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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 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 requires 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 coordinated activities required to:

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

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

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

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

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

**Over-determined problem** 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 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 licensed 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

1. PURPOSE OF THIS DOCUMENT

All persons applying for registration as Professional Engineers are expected to demonstrate the competencies specified in document R-02-PE at the prescribed level, irrespective of the trainee’s discipline, through work performed by the applicant within complex engineering activities 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 Engineers, document R-08-PE.

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

- Duration of training and period working at a level required for registration
- Principles of planning training and experience
- Progression of training Programme
- Documenting training and experience
- Demonstrating responsibility.

The second document R-08-PE provides both a high-level and outcome-by-outcome understanding of the competency standards as an essential basis for this discipline specific training guide.

This Guide, as well as R-04-P and R-08-PE, is subordinate to the Policy on Registration, document R-01-POL, the Competency Standard (R-02-PE) and the application process definition (R-03-PRO).

2. AUDIENCE

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

This guide applies to persons who have:

(a) completed the education requirements by obtaining an accredited BEng-type qualification, or a Washington-Accord Recognised qualification or through evaluation/assessment;
(b) Registered as Candidate Engineers;
(c) Embarked on a process of adequate 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

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 Engineer is permitted without being registered as a Candidate Engineer or without training under a C&U. Mentorship and adequate supervision are, however, key factors in effective development to the level required for registration. A C&U indicates that the company is committed to mentorship and supervision in accordance with the specific standards and policies for registration.

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, an external mentor’s services should be secured. The Voluntary Association (VA) for the discipline should be consulted for assistance in locating an external mentor. A mentor should be in place at all stages of the development process.

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

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

The 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 (see section 7.3 of this document).
4. CIVIL ENGINEERING

4.1 Civil Engineers (OFO 2142)

A Civil Engineer plans, designs, organises and oversees the construction and operation of civil engineering projects including the following:

- **Structural**: buildings, dams, bridges, roads, highways, runways, harbours, railways, water retaining;
- **Geotechnical**: township services earthworks, excavations, soil conservation and geotechnical processes;
- **Transportation** systems;
- **Hydraulic engineering systems**: water resources and supply, pipelines, canals, water treatment, stormwater and drainage, sewerage systems; sanitation waste disposal, coastal engineering.

Typical tasks a Civil Engineer may undertake include the following:

- Conducting research and developing new or improved theories and methods related to civil engineering.
- Advising on and designing infrastructures such as bridges, dams, harbours, roads, airports, stadiums, railways, canals, pipelines, treatment works, waste-disposal and flood-control systems, and residential, commercial, industrial and other large buildings.
- Determining and specifying construction methods, materials and quality standards and directing construction work.
- Establishing control systems to ensure efficient functioning of infrastructure as well as safety and environmental protection.
- Organising and directing maintenance and repair of existing civil engineering infrastructure.
- Analysing the behaviour of soil and rock when placed under pressure by proposed structures and designing structural foundations.
- Analysing the stability of structures and testing the behaviour and durability of materials used in their construction.
Practising Civil Engineers generally concentrate on one or more of these sub-disciplines:

- Structural Engineering
- Geotechnical Engineering
- Hydraulics Engineering and Water Resources and Supply Construction Engineering including Site Design
- Transport Engineering.

More specialised Civil Engineers may be in fields such as Transportation and Urban Planning, Biosystems Engineering, GIS and Land-use Management.

5. NATURE AND ORGANISATION OF THE INDUSTRY

Civil engineers may be employed in both the private and the public sector. Typically, in the private sector, they would be involved in consulting, contracting or in supplier or manufacturing organisations. Consultants are responsible for planning, designing, documenting and supervising the construction and/or operation of projects on behalf of their clients. Contractors are responsible for project implementation, and activities include planning, construction, labour and resource management. Those working in supply or manufacturing companies could be involved in research and development and would be involved in production, supply and quality control.

The public sector is responsible for service delivery and is usually the client, though in some departments, design and construction are also carried out. Civil engineers are required at all levels of the public sector, including at national, provincial and local government level, state-owned enterprises (SOEs) and public utilities. The public sector largely handles planning, specifying, overseeing implementation, operations and maintenance of infrastructure. An extension of the public sector would include tertiary academic institutions and research organisations.

Depending on where the candidate is employed, there may be situations where opportunities in-house are not sufficiently diverse to develop all the competencies required in both Groups A and B, noted in document R-02-PE. For example, the opportunity to develop problem-solving competence (including design or developing solutions) and to manage
engineering activities (including implementing or constructing solutions) may not both be available to the candidate. In such cases, employers are encouraged to put a secondment system in place.

It has been fairly common practice that where an organisation is unable to provide training in certain areas, secondments are arranged with other organisations so the candidate is able to develop all the competencies required for registration.

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

6. DEVELOPING COMPETENCY: DOCUMENT R-08-PE

6.1 Engineering lifecycle considerations

The Civil Engineer is involved in activities associated with the asset life cycle as shown in Figure 2.
6.2 Functions performed

A conventional path to registration usually involves the candidate carrying out the functions described in Table 1.

