of the engineering profession, the Voluntary Associations applicable to the Chemical Engineering Technician.

Candidates are encouraged to familiarise themselves with the Process Industries in general by reading journals, joining industry associations, attending training courses and conferences. This includes gaining knowledge of industry standards and specifications (such as ASME, TEMA, NFPA) and industry practices (such as API).

6.2 Functions Performed
The functions in which all chemical engineering Technicians need to be proficient, and are required to a greater or lesser extent in all the areas of employment are listed below. The parallels with the well-defined generic competence elements required by the competency standard R-02-PN should be clear. Applicants need to gain experience in these functions, even if it is not their core job function.

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

- Group A: Knowledge based problem solving (this should be a strong focus)
- Group B: Management and Communication
- Group C: Identifying and mitigating the impacts of engineering activity
- Group D: Judgement and responsibility
- Group E: Independent learning

It is very useful to measure the progression of the candidate’s competency by making use of the Degree of Responsibility, Problem Solving and Engineering Activity scales as specified in the relevant documentation.

The appendix A has been developed against the Degree of Responsibility Scale. Activities should be selected to ensure that the candidate reaches the required level of competency and responsibility.
It should be noted that the Candidate working at Responsibility Level E carries the responsibility appropriate to that of a registered person except that the Candidates supervisor is accountable for the Candidates recommendations and decisions.

The nature of work and degrees of responsibility defined in document R-04-P, are used here (and in Appendix A below):

<table>
<thead>
<tr>
<th>A: Being Exposed</th>
<th>B: Assisting</th>
<th>C: Participating</th>
<th>D: Contributing</th>
<th>E: Performing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergoes induction, observes processes, work of competent practitioners.</td>
<td>Performs specific processes, under close supervision.</td>
<td>Performs specific processes as directed with limited supervision.</td>
<td>Performs specific work with detailed approval of work outputs.</td>
<td>Works in team without supervision, recommends work outputs, responsible but not accountable</td>
</tr>
<tr>
<td>Responsible to supervisor</td>
<td>Limited responsibility for work output</td>
<td>Full responsibility for supervised work</td>
<td>Full responsibility to supervisor for immediate quality of work</td>
<td>Level of responsibility to supervisor is appropriate to a registered person, supervisor is accountable for applicant’s decisions</td>
</tr>
</tbody>
</table>

6.3 Statutory and Regulatory Requirements

The candidate engineering technician should become familiar with the legal requirements of the process industries including those acts that are generally applicable such as the OHS Act, and the Engineering Profession Act. The candidate engineering technician will be expected to have knowledge and understanding of the statutory requirements pertaining to the work and projects that are included in the experience report.

Candidate must familiarise themselves with South African national treasury instructions and construction regulations if they are implementing projects.

- Chemical engineers have to ensure that they understand and follow relevant statutory codes or rules when designing equipment’s like reactor vessels (e.g. ASME), nuclear equipment, systems, plants or processes. Examples are not limited to the following Acts and regulations:
  - ASME Standard for boiler and pressure vessels codes issued in 1914
  - SANS Codes for Specification for Piping Design / Material (ANSI), see www.sabs.co.za
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Compiler: MB Mtshali
Approving Officer: EL Nxumalo
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- Project and Construction Regulations Management Professions Act, 2000 (Act No. 48 of 2000)
- National Environmental Management Act No 107 of 1998
- Nuclear Energy Act 46 of 1999
- Occupational Health and Safety Act and Regulations No 85 of 1993
- ISO 9001: 2015
- South Africa Bureau of Standards (SABS) Act 24 of 1945; Act 29 of 2008
- List of SABS/TC 147 STANDARDS listing SANS codes for chemical use for treatment of water intended for human consumption and other purposes. E.g. SANS 241:2015 Drinking Water Standard
- SANS codes for food and beverages e.g. SANS 10133, etc. from www.sans.co.za
- Fire Protection Standard SANS Code 10139: 2012 for fire detection and alarm systems for buildings- system design, installation and servicing.

