

<b>ENGINEERING COUNCIL OF SOUTH AFRICA</b> <i>Standards and Procedures System</i>			 <b>E C S A</b>
<b>Competency Standard for Registration as a Professional Engineer</b>			
<b>Status: For approval of amendments by Council</b>			
<b>Document : R-02-PE</b>	<b>Rev-1.3</b>	<b>2 August 2011</b>	

## 1. Purpose

- 1.1 This Standard defines the competence required for registration as a Professional Engineer. 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 *complex engineering activities*, defined below, by integrated performance of the outcomes defined below at the level defined for each outcome. Required contexts and functions may be specified in the applicable Discipline Specific Guidelines.

2.1.2 **Level Descriptor:** *Complex engineering activities* have several of the following characteristics:

- (a) *Scope* of activities may encompass entire complex engineering systems or complex subsystems;
- (b) A *context* that is complex and varying, is multidisciplinary, requires teamwork, unpredictable, may need to be identified;
- (c) Requires diverse and significant *resources*: including people, money, equipment, materials, technologies;
- (d) Significant *interactions* exist between wide- ranging or conflicting technical, engineering or other issues;
- (e) Are *constrained* by time, finance, infrastructure, resources, facilities, standards & codes, applicable laws;
- (f) Have significant *risks* and *consequences* in a range of contexts.

2.1.3 *Activities* include but are not limited to: design; planning; investigation and problem resolution; improvement of materials, components, systems or processes; implementation, manufacture or construction; engineering operations; maintenance; closure or disposal; project management; research, development and commercialisation.

## 3. Group A Outcomes: Engineering Problem Solving

- 3.1 **Outcome 1:-** Define, investigate and analyse *complex engineering problems*.

3.1.1 **Complex Engineering Problems** have the following characteristics:

- (a) require in-depth fundamental and specialized engineering knowledge;

*and one or more of:*

- (b) are ill-posed, under- or overspecified, requiring identification and refinement;
- (c) are high-level problems including component parts or sub-problems;
- (d) are unfamiliar or involve infrequently encountered issues;

*and one or more of:*

- (e) solutions are not obvious, require originality or analysis based on fundamentals;
- (f) are outside the scope of standards and codes;
- (g) require information from variety of sources that is complex, abstract or incomplete;
- (h) involves wide-ranging or conflicting issues: technical, engineering and interested or affected parties;

*and one or both of:*

- (i) requires judgement in decision making in uncertain contexts;
- (j) have significant consequences in a range of contexts.

3.1.2 **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. This outcome is concerned with the understanding and judgement of a problem: Outcome 2 is concerned with the solution.

3.2 **Outcome 2:-** Design or develop solutions to *complex engineering problems*.

3.2.1 **Range Statement:** The solution may be the design of a component, system or process or a recommendation of the remedy to a problematic situation.

3.3 **Outcome 3:-** Comprehend and apply advanced knowledge: principles, specialist knowledge, jurisdictional and local knowledge.

3.3.1 **Range Statement:** Applicable knowledge includes:

- (a) Specialist knowledge that has depth in the practice area and is underpinned by the fundamental knowledge of an engineering discipline or cross-disciplinary area. In-depth specialist knowledge in practice area supports a fundamentals-based, first principles analytical approach, building models as required.
- (b) A working knowledge of interacting disciplines (engineering and other) to underpin teamwork
- (c) Jurisdictional knowledge includes legal and regulatory requirements as well as locally relevant codes of practice. As required for practice area, a selection of: law of contract, health and safety, environmental, intellectual property, contract administration, quality management, risk management maintenance management, regulation, project and construction management

#### **4. Group B Outcomes: Managing Engineering Activities**

4.1 **Outcome 4:-** Manage part or all of one or more *complex engineering activities*.

- 4.1.1 **Range Statement:** Management is directed at achieving engineering results through management of people, resources, processes, systems and money and involves:
- (a) Planning of *complex engineering* activities;
  - (b) Organising *complex engineering* activities;
  - (c) Leading engineering activities;
  - (d) Controlling *complex engineering* activities;

4.2 **Outcome 5:-** Communicate clearly with others in the course of his or her engineering activities.

- 4.2.1 **Range Statement:** Communication involves strategic, managerial, technical and wider impacts of engineering work. Material communicated includes concepts, analyses, proposals and informative subjects. The audience includes peers, superiors, persons implementing designs and other work, persons in other disciplines, clients and wider stakeholders. Communication functions must be performed reliably and repeatably.

## 5. Group C Outcomes: Impacts of Engineering Activity

5.1. **Outcome 6:-** Recognise and address the reasonably foreseeable social, cultural and environmental effects of *complex engineering activities*.

5.2. **Outcome 7:-** Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his or her *complex engineering activities*.

5.2.1 **Range Statement for outcomes 6 and 7:** Impacts and Regulatory requirements include:

- (a) Direct and indirect, immediate and long-term effects of engineering solutions;
- (b) Application of principles of sustainability;
- (c) Regulatory requirements that are explicit for the context and are generally applicable.

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

6.1. **Outcome 8:-** Conduct engineering activities ethically.

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

6.2 **Outcome 9:-** Exercise sound judgement in the course of *complex engineering activities*.

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

- (a) taking diverse, wide ranging risk factors into account; *or*
- (b) significant consequences in a range of contexts; *or*
- (c) wide ranges of interested and affected parties with widely varying needs.

6.4 **Outcome 10:-** Be responsible for making decisions on part or all of *complex engineering activities*.

6.4.1 **Range Statement:** *Responsibility* exercised for outcomes of significant parts of one or more *complex engineering activities*.

## 7. Group E Outcomes: Continuing Professional Development

7.1 **Outcome 11:-**Undertake professional development activities sufficient to maintain and extend his or her competence.

7.1.1 **Range Statement:** Professional development involves:

- (a) Planning own professional development strategy;
- (b) Selecting appropriate professional development activities; and
- (c) Recording professional development strategy and activities; while displaying independent learning ability;

## Appendix A: Definitions

**“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.

**“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.

**“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;
- (iii) procurement within engineering works or operations
- (iv) direct and control engineering processes, systems, commissioning, operation and decommissioning of equipment;
- (v) 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.

**“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.

**“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.

### Revision History

Version	Date	Status/Authorised by	Nature of Revision
Rev 1.0:		Approved by Council	
Rev 1.1 Draft A	26 Nov 2010	JIC Working Document	Fine tuning definition of level of problem solving, reformatting, assessment criteria moved to R-04-P
Rev1.1 Draft B	15 Feb 2011	Submitted to Council for Approval	Editorial and formatting
Rev 1.1	17 March 2011	Approved by Council	Minor editorial changes
Rev 1.2	11 Jan 2012	Approved by Council	Preamble added, minor changes
Rev 1.3	2 Aug 2012	JIC proposal to Council	Split Range statements for outcomes 4 and 5 and enhance latter
Rev 1.3	24 Nov 2012	Approved by Council	