These functions, as described in the Asset Lifecycle above, would be related to the “producing an asset” portion, but could also relate to the “use of an asset” portion.

In the case of “producing an asset”, the functions are expanded from the conventional sequence of an engineering project: conceive, design, implement and operate, and usually, the candidate experiences them in this order.

In the case of “use of an asset”, where the work involves operations and maintenance, the candidate may experience them differently, but the functions may be similar.

<table>
<thead>
<tr>
<th>Table 1: Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. ORIENTATION</strong></td>
</tr>
<tr>
<td>Be exposed to, observe and understand a range of processes, materials and products relevant to your employer and typical clients.</td>
</tr>
<tr>
<td><strong>2 DEVELOPING AN ENGINEERING BRIEF</strong></td>
</tr>
<tr>
<td><strong>2.1 Accurate identification and definition:</strong></td>
</tr>
<tr>
<td>Take an active part, probably in a supporting role, in researching, compiling and assessing basic data, background information and the meaning and purpose of an assignment.</td>
</tr>
<tr>
<td>Record your involvement in a report to your mentor and demonstrate the process by which the assignment was finally and properly defined.</td>
</tr>
<tr>
<td><strong>2.2 Systems approach</strong></td>
</tr>
<tr>
<td>It is generally accepted that to ensure a holistic (all encompassing) solution to a problem, all relevant aspects are to be considered.</td>
</tr>
<tr>
<td>In reports to your mentor, record how, through your own experience, you were involved in adopting the wider approach in defining problems.</td>
</tr>
<tr>
<td><strong>2.3 Standards and codes</strong></td>
</tr>
</tbody>
</table>

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When downloaded for the ECSA Document Management System, this document is uncontrolled and the responsibility rests with the user to ensure that it is in line with the authorised version on the database. If the ‘original’ stamp in red does not appear on each page, this document is uncontrolled.
Table 1: Functions

List the National and International standards, Codes of Practice, Environmental Requirements documents you have used. Discuss their relevance to your work in your reports to your mentor.

3 DESIGNING A SOLUTION

3.1 Resolution of an engineering brief
This involves compiling all relevant data acquired during the investigation period and a statement of the analytical work completed.

Finding alternative solutions
This involves the technical and financial evaluation of alternatives by, for example, assisting with a feasibility study covering aspects such as:

- Concepts and precedents
- Sources of information
- Estimates and budget quotations
- Quick design methods
- Writing, production and interpretation of feasibility reports
- Briefs for detail design.

In a report to your mentor, produce your preferred solution with justification, showing throughout (or by an accompanying statement) how this work contributed to the solution of the problem and identify the major factors on which the solution depended for accuracy or completeness.

3.2 Present the solution to a problem
This involves producing documentation on the solution including diagrams, charts and/or detailed drawings using acceptable standards.

In a report to your mentor, present the example for discussion and approval.

3.3 Choice of construction material when deciding on a solution
Read the supplier’s instructions for using patent materials. Read SABS specifications on civil engineering materials (naturally occurring processed and manufactured). List all references. Discuss the choice and use of prescribed materials for a specific solution with your mentor.

4 DOCUMENTATION

4.1 Purpose of documentation
This involves acquiring an appreciation that technical specifications are an essential part of a solution to the problem. Select or write a specification and/or amend an existing
Table 1: Functions

| Specification for a particular item of work.                  |
| Discuss a specification used in your work with your mentor. |

4.2 Costing of solutions
Cost solutions to problems by taking off quantities and doing cost estimates. Present examples to your mentor for discussion and comment.

4.3 Safety
State in a quarterly report which regulations apply and what safety criteria you have followed in the course of implementing solutions.

5 IMPLEMENTATION

5.1 Know how all parties to a contract exercise their duties and responsibilities
In a report to your mentor, demonstrate your knowledge of the duties and responsibilities of all parties to a contract and discuss the practical application of the various documents forming a particular contract with your mentor.

5.2 Know the procedure for issuing and/or receipt, registration and filing work instructions and/or drawings and amendments
Gain practical experience of these procedures and demonstrate this experience in a report to your mentor.

5.3 Keep an accurate daily record of events and instructions
Keep an up-to-date, accurate daily diary for inspection by your mentor.

5.4 Read and co-ordinate drawings and/or implement work instructions by being involved on a day-to-day basis in the process
Demonstrate your competence by the quality of your work and discuss this with your mentor.

5.5 Participate in the dimensional control and accuracy of the work you are implementing or controlling
Demonstrate your competence through the quality of your work and discuss this process with your mentor.

5.6 Know the use, performance and cost of equipment plant and/or labour resource
Include in a report to your mentor a list of all major items of which you have first-hand knowledge. Discuss your experience with your mentor.

5.7 Plan and programme section of work and be involved in progress monitoring and reporting.
Discuss the programme with your mentor.
Table 1: Functions

5.8 Measure and record or independently check work done for payment purposes
Take part in this work to prepare and check Interim Valuations and/or Final Accounts.
Demonstrate your involvement to your mentor.