6.4 Desirable Formal Learning

Chemical Engineering Technicians should register with relevant volunteer association to access list of training / conference / seminars and other relevant information e.g. SAIChe-IChemE, PMI, PMISA, CESA, SACPCMP, etc. The following list of formal learning activities is by no means extensive and is purely a sample of some useful courses:

- Risk assessment and analysis techniques (including HAZOPs)
- Problem solving and analysis tools e.g. brain storming, gap analysis, FMEA, Pareto Analysis, root cause analysis, problem tree analysis, trade off tools, etc.
- Project management techniques and tools, including conditions of contract, finance and economics, quality systems, stakeholder management and Project Management (planning,
scheduling and project controls) tools and software’s e.g. Ms Project, Primavera, Project Risk Analysis tools, Earn Value Management (EVM), and other SAP Tools.

- Simulation tools, e.g. Aspen, SimSci, ChemCAD, AFT, Metsim
- Occupation Health and Safety including the OHS Act and “safety in design”
- Formally registered CPD courses in Chemical/Process Engineering and associated disciplines.
- Value Engineering and other Value Improvement Practices (VIPs).
- Preparation of engineering design specifications.
- Environmental aspects of projects and plant operations.
- Regulatory and statutory of equipment operating codes and regimes.
- Professional skills such as report writing, presentations, facilitation and negotiation skills.
- Plant operations performance monitoring tools.
- Compilation of plant operation procedures.
- Operate, monitor, optimise and maintain plant or process.
- Project life cycle phases and systems or equipment lifecycle (up to decommissioning process).
- Process Safety Management

7. PROGRAMME STRUCTURE AND SEQUENCING

7.1 Best Practice

The best practice is the development process to assist the applicants to become registered professional engineering Technicians. Best practice comprises of the process for continuous development for the candidate. A number of courses (technical and management) must be attended in order to gain IPD point required for registration requirements. On job learning from the organization the candidate is employed in. Refer to SAICHE (South African Institution of Chemical Engineers) and IChemE (Institution of Chemical Engineers) for some best practice ideas. Applicant may register with these bodies to gain access to courses, articles and relevant information for their development. This may also open opportunity to meet with experts during seminars.

It is suggested that the candidate works with their mentors to determine appropriate projects to gain exposure to elements of the asset life cycle, to ensure that their designs are constructible, operable, and are designed considering life cycle costing and long-term sustainability. There must be a regular reporting structure with suitable recording of evidence of achievement against the competency outcomes and responsibility need to be put in place.
There is no ideal training programme structure or unique sequencing that constitutes best practice. The training programme for each candidate will depend on the work opportunities available at the time for the employer to assign to the candidate. This means that each candidate will effectively undertake a unique programme where the various activities carried out at the discipline specific level must then be linked to the generic competency requirements of R-08-PN.

7.2 Realities

Candidate Engineering Technicians are advised that although 3 years is the minimum period of experience following graduation, in practice it is found that very seldom do chemical engineering technicians meet the experience requirements in this time, and then only if they have followed a structured training program.

Applicants are advised to gain at least 5 years of experience before applying in a broadly defined engineering responsible level. Furthermore, as the application procedure only allows deferral for 1 year (plus a possible additional 1-year extension of deferral in specific circumstances), applicants will lose their application fee if they cannot achieve the necessary competency within that deferral time period.

Applicant are advised to undertake project management courses for IDP as the chemical engineering work involve project management activities during design, construction and commission, hand over and decommissioning activities. Other courses may include software training for designs and simulation processes.

It is not mandatory for chemical engineers to be involved in equipment or process design if the organization they are employed does not provide such services. In this case chemical engineers are to undertake the well-defined engineering activities of solving engineering problems and develop solutions or be part of reviewing engineering design or provide statement of work to develop solutions or compile technical requirement specification.

It is not expected that applicants will have to change jobs in order to work in all four areas (although that is often a good way, followed by many candidate engineering technicians, of being sure of getting the broadest possible experience). What is expected for ECSA registration is that in whatever area they are employed, applicants ensure that they undertake well-defined
tasks that provide experience in the 3 generic engineering competence elements: of problem investigation and analysis, problem solution and execution / implementation. It should not take too much thought to realise that problem investigation, problem solution, execution / implementation is all required in every one of the areas above, to a greater or lesser extent. It should be possible, by judicious selection of well-defined work task opportunities with the same employer, to gain experience in all three elements.

It is also important that the applicants be able to demonstrate that they have gained experience at increasing levels of responsibility ultimately operating at the level expected of a professional engineering technician within the areas of problem investigation and analysis; problem solution and execution / implementation. To this end, it is important for candidate engineering Technicians to work closely with their mentors and employers to plan well-defined workplace opportunities in order to gain the necessary experience and expertise.

