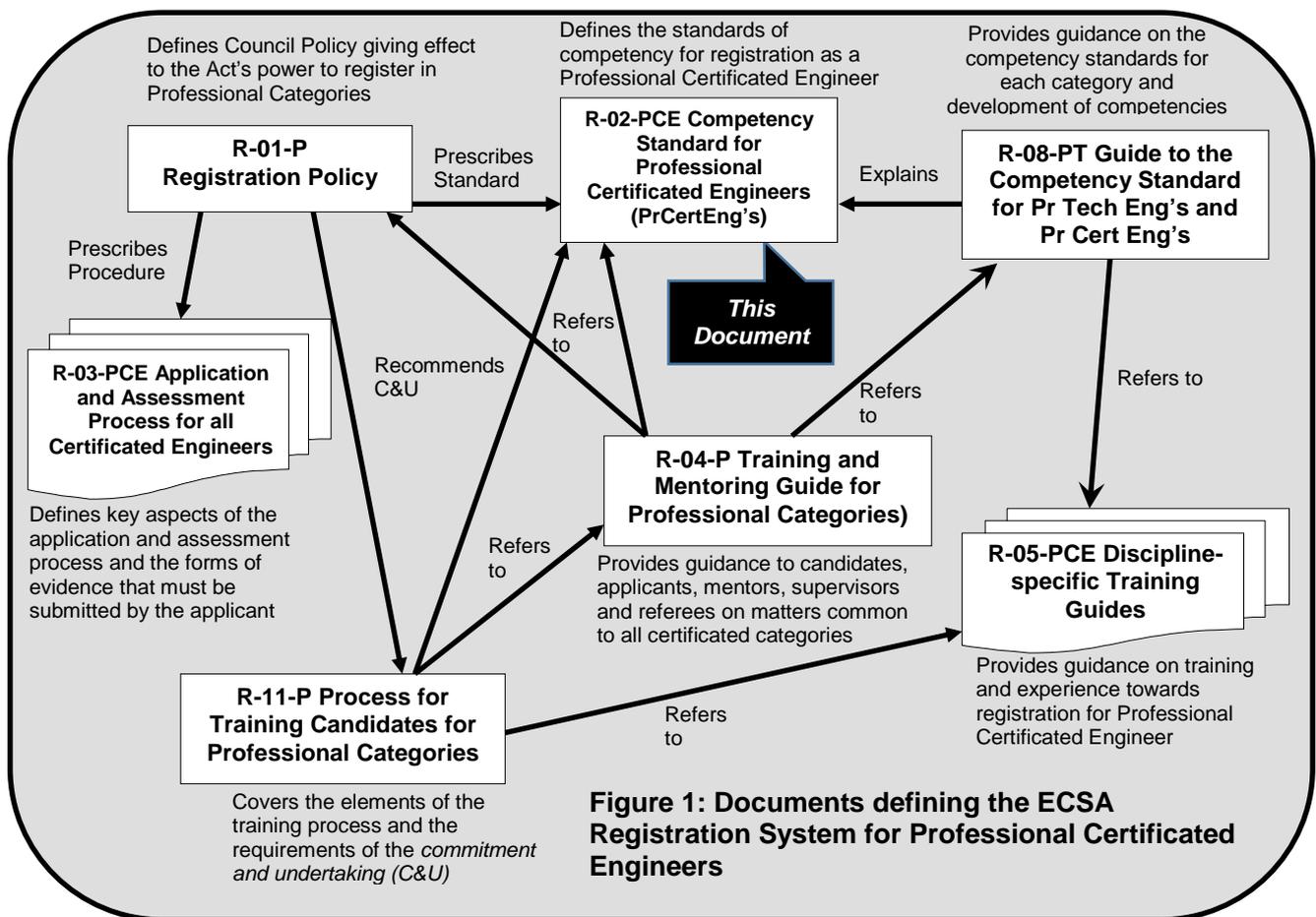


ENGINEERING COUNCIL OF SOUTH AFRICA <i>Standards and Procedures System</i>		 E C S A
Competency Standard for Registration as a Professional Certificated Engineer		
Status: Ratified By Council		
Document : R-02-PCE	Rev-2 Concept G	

Background: The ECSA Registration System Documents

The documents that define the Engineering Council of South Africa (ECSA) system for registration in professional categories are shown in Figure 1 which also locates the current document.



1. Purpose of this document

- 1.3 This Standard defines the competence required for registration as a Professional Certificated Engineer. Acronyms and definitions of terms having particular meaning within this standard are given in the text and in Appendix A.