5.9 Have a critical approach to safety matters in the implementation process and to the observance of safe working practices
Know your responsibilities relating to safety and be familiar with legislation relating to your particular work. Appreciate good safety practices relevant to your work by reference to your company safety manual.
Emphasise your involvement in safety matters in a report to your mentor.

6.3 Contextual knowledge

Candidates are expected to have knowledge of the following topics:
General appreciation of engineering procedures applicable to civil engineering
Read the information brochures provided by:
- South African Institution of Civil Engineering (SAICE)
- Consulting Engineers South Africa (CESA)
- South African Federation of Civil Engineering Contractors (SAFCEC)

Discuss the procedures with your mentor at a quarterly interview.

Show a working knowledge of the SAICE constitution and by-laws
- Read all these documents
- Discuss the documents with your mentor at a quarterly interview.

Relationships between Organisations
Display a working knowledge of the roles of and interaction between organisations such as:
- Engineering Council of South Africa (ECSA)
- SA Institution of Civil Engineering (SAICE)
- Consulting Engineers South Africa (CESA)
- SA Federation of Civil Engineering Contractors (SAFCEC)
• Building Industries Federation South Africa (BIFSA)
• Construction Industry Development Board (CIDB).

Knowledge of General Conditions of Contract
Display a working knowledge of Conditions of Contract used in civil engineering such as SAICE GCC, JBCC, FIDIC, NEC.

Structure of organisation where candidate is employed
Study all available organisation charts. Write a report on the management structure of your organisation/project team, defining your roles and responsibilities.

6.4 Industry-related statutory requirements
Candidates are expected to have a working knowledge of the following Acts:

• Engineering Profession Act, 46 of 2000, its Rules, specifically the Code of Conduct;

Candidates may, depending on their area of practice, need to have a working knowledge of the following Acts:

• National Building Regulations and Building Standards Act, 103 of 1977, as amended by Act 49 of 1995;
• Water Services Act, 108 of 1997, as amended by Act 30 of 2004;

Many Acts not listed in this document may be pertinent to the candidate’s work functions. Candidates are expected to have some basic knowledge of these Acts where applicable.
6.5 Recommended formal learning activities

Candidates may find many of the following lists of formal learning activities, which are by no means comprehensive, useful in developing their competencies:

Discipline specific courses relating to areas of practice
- Report Writing
- Project Management
- Conditions of Contract
- Standard Specifications
- Preparation of Specifications
- Negotiation Skills
- Engineering Finance
- Risk Analysis
- Quality Systems
- Occupation Health and Safety
- Quality Systems
- Environment Impacts

7. PROGRAMME STRUCTURE AND SEQUENCING

7.1 Best-practice programmes

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

The training programme for each candidate depends on the work opportunities available for the employer to assign to the candidate at the time. Best practice programmes are those that address the development of the competencies needed for each candidate to be able to successfully register as a professional engineer.
The training programme should be such that the candidate progresses through levels of work capability, which are described in document R-04-P, such that by the end of the training period, the candidate performs individually and as a team member at the level of problem-solving and engineering activity required for registration and exhibits degree of responsibility E.

Depending on the nature of the work undertaken by an employer, it may be possible to develop a training programme that provides opportunities for the candidate to undertake the work functions described in section 6, Table 1. In some cases, an employer may only cover some of the functions described in section 6, Table 1. In such cases, the employer and candidate should make appropriate arrangements as described in section 5 of this document.

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

7.2 Considerations for special cases

Document R-08-PE adequately describes what is expected of persons whose formative development has not followed a conventional path, for example academics, researchers and specialists.

The overriding consideration is that, irrespective of the route followed, the applicant must provide evidence of competence against the standard.

7.3 Moving into or between candidacy programmes

This guide assumes that a candidate enters a programme after graduation and continues with the programme until ready to submit a registration application. It also assumes 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.
- On entering the new programme, the Mentor and Supervisor should review the candidate’s development in the light of the past experience and the opportunities and requirements of the new programme, and plan at least the next phase of the candidate’s programme.
### REVISION HISTORY

<table>
<thead>
<tr>
<th>Revision number</th>
<th>Revision date</th>
<th>Revision details</th>
<th>Approved by</th>
</tr>
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<tbody>
<tr>
<td>Rev 0: Concept A</td>
<td>26 Jan 2012</td>
<td>Initial attempt at Civil DSTG</td>
<td></td>
</tr>
<tr>
<td>Rev 0: Concept B</td>
<td>6 July 2012</td>
<td>New Draft of template</td>
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</tr>
<tr>
<td>Rev 0: Concept C</td>
<td>17 Sept 2012</td>
<td>Amended Hay/Lawless</td>
<td></td>
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<tr>
<td>Rev 0: Concept D</td>
<td>29 Oct 2012</td>
<td>Standard sections 1-3 inserted</td>
<td></td>
</tr>
<tr>
<td>Rev 0: Concept E</td>
<td>12 Feb 2013</td>
<td>Minor edit</td>
<td></td>
</tr>
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<td>Rev 1</td>
<td>1 Mar 2013</td>
<td>Routine Review Approval</td>
<td>Registration Committee</td>
</tr>
<tr>
<td>Rev 2</td>
<td>25 July 2019</td>
<td>Routine Review Approval</td>
<td>RPSC</td>
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The Discipline-Specific Training Guide for:

**Candidate Engineers in Civil Engineering**

Revision 2 dated 25 July 2019 and consisting 19 pages reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research, Policy and Standards (RPS).