7.3 Generalists, specialists, researchers and academics

Chemical Engineering Technicians often work in areas such as academia, Research & Development, lecturers or highly specialised fields where it is often difficult to gain the breadth of experience required for registration. These candidates must still obtain the necessary experience to enable them to demonstrate that they have met the competencies specified in document R-02-PN at the level expected of a professional engineering technician. It is expected that this will take longer than it would for candidates working in more general areas.

Candidate Engineering Technicians that wishes to specialise in designing fire protection systems may wish to follow the route as specified in the document R-05-FPSP-SC.

Chemical Engineering Technicians may find themselves gaining experience from diverse industries such as mining, metallurgy, etc. Chemical metallurgy uses chemical processing at high temperature or in solution to convert minerals from inorganic compounds to useful metals and other materials.

The candidate working towards being a professional engineering technologist while they are in the academic environment they need acquire the following well-defined engineering activities:

Teaching / Lecturing /Facilitation:

- Reading in applicable fields of knowledge
• Curriculum development
• Selection and development of teaching materials
• Compilation of lecture notes
• Compilation of examination papers
• Demonstration of application of theory in practice
• Serve as supervisor for student projects

Research or Further Studying:
• Literature survey
• Obtaining higher qualifications
• Advancement of the current state of the art of technology
• Theoretical research / development of analytical techniques
• Practical / experimental research
• Participating in international collaborative research

Laboratory Experiments Activities:
• Experimentation
• Design and building of laboratories
• Experimental equipment design / construction
• Experiment design
• Development of new manufacturing techniques

Conferences /Symposia / Seminars:
• Publishing papers (peer-review journals and international conferences)
• Public peaking, etc.

Consulting:
• Consulting to industry in solving real problems encountered in engineering practice
• Design of products /structure / systems / components

7.4 Multi-disciplinary exposure
Interphase management between various disciplines needs to be formalised. Details of signed-off
7.5 Orientation requirements

- Introduction to company safety regulations
- Company code of conduct
- Company staff code and regulations
- Typical functions and activities in company
- Hands on experience and orientation in each of the major company divisions

7.6 Moving into or between Candidacy 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 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 be completed:

- The candidate must complete the Training and Experience Summary (TES) and Training and Experience Reports (TER) for the previous programme or unstructured experience. In the latter case it is important to reconstruct the experience as accurately as possible. The TERs must be signed off in the appropriate manner.
- On entering the new programme, the Mentor and Supervisor should review the candidate’s development in the light of the past experience and opportunities and requirements of the new programme and plan at least the next phase of the candidate’s programme.
Discipline-Specific Training Guideline for:

Candidate Engineering Technicians in Chemical Engineering

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

Business Unit Manager

Date

Executive: RPS

Date

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

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QM-TEM-001 Rev 9 – ECSA Policy/Procedure
APPENDIX A: TRAINING ELEMENTS

Synopsis: A candidate engineering technician should achieve specific competencies at the prescribed level during his/her 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 to 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; and
11. Become conversant with your employer’s training and development program and develop your own lifelong development program within this framework.

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

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

#### 1. Purpose
This standard defines the competence required for registration as a Professional Engineering Technician. Definitions of terms having particular meaning within this standard is given in text in Appendix D.

#### 2. Demonstration of Competence
Competence must be demonstrated within well-defined engineering activities, defined below, by 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 Discipline Specific Guidelines.

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

- **Scope** of practice area is defined by techniques applied; change by adopting new techniques into current practice;
- **Practice area** is located within a wider, complex context, with well-defined working relationships with other parties and disciplines;
- **Work involves** familiar, defined range of resources, including people, money, equipment, materials, technologies;
- **Require resolution of interactions** manifested between specific technical factors with limited impact on wider issues;
- **Are constrained by operational context, defined work package, time, finance, infrastructure, resources, facilities, standards and codes, applicable laws;**

#### Explanation and Responsibility Level
Discipline Specific Training Guides (DSTG) gives context to the purpose of the Competency Standards. Professional Engineering Technicians operate within the nine disciplines recognised by ECSA. Each discipline can be further divided into sub-disciplines and finally into specific workplaces as given in Clause 4 of the specific Discipline Specific Training Guideline. DSTG's 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 utilised to develop the competence of the trainee towards achieving the standards below at a responsibility level E, i.e. Performing. (Refer to 7.1 of the specific DSTG)