2. Demonstration of Competence

2.1 Competence must be demonstrated within *broadly-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 referred to as mandatory generic requirements in the applicable Discipline Specific Training Guidelines and Requirements, document R-05-PCE, applicable to holders of the following Government Certificates of Competency:

- (a) Electrical Engineer's Certificate of Competency issued in terms of the Mines Health and Safety Act, 1996;
- (b) Mechanical Engineer's Certificate of Competency issued in terms of the Mines Health and Safety Act, 1996;
- (c) Electrical Engineer's Certificate of Competency issued in terms of the Occupational Health and Safety Act, 1993;
- (d) Mechanical Engineer's Certificate of Competency issued in terms of the Occupational Health and Safety Act, 1993;
- (e) Manager's Certificate of Competency (Metalliferous) issued in terms of the Mines Health and Safety Act, 1996;
- (f) Manager's Certificate of Competency (Coal) issued in terms of Mines Health and Safety Act, 1996; and
- (g) Chief Engineer Officer – Foreign Going Certificate of Competency issued in terms of the Merchant Shipping Act, 1951.

2.2 To register as a Professional Certificated Engineer, a minimum period of three (3) years appropriate post-Government Certificate of Competency experience and training, which shall include a legal appointment as a Certificated Engineer for at least one (1) year in a non-acting capacity, and updating of competence throughout, is required. Only experience and legal appointments, which meet the following requirements, shall be considered:

The Council would, inter alia, consider the following experience to be appropriate:

- (a) A minimum of three (3) years as:
 - (i) Mining Manager at a metalliferous or coal mine of which **one (1) year** must include an appointment in terms of the Mines Health and Safety Act, 1996 (Act No 29 of 1996) which requires the possession of a Government Certificate of Competency
 - (ii) Engineer (Electrical or Mechanical) of which **one (1) year** must include an appointment in terms of the Mines Health and Safety Act, 1996 (Act No 29 of 1996) in charge of installed power of no less than 2 500 kW,
 - (iii) Engineer (Electrical or Mechanical) of which **one (1) year** must include an appointment in terms of the General Machinery Regulations issued in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) in charge of installed power of no less than 3000 kW.
 - (iv) A Chief or Second Marine Engineer Officer on a vessel with a registered power of no less than 3 000 kW in terms of the Merchant Shipping Act, 1951 (Act No 57 of 1951),

- (b) In all cases mentioned above, the experience shall entail direct involvement in the solution of problems related to the installation, operation and/or maintenance of machinery which require sound engineering judgement and management.
- (c) Experience gained as an Engineer, shall include engineering drawings and design reviews for compliance with operational requirements, risk assessment, analysis and synthesis of solutions to production related problems, failure analysis and incident investigations, construction methods and construction management, training and personnel development – project execution methodologies, stakeholder management, and operational optimization provided that at least two of the required three years of experience are directly concerned with the installation, operation and/or maintenance of machinery which require sound engineering judgement and management and which demonstrates the applicant's competence at the required level of broadly defined engineering work.
- (d) **Alternative Certificates and Exemptions**
- (i) The holder of a Certificate of Competency issued in terms of the Minerals Act of 1991, who wishes to qualify for the equivalent certificate for Factories, shall re-apply for acceptance as a candidate together with proof of at least one year's appropriate experience in the maintenance and operation of machinery at a factory to the satisfaction of the Commission of Examiners. After acceptance the subject Legal Knowledge (Factories) must be passed.
- (ii) The holder of a Certificate of Competence as Mechanical Engineer who wishes to qualify for a certificate as an Electrical Engineer shall re-apply. He/she shall produce proof of appropriate experience, which shall be to the satisfaction of the Commissioner of Examiners. Such experience shall consist of at least 2 years' experience in the maintenance and operation of electrical machinery or at least 4 years "mixed" experience in the maintenance and operation of both electrical and mechanical machinery, which was gained after the acquisition of the mechanical certificate. The applicant will also be required to produce proof of passing the conversion subjects required to cover the syllabus for the Certificate of Competency as Electrical Engineer, with a mark of at least 50%.
- (iii) The holder of a Certificate of Competency as an Electrical Engineer who wishes to qualify for a certificate as Mechanical Engineer shall re-apply. He shall produce proof of appropriate experience, which shall be to the satisfaction of the Commissioner of Examiners. Such experience shall consist of at least 2 years' experience in the maintenance and operation of mechanical machinery or at least 4 years "mixed" experience in the maintenance and operation of both mechanical and electrical machinery, which was gained after the acquisition of the electrical certificate. The applicant will also be required to produce proof of passing the conversion subjects required to cover the syllabus for the Certificate of Competency as Mechanical Engineer, with a mark of at least 50%.