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Business Unit Manager

Executive: RPS

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

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Appendix A: Training Elements

**Synopsis:** A candidate engineer 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.

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

Responsibility Levels: A = Being Exposed; B = Assisting; C = Participating; D = Contributing; E = Performing.
<table>
<thead>
<tr>
<th>Competency Standards for Registration as a Professional Engineer</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Purpose</strong></td>
<td>Discipline Specific Training Guides (DSTG) gives context to the purpose of the Competency Standards. Professional Engineering s 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 experimental 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 in the specific DSTG)</td>
</tr>
</tbody>
</table>

This standard defines the competence required for registration as a Professional Engineer. 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 complex 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: Complex engineering activities**

have several of the following characteristics:

- **a)** Scope of practice area is linked to technologies used and changes by adoption of new technology into current practice;
- **b)** Practice area is located within a wider, complex context, requires teamwork, has interfaces with other parties and disciplines;
- **c)** Involve the use of 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 the practice area and in related areas.

**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.

Engineering activities can be divided into (approximately):

- 5% Complex (Professional Engineers)
- 5% Broadly Defined (Professional Engineering Technologists)
- 10% Well-defined (Professional Engineering Technicians)
- 15% Narrowly Well-defined (Registered Specified Categories)
- 20% Skilled Workman (Engineering Artisan)
- 55% Unskilled Workman (Artisan Assistants)

The activities can be in-house or contracted out; evidence of integrated performance can be submitted irrespective of the situation.

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

- **a)** Scope of practice area does not cover the entire field of the discipline (exposure limited to the sub-discipline and specific workplace). Some technologies used are well established and adoption of new technologies needs investigation and evaluation;
- **b)** Practice area varies substantially with unlimited location possibilities and an additional responsibility to identify the need for advice on complex activities and problems. Complex activities in the sub-discipline needs interfacing with professional engineers, professional technicians, artisans, architects, financial staff, etc. as part of the team;
- **c)** The bulk of the work involves familiar, defined range of resources, including people, money, equipment, materials, but new technologies are investigated and implemented;
- **d)** Most of the impacts in the sub discipline are on wider issues, but some arise from conflicting technical and engineering issues that have to be addressed by the application of complex non-standard engineering principles;
- **e)** The work packages and associated parameters are constrained by operational context with variations limited to different locations only. (Cannot be covered by standards and codes).
- **f)** Even locally important minor risks can have far reaching consequences.

**Activities** include but are not limited to: design; planning; investigation and problem resolution; improvement of materials, components, systems or processes; engineering operations; maintenance; project management. For Engineering s 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><strong>Group A: Engineering Problem Solving.</strong></th>
<th><strong>Explanation and Responsibility Level</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome 1:</strong> Define, investigate and analyse complex engineering problems</td>
<td><strong>Responsibility level E</strong> Advice</td>
</tr>
</tbody>
</table>

Complex engineering problems have the following characteristics:
(a) require coherent and detailed engineering knowledge, underpinning the technology area;
and one or more of:
(b) are ill-posed, under- or over specified, require 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 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 and 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.

- (a) coherent and detailed engineering knowledge for Engineering means the problem encountered cannot be solved without the combination of all the relevant detail including engineering principles applicable to the situation;
- (b) the nature of the problem is not immediately obvious, and further investigation to identify and interpret the real nature of the problem is necessary;
- (c) the problem is not easily recognised as part of the larger engineering task, project or operation and may be obscured by the complexity of the larger system;
- (d) recognised that the problem can be classified as a falling within a typical solution requiring innovative adaptation to meet the specific situation;
- (e) solving the problem needs a step by step approach adhering to proven logic;
- (f) the standards, codes and documented procedures must be analysed to determine to what extent they are applicable to solve the problem and justification must be given to operate outside these;
- (g) the responsibility lies with the Engineering to verify that some information received as part of the problem encountered may remain incomplete and solutions to problems may need justified assumptions;
- (h) the problem handled by an Engineering may be solved by alternatives that are unaffordable, detrimental to the environment, socially unacceptable, not maintainable, not sustainable, etc. The will have to justify his / her recommendation;
- (i) practical solutions to problems includes knowledge and judgement of the roles displayed by the multi-disciplinary team and impact of own work in the interactive environment;
- (j) Engineering must realise that their actions might seem to be of local importance only, but may develop into significant consequences extending beyond their own ability and practice area.

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OM-TEM-001 Rev 0 – ECSA Policy/Procedure
**Assessment Criteria:** A structured analysis of complex problems typified by the following performances is expected:

1.1 Performed or contributed in defining engineering problems leading to an agreed definition of the problems to be solved.