**Level Descriptor:** WDEA in the various disciplines are characterised by several or all of:

- **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;
- **Practice area** varies substantially with unlimited location possibilities and an additional responsibility to identify the need for complex and/or broadly defined advice to be included in the well-defined working relationships with other parties and disciplines;
- **The bulk of the work involves** familiar, defined range of resources, including people, money, equipment, materials, technologies;
- **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.**
- **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) Have risks and consequences that are locally important but are generally not far reaching.

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.

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; engineering operations; maintenance; 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:

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

**Well-defined engineering problems have the following characteristics:**

(a) can be solved mainly by practical engineering knowledge, underpinned by related theory;
(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 familiar context;
(e) can be solved by standardised or prescribed ways;
(f) are encompassed by standards, codes and documented procedures;
(g) information is concrete and largely complete, but requires checking and possible supplementation;
(h) involve several issues but few of these imposing conflicting constraints and a limited range of interested and affected parties;
(i) requires practical judgment in practice area in evaluating solutions, considering interfaces to other role players;
(j) have consequences which are locally important but not far reaching (wider impact are dealt with by others).

(a) practical problems 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) discrete means individually distinct: The problem is easily recognised as part of the larger engineering task, project or operation;
(d) recognised that the problem occurred in the past or the possibility exists that it might have happened before – definitely not something new;
(e) 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;
(f) the responsibility lies with the Engineering Technician to check the information received as part of the problem encountered is correct, and added to as is necessary to ensure the correct and complete execution of the work;
(g) the problem handled by an Engineering Technician must be limited to well-known matters preferably needing standardised solutions without possible complications;
(h) practical solutions to problems includes knowledge of the skills displayed by Practical Specialists and Engineering Artisans without sacrificing theoretical engineering principles and / or cutting corners to satisfy parties involved;
(i) Engineering Technicians must realise that their actions might seem to be of local importance only, but may develop into further problems where support from Engineers and Technologists might be needed to deal with these consequences.

**Assessment Criteria:** A structured analysis of well-defined problems typtified by the following performances is expected:

1.1 State how you interpreted the work instruction received, checking with your client or supervisor if your interpretation is correct
1.2 Describe how you analysed, obtained and evaluated further clarifying

To perform an engineering task an Engineering Technician will typically receive an instruction from a senior person (customer) to do this task, and must:

1.1 Make very sure that 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 that the instruction and information to do the work is fully understood and is complete, including the
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 practiced regularly by the candidate. This outcome 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.

Assessment Criteria: This outcome is normally demonstrated after a problem analysis as 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 you designed or developed and analysed alternative approaches to do the work. Impacts checked. Calculations attached

2.2 State what the final solution to perform the work was, client or your supervisor in agreement

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

After the task received is fully understood and interpreted, a solution to the problem posed can be developed (designed).

To synthesise a solution means “the combination of separate parts, elements, substances, etc. into a whole or into a system” by:

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 Engineering Technician will in some cases not be able to support proposals with the complete theoretical calculation to substantiate every aspect, and must in these cases refer his/her alternatives to an Engineer or Technologist 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 submitted deviating from those specified.

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

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

Responsibility level E
Comprehend means “to understand fully”. The jurisdiction in which an Engineering Technician practices is given in Clause 4 of the specific DSTG.

Design work for Engineering Technicians is mostly to utilise and configure manufactured components and repetitive design work using an existing design as an example. Engineering Technicians apply existing codes and procedures in their design work. Investigation would be on well-defined incidents and condition monitoring and operations mostly on controlling.
3.1 State what NDip level engineering standard procedures and systems you used to execute the work, and how NDip level theory was applied to understand and/or verify these procedures;

3.2 Give your own NDip level theoretical calculations and/or reasoning on why the application of this theory is considered to be correct (Actual examples).

**Range Statement:** Applicable knowledge includes:

(a) Technical knowledge that is applicable to the practice area irrespective of location, supplemented by locally relevant knowledge, for example established properties of local materials.

(b) A working knowledge of interacting disciplines. Codified knowledge in related areas: financial, statutory, safety, management.