In evaluating an applicant's experience, Council takes the following classification of outcomes into consideration:

- (i) Group A: Engineering problem solving
- (ii) Group B: Managing engineering activities
- (iii) Group C: Impacts of engineering activity
- (iv) Group D: Exercises judgment, takes responsibility and acts ethically
- (v) Group E: Initial professional development

2.2.1 **Level Descriptor:** *Broadly-defined Engineering Activities (BDEA)*: are characterized by several or all of:

- a) *Scope* of practice area is linked to technologies used and changes by adoption of new technology into current practice;
- b) Practice area is located within a wider, complex *context*, requires teamwork, has interfaces to other parties and disciplines;
- c) Involve the use a variety *resources* (including people, money, equipment, materials, technologies);
- d) Require resolution of occasional problems arising from *interactions* between wide-ranging or conflicting technical, engineering or other issues;
- e) Are *constrained* by available technology, time, finance, infrastructure, resources, facilities, standards and codes, applicable laws;
- f) Have *significant risks* and *consequences* in practice area and in related areas.

2.2.2 Activities include but are not limited to: design or design reviews; planning; incident investigation and failure analysis, analysis and synthesis of solution to production problems, operational optimisation aimed at improving of materials, components, systems or processes.

Operational, construction; maintenance and project management.

Development of efficiency enhancing methods of work and systems,

Commissioning, decommissioning and disposal of assets, including the closure of operations.

3. Competency Standards

Group A Outcomes: Engineering Problem Solving

3.1 Outcome 1:

Define, investigate and analyse ***broadly-defined engineering*** problems.

3.1.1 **Level Descriptor:** *Broadly-defined engineering problems* have the following characteristics:

- a) require coherent and detailed engineering knowledge underpinning the applicable technology area;

and one or more of:

- b) are ill-posed, or under or over-specified, requiring identification and interpretation into the technology area;
- c) encompass systems within complex engineering systems;
- d) belong to families of problems which are solved in well-accepted but innovative and sustainable ways;

and one or more of:

- e) can be solved by structured analysis techniques;
- f) may be partially outside standards and codes (must provide justification to operate outside);
- g) require information from practice area and sources interfacing with practice area that is complex or incomplete;
- h) involves a variety of issues which may impose conflicting constraints: technical, engineering and interested or affected parties;

and one or both of:

- i) requires judgement in decision making in practice area, considering interfaces to other areas;
- j) have significant consequences which are important in practice area, but may extend more widely.

3.1.2 Competency Indicators: A definition, investigation into and analysis of **broadly-defined engineering** problems within the competence area, typified by the following performances, is expected:

- 3.1.2.1 Performed or contributed in defining engineering problems leading to an agreed definition of the problems to be solved;
- 3.1.2.2 Performed or contributed in investigating engineering problems including collecting, organising and evaluating information;
- 3.1.2.3 Performed or contributed in analysing engineering problems, using conceptualisation, justified assumptions, limitations and evaluation of results.

3.1.3 Range Statement: The problem may be a design requirement, an applied research and development requirement or a problematic situation in an existing component, system or process. The problem is one amenable to solution by technologies known to the applicant applicable to the competence area. This outcome is concerned with the understanding of a problem: Outcome 2 is concerned with the solution.

3.2 Outcome 2:

Design or develop sustainable solutions to **broadly-defined engineering** problems.

3.2.1 Competency Indicators: This outcome is normally demonstrated after a problem analysis as defined in outcome 1. Working systematically to reach a solution to a **broadly-defined** problem, typified by the following performances is expected:

- 3.2.1.1 Designed or developed solutions to broadly-defined engineering problems. Check impacts and sustainability;
- 3.2.1.2 Systematically synthesised solutions and alternative solutions or approaches to the problem by analysing designs against requirements, including costs and impacts on outside parameters;
- 3.2.1.3 Drawing up of detailed specification requirements and design documentation for implementation to the satisfaction of the client.

3.2.2 Range Statement: Solutions are those enabled by the technologies in the applicant's competence area. Engineering should look not only to decrease impacts, but also to restore and regenerate through design.

3.3 Outcome 3:

Comprehend and apply the knowledge embodied in widely accepted and applied engineering procedures, processes, systems or methodologies and those specific to the jurisdiction in which he/she practices.

3.3.1 Competency Indicators: This outcome is normally demonstrated in the course of planning, investigation or operations confined to the competence area:

- 3.3.1.1 Applied engineering principles, practices, technologies, including the application of GCC level theory in the practice area;
- 3.3.1.2 Indicated working knowledge of areas of practice that interact with practice area to underpin team work;
- 3.3.1.3 Applied related knowledge of finance, statutory, sustainability, safety and management.