1.2 Performed or contributed in investigating engineering problems including collecting, organising and evaluating information.

1.3 Performed or contributed in analysis of engineering problems using conceptualisation, justified assumptions, limitations and evaluation of results.

<table>
<thead>
<tr>
<th>Assessment Criteria</th>
<th>Expected Performances</th>
</tr>
</thead>
<tbody>
<tr>
<td>To perform an engineering task an engineering will typically receive an instruction from a senior person (customer) to do a specific task, and must:</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>1.2 The engineering problem and related information must be segregated from the bulk of the information, investigated and evaluated.</td>
<td></td>
</tr>
<tr>
<td>1.3 Ensure that the instruction and information to do the work is fully understood and complete, including engineering theory needed to understand the task and acceptance criteria, and to carry out and/or check calculations. If needed supplementary information must be gathered, studied and understood. Concepts and assumptions must be justified by engineering theory and calculations, if applicable.</td>
<td></td>
</tr>
</tbody>
</table>

**Range Statement:** The problem may be a design requirement, an applied Research and Development requirement or a problematic situation in an existing component, system or process. The problem is one amenable to solution by technologies known to the candidate. This outcome is concerned with the understanding of a problem: Outcome 2 is concerned with the solution.

<table>
<thead>
<tr>
<th>Range Statement</th>
<th>Expected Performances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please refer to clause 4 of the specific Discipline Specific Training Guideline.</td>
<td></td>
</tr>
</tbody>
</table>
### Outcome 2:
Design or develop solutions to complex engineering problems

<table>
<thead>
<tr>
<th>Responsibility level C and D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design means “drawing or outline from which something can be made”. Develop means &quot;come or bring into a state in which it is active or visible&quot;.</td>
</tr>
</tbody>
</table>

**Assessment Criteria:** This outcome is normally demonstrated after a problem analysis as defined in outcome 1. Working systematically to synthesise a solution to a complex problem, typified by the following performances is expected:

1. **Designed or developed solutions to complex engineering problems.**
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. **Drawing up of detailed specification requirements and design documentation for implementation to the satisfaction of the client.**

**Range Statement:** Solutions are those enabled by the technologies in the candidate’s practice area.

**Responsibility**

#### 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.

<table>
<thead>
<tr>
<th>Responsibility level E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehend means &quot;to understand fully&quot;. The jurisdiction in which an Engineering practices is given in Clause 4 of the specific Discipline Specific Training Guideline.</td>
</tr>
</tbody>
</table>
### Assessment criteria
This outcome is normally demonstrated in the course of design, investigation or operations.

3.1 Applied engineering principles, practices, technologies, including the application of BEng theory in the practice area.

3.2 Indicated working knowledge of areas of practice that interact with practice area to underpin team work.

3.3 Applied related knowledge of finance, statutory, safety and management.

### 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.
- **(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.

### Design work for Engineers

Design work for Engineers is based on BEng theory and is mostly the utilisation and configuration of manufactured components and selected materials and associated novel technology. Engineers develop and apply codes and procedures in their design work. Investigation would be on complex be incidents and condition monitoring, and operations mostly on developing and improving engineering systems and operations.

3.1 Calculations at BEng theoretical level confirming the correct application and utilisation of equipment, materials and systems listed in Clause 4 of the specific Discipline Specific Training Guideline must be done on broadly-defined activities.

3.2 The understanding of complex procedures and techniques must be based on fundamental mathematical, scientific and engineering knowledge, as part of personal contribution within the engineering team.

3.3 The ability to manage the resources within legal and financial constraints must be evident.

- **(a)** The specific location of a task to be executed is the most important determining factor in the layout design and utilisation of equipment. A combination of educational knowledge and practical experience must be used to substantiate decisions taken including a comprehensive study of systems, materials, components and projected customer requirements and expectations. New ideas, materials, components and systems must be investigated, evaluated and applied accompanied by complex theoretical motivation.

- **(b)** In spite of having a working knowledge of interacting disciplines, Engineering takes responsibility for the multidisciplinary team of specialists like Civil Engineers on structures and roads, Mechanical Engineers on fire protection equipment, Architects on buildings, Electrical Engineers on communication equipment, etc.

- **(c)** Jurisdictional in this instance means “having the authority”, and Engineering must be aware of and decide on the relevant requirements applicable to each specific project that he/she is responsible for. They are usually appointed as the “responsible person” for specific projects in terms of the OHS Act.
### Group B: Managing Engineering Activities.

#### Outcome 4:
Manage part or all of one or more complex engineering activities.

**Assessment Criteria:**
- The candidate is expected to display personal and work process management abilities:
  - 4.1 Managed self, people, work priorities, processes and resources in complex engineering work.
  - 4.2 Role in planning, organising, leading and controlling complex engineering activities evident.
  - 4.3 Knowledge of conditions and operation of contractors and the ability to establish and maintain professional and business relationships evident.