(c) Jurisdictional knowledge includes legal and regulatory requirements as well as prescribed codes of practice.

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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.

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 it was derived from NDip theory.

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

(b) In spite of having a working knowledge of interacting disciplines, Engineering Technicians must appreciate the importance of working with specialists like Civil Engineers on structures and roads, Mechanical Engineers on fire protection equipment, Architects on buildings, Electrical Engineers on communication equipment, etc. 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. They may even be appointed as the "responsible person" for specific duties in terms of the OHS Act.
<table>
<thead>
<tr>
<th>Outcome 4: Managing Engineering Activities.</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manage part or all of one or more well-defined engineering activities.</td>
<td>Responsibility level D</td>
</tr>
<tr>
<td>Manage means “control”.</td>
<td></td>
</tr>
<tr>
<td><strong>Assessment Criteria:</strong> The display of personal and work process management abilities is expected:</td>
<td>In engineering operations and projects Engineering Technicians will typically be given the responsibility to carry out specific tasks and/or complete projects.</td>
</tr>
<tr>
<td>4.1 State how you managed yourself, priorities, processes and resources in doing the work (e.g. bar chart);</td>
<td>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.</td>
</tr>
<tr>
<td>4.2 Describe your role and contribution in the work team.</td>
<td>4.2 Depending on the task, Engineering Technicians can be the team leader, a team member, or can supervise appointed contractors.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Range Statement for Outcomes 4 and 5: Management and communication in well-defined engineering involves:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Planning well-defined activities;</td>
<td>(a) Planning means “the arrangement for doing or using something, considered in advance”.</td>
</tr>
<tr>
<td>(b) Organising well-defined activities;</td>
<td>(b) Organising means “put into working order; arrange in a system; make preparations for”.</td>
</tr>
<tr>
<td>(c) Leading well-defined activities and</td>
<td>(c) Leading means to “guide the actions and opinions of; influence; persuade”.</td>
</tr>
<tr>
<td>(d) Controlling well-defined activities.</td>
<td>(d) Controlling means the “means of regulating, restraining, keeping in order; check”.</td>
</tr>
</tbody>
</table>

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

Engineering Technicians write or participate in writing specifications for the purchase of materials and/or 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.
<table>
<thead>
<tr>
<th>Group C: Impacts of Engineering Activity.</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome 6:</strong> Recognise the foreseeable social, cultural and environmental effects of well-defined engineering activities generally</td>
<td><strong>Responsibility level B</strong> 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”.</td>
</tr>
<tr>
<td><strong>Assessment Criteria:</strong> This outcome is normally displayed in the course of analysis and solution of problems, by typically:</td>
<td></td>
</tr>
<tr>
<td>6.1 Describe the social, cultural and environmental impact of this engineering activity;</td>
<td>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 wild life, dangerous rotating and other machines, demolishing of structures, etc.</td>
</tr>
<tr>
<td>6.2 State how you communicated mitigating measures to affected parties and acquired stakeholder engagement.</td>
<td>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.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his or her well-defined engineering activities.</th>
<th><strong>Responsibility level E</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment Criteria:</strong></td>
<td></td>
</tr>
<tr>
<td>7.1 List the major laws and regulations applicable to this particular activity and how health and safety matters were handled;</td>
<td>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 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;</td>
</tr>
<tr>
<td>7.2 State how you obtained advice in doing risk management for the work and elaborate on the risk management system applied.</td>
<td>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 exist that safety and sustainability cannot be guaranteed.</td>
</tr>
</tbody>
</table>
Range Statement for Outcomes 6 and 7: Impacts and regulatory requirements include:

(a) Impacts to be considered are generally those identified within the established methods, techniques or procedures used in the practice area;
(b) Regulatory requirements are prescribed;
(c) Apply prescribed risk management strategies;
(d) Effects to be considered and methods used are defined;
(e) Prescribed safe and sustainable materials, components and systems.
(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 town will be entirely different to construction in a rural area. The methods, techniques or procedures will differ accordingly, and is 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 confirm or check that the instructions are in line with regulations. The Engineering Technician is responsible to see to it that this is done, and if not, establishes 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 Engineering Technician checks that this is done.
(c) Risks are mostly associated with elevated structures, subsidence of soil, electrocution of human beings and moving parts on machinery. Risk management strategies are usually done 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, clearly defined.
(e) Usually the safe and sustainable materials, components and systems 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 report anything that he/she is not satisfied with.
(f) Staff working on the task or project as well as persons affected by the engineering work being carried out.