3.3.2 Range Statement: Applicable knowledge includes:

- a) Technological knowledge that is well-established and applicable to the practice area irrespective of location, supplemented by locally relevant knowledge, for example, established properties of local materials. Emerging technologies are adopted from formulations of others.
- b) A working knowledge of interacting disciplines (engineering and other) to underpin teamwork confined to the competence area.
- c) Jurisdictional knowledge includes legal and regulatory requirements as well as locally relevant codes of practice, as required for practice area: law of contract, contract administration, health and safety, environmental, application of sustainable materials and practices, intellectual property, quality management, risk management, maintenance management, regulation, project management or construction management

Group B Outcomes: Managing Engineering Activities

3.4 Outcome 4:

Manage part or all of one or more *broadly-defined engineering* activities.

3.4.1 Competency Indicators: The display of personal and work process management abilities is expected confined to the competence area:

- 3.4.1.1 Managed self, people, work priorities, processes and resources in broadly-defined engineering work;
- 3.4.1.2 Role in planning, organising, leading and controlling broadly-defined engineering activities evident;
- 3.4.1.3 Knowledge of conditions and operation of contractors and the ability to establish and maintain professional and business relationships evident.

3.5 Outcome 5:

Communicate clearly with others in the course of his or her engineering activities.

3.5.1 Competency Indicators: Demonstrates effective communication by providing evidence:

- 3.5.1.1 Ability to write clear, concise, effective technical, legal and editorially correct reports shown;
- 3.5.1.2 Ability to issue clear instructions to stakeholders using appropriate language and communication skills evident;
- 3.5.1.3 Oral presentations made using structure, style, language, visual aids and supporting documents appropriate to the audience and purpose.

3.5.2 Range Statement for Outcomes 4 and 5: Management and Communication in *broadly-defined engineering* involves:

- a) Planning activities;
- b) Organising activities;
- c) Leading activities;
- d) Implementing activities; and
- e) Controlling the activities.

Communication relates to technical aspects and wider impacts of professional work. Audience includes supervisors, peers, subordinates, other disciplines, clients and stakeholders audiences confined to the competence area. Appropriate modes of communication must be selected. The Certificated Engineer is expected to perform the communication functions reliably and repeatedly.

Group C Outcomes: Impacts of Engineering Activity

3.6 Outcome 6:

Recognise and address the foreseeable social, cultural, environmental and sustainability effects of ***broadly-defined engineering*** activities.

3.6.1 Competency Indicators: This outcome is normally displayed in the course of evaluating and planning tasks within the competence area, by typically providing evidence of the:

3.6.1.1 Ability to identify interested and affected parties and their expectations in regard to interactions between technical, social, cultural, environmental and long term sustainability considerations;

3.6.1.2 Measures taken to mitigate the negative effects of engineering activities.

3.7 Outcome 7:

Meet all legal and regulatory requirements and protect the health and safety of persons and adhere to sustainable practices in the course of his or her ***broadly-defined engineering*** activities.

3.7.1 Competency Indicators:

3.7.1.1 Identifying applicable legal, regulatory, health and safety requirements and standards and sustainable practices for the ***broadly-defined engineering*** activity;

3.7.1.2 Stating circumstances where applicant assisted in, or demonstrated awareness of the selection of safe and sustainable materials, components and systems and have identified risk and applied risk management strategies.

3.7.2 Range Statement for Outcomes 6 and 7: Impacts and Regulatory requirements include:

- a) Requirements include both explicitly regulated factors and those that arise in the course of particular work;
- b) Impacts considered extend over the lifecycle of the project and include the consequences of the technologies applied;
- c) Effects to be considered include direct and indirect, immediate and long-term related to technology used;
- d) Safe and sustainable materials, components and systems;
- e) Regulatory requirements are explicit for the context and general;
- f) Apply defined, widely accepted risk management strategies;
- g) Persons whose health and safety are to be protected are both inside and outside the workplace.

Group D Outcomes: Exercise judgement, take responsibility and act ethically

3.8 Outcome 8:

Conduct engineering activities ethically.

3.8.1 Competency Indicators: Sensitivity to ethical issues and the adoption of a systematic approach to resolving these issues is expected, typified by:

3.8.1.1 Conversance and operation in compliance with ECSA's Code of Conduct for registered persons confirmed;

3.8.1.2 How ethical problems and affected parties were identified, and the best solution to resolve the problem selected.