**Responsibility level D**
Manage means “control”.

**Explanation and Responsibility Level**
- In engineering operations Engineering s will typically be given the responsibility to carry out projects.
- 4.1 Resources are usually subdivided based on availability and controlled by a work breakdown structure and scheduling to meet deadlines. Quality, safety and environment management are important aspects.
- 4.2 The basic elements of management must be applied to complex engineering work.
- 4.3 Depending on the project, Engineering s can be the team leader, a team member, or can supervise appointed contractors. To achieve this, maintenance of relationships is important and must be demonstrated.

#### Outcome 5:
Communicate clearly with others in the course of his or her broadly-defined engineering activities.

**Assessment Criteria:**
- Demonstrates effective communication by:
  - 5.1 Ability to write clear, concise, effective technical, legal and editorially correct reports shown.
  - 5.2 Ability to issue clear instructions to stakeholders using appropriate language and communication skills evident.
  - 5.3 Oral presentations made using structure, style, language, visual aids and supporting documents appropriate to the audience and purpose.

**Responsibility level C**

<table>
<thead>
<tr>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Refer to Range Statement for Outcome 4 and 5 below.</td>
</tr>
<tr>
<td>- Refer to Range Statement for Outcome 4 and 5 below.</td>
</tr>
<tr>
<td>- Presentation of point of view mostly occurs in meetings and discussions with immediate supervisor.</td>
</tr>
</tbody>
</table>
Range Statement for Outcomes 4 and 5: Management and communication in well-defined engineering involves:

<p>| | |</p>
<table>
<thead>
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<th></th>
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</thead>
</table>
| (a) Planning complex activities; | (a) Planning means “the arrangement for doing or using something, considered in advance”.
| (b) Organising complex activities; | (b) Organising means “put into working order; arrange in a system; make preparations for”.
| (c) Leading complex activities and | (c) Leading means to “guide the actions and opinions of; influence; persuade”.
| (d) Controlling complex activities. | (d) Controlling means the “means of regulating, restraining, keeping in order; check”.

Engineering’s write specifications for the purchase of materials and/or work to be done, recommendations on tenders received, place orders and variation orders, write work instructions, report back on work done, draw, correct and revise drawings, compile test reports, use operation and maintenance manuals to write work procedures, write inspection and audit reports, write commissioning reports, prepare and present motivations for new projects, compile budget reports, report on studies done and calculations carried out, report on customer requirements, report on safety incidents and risk analysis, report on equipment failure, report on proposed system improvement and new techniques, report back on cost control, etc.
### Group C: Impacts of Engineering Activity.

<table>
<thead>
<tr>
<th>Outcome 6:</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
</table>
| Recognise the foreseeable social, cultural and environmental effects of complex engineering activities generally | Responsibility level B  
Social means "people living in communities; of relations between persons and communities". Cultural means “all the arts, beliefs, social institutions, etc. characteristic of a community”. Environmental means “surroundings, circumstances, influences”. |

**Assessment Criteria:** This outcome is normally displayed in the course of analysis and solution of problems. The candidate typically:

- **6.1** Ability to identify interested and affected parties and their expectations in regard to interactions between technical, social, cultural and environmental considerations shown.

- **6.2** Measures taken to mitigate the negative effects of engineering activities evident.

- **6.1 Engineering impacts heavily on the environment e.g. servitudes, expropriation of land, excavation of trenches with associated inconvenience, borrow pits, dust and obstruction, street and other crossings, power dips and interruptions, visual and noise pollution, malfunctions, oil and other leaks, electrocution of human beings, detrimental effect on animals and wild life, dangerous rotaiting and other machines, demolishing of structures, etc.**

- **6.2 Mitigating measures taken may include environmental impact studies, environmental impact management, community involvement and communication, barricading and warning signs, temporary crossings, alternative supplies (ring feeders and bypass roads), press releases, compensation paid, etc.**

<table>
<thead>
<tr>
<th>Outcome 7:</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his or her complex engineering activities.</td>
<td>Responsibility level E</td>
</tr>
</tbody>
</table>

**Assessment Criteria:**

- **7.1** Identified applicable legal and regulatory requirements including health and safety requirements for the engineering activity.

- **7.2** Circumstances stated where applicant assisted in, or demonstrated awareness of the selection of save and sustainable materials, components and systems and have identified risk and applied risk management strategies.

- **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;

- **7.2** It is essential to attend a Risk Management (Assessment) course, and to investigate and study the materials, components and systems used in the workplace. The Engineering seeks advice from knowledgeable and experienced specialists if the slightest doubt exist that safety and sustainability cannot be guaranteed.
Range Statement for Outcomes 6 and 7: Impacts and regulatory requirements include:

(a) Requirements include both explicit regulated factors and those that arise in the course of particular work;

(b) Impacts considered extend over the lifecycle of the project and include the consequences of the technologies applied;

(c) Effects to be considered include direct and indirect, immediate and long-term related to the technology used;

(d) Safe and sustainable materials, components and systems;

(e) Regulatory requirements are explicit for the context in general.