Group D: Exercise judgment, take responsibility, and act ethically.

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 means. Systematic means “methodical; based on a system”.

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systematic approach to resolving these issues is expected, typified by:

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>8.1</td>
<td>State how you identified ethical issues and affected parties and their interest and what you did about it when a problem arose.</td>
</tr>
<tr>
<td>8.2</td>
<td>Confirm that you are con-versant and in compliance with ECSA’s Code of Conduct and why this is important in your work.</td>
</tr>
</tbody>
</table>

### Outcome 9:
Exercise sound judgement in the course of well-defined engineering activities

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

1. **State the factors applicable to the work, their interrelationship and how you applied the most important factors.**
2. **Describe how you foresaw work consequences and evaluated situations in the absence of full evidence.**

**Range Statement for Outcomes 8 and 9:**
Judgement in decision making involves:

- (a) taking limited risk factors into account some of which may be ill-defined; or
- (b) consequences are in the immediate work contexts; or
- (c) identified set of interested and affected parties with defined needs to be taken into account.

### Outcome 10:
Be responsible for making decisions on part or all of all of one or more 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:

1. **Show how you used NDip theoretical calculations to justify decisions taken in doing engineering work. Attach actual calculations;**
2. **State how you took responsible advice on any matter falling outside your own education and experience;**
3. **Describe how you took responsibility for your own work and evaluated any shortcoming in your output.**

1. **The calculations, for example fault levels, load calculations, losses, etc. are done to ensure that the correct material and components are utilized.**
2. **The Engineering Technician does not operate on tasks at a higher level than well-defined and consult 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.”**
### Range Statement

**Responsibility** must be discharged for significant parts of a one or more 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 would be 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)

**Outcome 11:** 
Undertake independent learning activities sufficient to maintain and extend his or her competence

**Assessment Criteria:** Self-development managed by typically:

- **11.1** Provide your strategy adopted independently to enhance professional development. (IPD report);
- **11.2** Be aware of the philosophy of employer in regard to professional development.

**Range Statement:** Professional development involves:

(a) Taking ownership of own professional development;
(b) Planning own professional development strategy;
(c) Selecting appropriate professional development activities; and
(d) Recording professional development strategy and activities; while displaying independent learning ability.

**Explanation and Responsibility Level**

<table>
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<tr>
<th>Responsibility level D</th>
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</table>

11.1 If possible, a specific field of the sub-discipline is chosen, available developmental alternatives established, a program 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 be in charge of experiential development towards Professional Engineering Technician level. Knowledge of the employer’s policy and procedures on training is essential.

(a) This is your professional development, not the organisation you are working for.

(b) In most places of work training is seldom organised by some training department. It is up to the Engineering Technician to manage his/her own experiential development. Engineering Technicians 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.

(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.
APPENDIX B: TRAINING ELEMENTS SCOPE

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<th>Work Experience and Scope</th>
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<td>Company regulations</td>
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<td>Exposure to engineering principles and processes</td>
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<td>1.2.1</td>
<td>(Responsibility level A, B, C)</td>
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<td>1.2.2</td>
<td>Laboratory and Testing</td>
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<tr>
<td>1.2.10</td>
<td>Problem Investigation</td>
</tr>
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</table>

### 1.3 Experience in design and application of design knowledge

**(Typically 12 to 18 months)** and would focus on planning, design and application

<table>
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<th>(Responsibility level C&amp;D)</th>
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<td>Research and investigation</td>
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<td>1.3.3</td>
<td>Preparation of specifications and associated documentation</td>
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<td>1.3.4</td>
<td>System modeling and integration</td>
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<tr>
<td>1.3.5</td>
<td>System &amp; Software Designs</td>
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<tr>
<td>1.3.6</td>
<td>Component / Product designs</td>
<td></td>
</tr>
<tr>
<td>1.3.7</td>
<td>Preparation of contract documents and associated documentation</td>
<td></td>
</tr>
<tr>
<td>1.3.8</td>
<td>Preparation of project management documents</td>
<td></td>
</tr>
<tr>
<td>1.3.9</td>
<td>Application of quality systems</td>
<td></td>
</tr>
<tr>
<td>1.3.10</td>
<td>Configuration and Documentation management (Quality Management Systems)</td>
<td></td>
</tr>
<tr>
<td>1.3.11</td>
<td>Development of standards and procedures</td>
<td></td>
</tr>
</tbody>
</table>