3.8.2 Range Statement: Ethical behaviour is at least that defined by the Code of Conduct.

3.9 Outcome 9:

Exercise sound judgement in the course of ***broadly-defined engineering*** activities.

3.9.1 Competency Indicators: Exhibition of judgement is demonstrated by:

3.9.1.1 Exercising judgement in arriving at a conclusion within the application of technologies and their interrelationship to other disciplines and technologies;

3.9.1.2 Taking factors into consideration given, bearing in mind, risk, consequences in technology application and affected parties.

3.9.2 Range Statement: Judgement is expected both within the application of the applicant's technologies, in their wider impacts and when dealing with interfaces to other disciplines and technologies. *Judgement* in decision making involves:

a) taking several risk factors into account; **and**

b) significant consequences in a technology application and related contexts; **and**

c) ranges of interested and affected parties with varying needs taken into account, including needs for sustainability.

3.10 Outcome 10:

Be responsible for making decisions on part or all of ***broadly-defined engineering*** activities.

3.10.1 Competency Indicators: Responsibility is displayed by the following performance carried out within the competency area:

3.10.1.1 Engineering, social, environment and sustainable development taken into consideration in discharging responsibilities for significant parts of one or more activities;

3.10.1.2 Advice sought from a responsible authority on matters outside your area of competence;

3.10.1.3 Academic knowledge of at least GCC level combined with past experience used in formulating decisions.

3.10.2 Range Statement: The applicant is expected to demonstrate adequately discharging responsibility for significant parts of one or more ***broadly-defined engineering activity***.

Group E Outcome: Continuing Professional Development

3.11 Outcome 11:-

Undertake professional development activities sufficient to maintain and extend his or her competence.

3.11.1 Competency Indicators: Self-development is managed by typically:

3.11.1.1 Adopting strategy independently to enhance professional development;

3.11.1.2 Showing awareness of philosophy in regard to professional development.

3.11.2 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;

Appendix A: Acronyms and Definitions

“**Competency area**” means the performance area where all the outcomes can be demonstrated at the level prescribed in a specific technology in an integrated manner.

“**Competency Indicators**” means the typifying guide to evidence indicating competence and is not normative.

“**Continuing Professional Development**” means the systematic, accountable maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional and technical duties throughout an engineering practitioner’s career.

“**Engineering science**” means a body of knowledge, based on the natural sciences and using a 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 specializations.

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

“**GCC**” any one of the seven (7) Government Certificates of Competency defined in 2.1 above.

“**Ill-posed problem**” means a problem 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 in a particular competency area.

“**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) procurement within engineering works or operations
- v) direct and control engineering processes, systems, commissioning, operation and

- decommissioning of equipment;
- vi) maintain engineering works or equipment in a state in which it can perform its required function.

“Outcome” at the professional level, means a statement of the performance that a person must demonstrate in order to be judged competent to operate in a competency area.

“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.

“P” means Professional.

“PCE” means Professional Certificated Engineer.

“Pr Cert Eng” means Professional Certificated Engineer.

“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.

“R” means Registration.

“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 in a particular competency area.

“Sustainable development” means development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Engineering should look not only to decrease impacts, but also to restore and regenerate through design.

Revision History

Version	Date	Status/Authorised by	Nature of Revision
Rev 1:	?	?	?
Rev 2 Concept A	7 May 2015	Draft for submission to SGG	New version generated from R-02-PN with discipline specific requirements added.
Rev 2 Concept B	29 May 2015	SGG draft	Logical improvements recommended by the SGG implemented. Consensus on the inclusion of Competency Indicators could not be reached
Rev 2 Concept C	1 July 2015	SGG draft for submission to the ESGB	Figure 1 amended to include the Commitment and Undertaking (C&U)
Rev 2 Concept D	20160301	SGG draft for submission to the ESGB, updated by duTG	Align with category requirements
Rev 2 Concept E	20161125	Final draft submitted to RegCom: PrCertEng updated by duTG	General – Approved for Presentation to PDSG
Rev 2 Concept F	10 April 2017	For Consideration by the PDSGC	Align with R-05-PCE. Competency Indicators inserted into the outcomes and removed from Appendix B.
Rev 2 Concept G	10 May 2017	For Consideration by the Pr Cert Eng's Working Group	Incorporating some additions recommended by Mr Botsane – alignment with R-05-PCE left intact.
Rev 2 Concept G	3 July 2017	For consideration by PDSGC	Approved
Rev 2 Concept G	17 Aug 2017	For ratification by Council	Ratified
ECSA CONTROLLED COPY		Executive: Policy Development and Standards Generation	 <hr/> John Cato 2017-08-19 <hr/> Date