(a) The impacts will vary substantially with the location of the task, e.g. the impact of laying a cable or pipe in the main street of town will be entirely different to construction in a rural area. The methods, techniques or procedures will differ accordingly and may be complex, and is identified and studied by the Engineering 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 is responsible to see to it that this is done, and when necessary 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 checks that this is done, but may authorise unavoidable deviation after setting condition for such deviations. Projects are mostly carried out where contact with the public cannot be avoided, and safety measures like barricading and warning signs must be used and maintained.

(c) Effects associated with risk management are mostly well known if not obvious, and methods used to address, clearly defined. Risks are mostly associated with elevated structures, subsidence of soil, electrocution of human beings and moving parts on machinery. The Engineering needs to identify, analyse and manage any long term risks, and develop strategies to solve these by using alternative technologies.

(d) The safe and sustainable materials, components and systems must be selected and prescribed by the Engineers or other professional specialists must be consulted. It is the responsibility of the Engineering to ensure that his/her knowledge and experience to confirm that prescription by others are correct and safe.

(e) Application of regulations associated with the particular aspects of the project must be carefully identified and controlled by the Engineering.
| Outcome 8: | Conduct engineering activities ethically. | Responsibility level E  
Ethically means "science of morals; moral soundness". Moral means "moral habits; standards of behaviour; principles of right and wrong". |
| --- | --- | --- |
| **Assessment Criteria:** | Sensitivity to ethical issues and the adoption of a systematic approach to resolving these issues is expected, typified by: | Systematic means "methodical; based on a system".  
8.1 Conversance and operation in compliance with ECSA’s Rules of Conduct for registered persons confirmed  
8.2 How ethical problems and affected parties were identified, and the best solution to resolve the problem selected.  
8.2 Ethical problems that can occur include tender fraud, payment bribery, alcohol abuse, sexual harassment, absenteeism, favouritism, defamation, fraudulent overtime claims, fraudulent expenses claimed, fraudulent qualifications, misrepresentation of facts, etc. |
| Outcome 9: | Exercise sound judgement in the course of complex engineering activities | Responsibility level E  
Judgement means “good sense: ability to judge”. |
| **Assessment Criteria:** | Judgement exercised in arriving at a conclusion within the application of technologies and their interrelationship to other disciplines and technologies.  
Facts taken into consideration given, bearing in mind, risk, consequences in technology application and affected parties.  
The extent of a project given to a junior Engineering is characterised by the several complex and a few well-defined factors and the resulting interdependence. He/she will seek advice if educational and/or experiential limitations are exceeded.  
Taking risky decisions will lead to equipment failure, excessive installation and maintenance cost, damage to persons and property, etc. Evaluation includes engineering calculations to substantiate decisions taken, and assumptions made. |
| **Range Statement for Outcomes 8 and 9:** | Judgement in decision making involves: | In Engineering about 5% of engineering activities can be classified as complex where the Engineering uses standard procedures, codes of practice, specifications, etc., but develops variations and completely unique standards when needed. Judgement must be displayed to identify any activity falling inside the complex range, as defined above by:  
(a) Getting the work done in spite of numerous risk factors needs good judgement and substantiated decision making.  
(b) Consequences are part of the project e.g. extra cost due to unforeseen conditions, incompetent contractors, long term environmental damage, etc.  
(c) Interested and affected parties with defined needs that may be in conflict e.g. need for a service irrespective of environmental damage, local traditions and preferences, etc. needs sound management and judgement. |

**Group D: Exercise judgment, take responsibility, and act ethically.**
### Outcome 10:
Be responsible for making decisions on part or all of one or more complex engineering activities

<table>
<thead>
<tr>
<th>Responsibility level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>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.”.</td>
</tr>
</tbody>
</table>

#### Assessment criteria:
Responsibility is displayed by the following performance:

1. **Engineering, social, environment and sustainable development** taken into consideration in discharging responsibilities for significant parts of one or more activities.
2. Advice sought from a responsible authority on matters outside your area of competence.
3. Academic knowledge of at least BEng level combined with past experience used in formulating decisions.

<table>
<thead>
<tr>
<th>Range Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsibility must be discharged for significant parts of one or more complex engineering activity.</td>
<td>The responsibility is mostly allocated within a team environment with an increasing designation as experience is gathered.</td>
</tr>
</tbody>
</table>

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) | Explanation and Responsibility Level
---|---
### Outcome 11: Undertake independent learning activities sufficient to maintain and extend his or her competence
#### Responsibility level D

<table>
<thead>
<tr>
<th>Assessment Criteria</th>
<th>Explanation and Responsibility Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.1 Strategy independently adopted to enhance professional development evident.</td>
<td>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.</td>
</tr>
<tr>
<td>11.2 Awareness of philosophy of employer in regard to professional development evident.</td>
<td>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 level.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Range Statement: Professional development involves:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Planning own professional development strategy;</td>
</tr>
<tr>
<td>(b) Selecting appropriate professional development activities; and</td>
</tr>
<tr>
<td>(c) Recording professional development strategy and activities; while displaying independent learning ability.</td>
</tr>
<tr>
<td>(a) In most places of work training is seldom organised by some training department. It is up to the Engineering to manage his/her own experiential development. Engineering is 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.</td>
</tr>
<tr>
<td>(b) Preference must be given to engineering development rather than developing soft skills.</td>
</tr>
<tr>
<td>(c) Developing a learning culture in the workplace environment of the Engineering is vital to his / her success. Information is readily available, and most senior personnel in the workplace are willing to mentor, if approached.</td>
</tr>
</tbody>
</table>
### Appendix B: Training Elements Scope