### 1.4 Experience in the execution of engineering tasks

Rest of training period, focus should be on projects and project management. (Working in one or more of these but not in all)

<table>
<thead>
<tr>
<th>1.4.1</th>
<th>(Responsibility level E)</th>
<th>Plant &amp; Process Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4.2</td>
<td>Process Optimisation</td>
<td></td>
</tr>
<tr>
<td>1.4.3</td>
<td>Manufacture / Production</td>
<td></td>
</tr>
<tr>
<td>1.4.4</td>
<td>Construction and Installation</td>
<td></td>
</tr>
<tr>
<td>1.3.5</td>
<td>Project Management</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>1.3.6</td>
<td>Commissioning</td>
<td></td>
</tr>
<tr>
<td>1.3.7</td>
<td>Plant Operations and Maintenance</td>
<td></td>
</tr>
<tr>
<td>1.3.8</td>
<td>Modifications</td>
<td></td>
</tr>
<tr>
<td>1.3.9</td>
<td>Decommissioning</td>
<td></td>
</tr>
<tr>
<td>1.3.10</td>
<td>Process Safety</td>
<td></td>
</tr>
<tr>
<td>1.3.11</td>
<td>Research and Development</td>
<td></td>
</tr>
</tbody>
</table>

**Responsibility Level E**

2. **Solving problems based on engineering and contextual knowledge**

<table>
<thead>
<tr>
<th>2.1</th>
<th>Conceptualisation of well-defined engineering problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1</td>
<td>Receive brief</td>
</tr>
<tr>
<td>2.1.2</td>
<td>Interpret client’s requirements</td>
</tr>
<tr>
<td>2.1.3</td>
<td>Gathers information required for problem analysis</td>
</tr>
<tr>
<td>2.1.4</td>
<td>Participate in developing preliminary solutions</td>
</tr>
</tbody>
</table>

2.2. **Design or development processes for well-defined engineering problems**

<table>
<thead>
<tr>
<th>2.2.1</th>
<th>Identifies and analyses alternative approaches for design / solution / development processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.2</td>
<td>Documentation development for Implementing well-defined engineering Solutions</td>
</tr>
</tbody>
</table>

3. **Implementing projects or operating engineering systems or processes**

<table>
<thead>
<tr>
<th>3.1</th>
<th>Planning processes for Implementation or Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.1</td>
<td>Develop business and stakeholder relationships</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>3.1.2</td>
<td>Scope and plan</td>
</tr>
<tr>
<td>3.2</td>
<td>Organising processes for Implementation or Operations</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Manage resources</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Optimisation of resources and processes</td>
</tr>
<tr>
<td>3.3</td>
<td>Controlling processes for Implementation or Operations</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Monitor progress and delivery</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Monitor quality</td>
</tr>
<tr>
<td>3.4</td>
<td>Close out Processes for Implementation or Operations</td>
</tr>
<tr>
<td>3.4.1</td>
<td>Commissioning processes</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Development of operational documentation</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Handover processes</td>
</tr>
<tr>
<td>3.5</td>
<td>Maintenance and repair processes</td>
</tr>
<tr>
<td>3.5.1</td>
<td>Maintenance planning and scheduling</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Monitor quality</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Oversee repairs and/or implement remedial processes</td>
</tr>
<tr>
<td>4</td>
<td>Risk and Impact Mitigation</td>
</tr>
<tr>
<td>4.1</td>
<td>Impact and risk assessments</td>
</tr>
<tr>
<td>4.1.1</td>
<td>Impact assessments</td>
</tr>
<tr>
<td>4.1.2</td>
<td>Risk assessments</td>
</tr>
</tbody>
</table>

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### 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
- **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** Communicates effectively

#### 5.4 Exercising Judgement and Taking Responsibility

- **5.4.1** Ethical practices
- **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

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<table>
<thead>
<tr>
<th>Section</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5.1</td>
<td>Plan own development strategy</td>
</tr>
<tr>
<td>5.5.2</td>
<td>Construct initial professional development record</td>
</tr>
</tbody>
</table>