<table>
<thead>
<tr>
<th>Occupational Tasks</th>
<th>Work Experience and Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td></td>
</tr>
<tr>
<td>1.1 Training Induction Programme</td>
<td>(Typically 1 to 5 days)</td>
</tr>
<tr>
<td>1.1.1</td>
<td>Company structure</td>
</tr>
<tr>
<td>1.1.2</td>
<td>Company policies</td>
</tr>
<tr>
<td>1.1.3</td>
<td>Company Code of Conduct</td>
</tr>
<tr>
<td>1.1.4</td>
<td>Company safety regulations</td>
</tr>
<tr>
<td>1.1.5</td>
<td>Company staff code</td>
</tr>
<tr>
<td>1.1.6</td>
<td>Company regulations</td>
</tr>
<tr>
<td>1.2 Exposure to engineering principles and processes</td>
<td>(Typically 6 to 12 months) and cover how things are: (Experience in one or more of these but not all)</td>
</tr>
<tr>
<td>1.2.1 (Responsibility level A, B, C)</td>
<td>Manufacturing / Production</td>
</tr>
<tr>
<td>1.2.2</td>
<td>Laboratory and Testing</td>
</tr>
<tr>
<td>1.2.3</td>
<td>Project Management</td>
</tr>
<tr>
<td>1.2.4</td>
<td>Process Optimisation and Design</td>
</tr>
<tr>
<td>1.2.5</td>
<td>Plant Operations and Maintenance, Construction, Commissioning and Decommissioning</td>
</tr>
<tr>
<td>1.2.6</td>
<td>Heat treatment (Use of equipment e.g. furnace, spectrometer)</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>1.2.7</td>
<td>Mechanical testing of materials</td>
</tr>
<tr>
<td>1.2.8</td>
<td>Non-destructive testing of materials</td>
</tr>
<tr>
<td>1.2.9</td>
<td>Chemical analysis</td>
</tr>
<tr>
<td>1.2.10</td>
<td>Problem Investigation &amp; Failure investigations</td>
</tr>
</tbody>
</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>
<thead>
<tr>
<th>1.3.1</th>
<th>(Responsibility level C&amp;D) Analysis of data and systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3.2</td>
<td>Research and investigation</td>
</tr>
<tr>
<td>1.3.3</td>
<td>Preparation of specifications and associated documentation</td>
</tr>
<tr>
<td>1.3.4</td>
<td>System modeling and integration</td>
</tr>
<tr>
<td>1.3.5</td>
<td>System &amp; Software Designs</td>
</tr>
<tr>
<td>1.3.6</td>
<td>Component / Product designs</td>
</tr>
<tr>
<td>1.3.7</td>
<td>Preparation of contract documents and associated documentation</td>
</tr>
<tr>
<td>1.3.8</td>
<td>Preparation of project management documents</td>
</tr>
<tr>
<td>1.3.9</td>
<td>Application of quality systems</td>
</tr>
<tr>
<td>1.3.10</td>
<td>Configuration and Documentation management (Quality Management Systems)</td>
</tr>
<tr>
<td>1.3.11</td>
<td>Development of standards and procedures</td>
</tr>
</tbody>
</table>
## 1.4 Experience in the execution of engineering tasks

<table>
<thead>
<tr>
<th>1.3.1</th>
<th>(Responsibility level E)</th>
<th>Plant &amp; Process Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3.2</td>
<td>Process Optimisation</td>
<td></td>
</tr>
<tr>
<td>1.3.3</td>
<td>Manufacture / Production</td>
<td></td>
</tr>
<tr>
<td>1.3.4</td>
<td>Construction and Installation</td>
<td></td>
</tr>
<tr>
<td>1.3.5</td>
<td>Project Management</td>
<td></td>
</tr>
<tr>
<td>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>Safety Standards and Processes</td>
<td></td>
</tr>
<tr>
<td>1.3.11</td>
<td>Research and Development</td>
<td></td>
</tr>
</tbody>
</table>

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

## 2 Solving problems based on engineering and contextual knowledge

<table>
<thead>
<tr>
<th>2.1</th>
<th>Conceptualisation of complex engineering problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1</td>
<td>Receive brief</td>
</tr>
<tr>
<td>2.1.2</td>
<td>Investigate / evaluate requirements</td>
</tr>
</tbody>
</table>
2.1.3 Develop preliminary solutions
2.1.4 Justify the preliminary design
2.2 Design or development processes for complex engineering problems
   2.2.1 Detailed design or development processes
   2.2.2 Documentation development for Implementing complex engineering Solutions

3 Implementing projects or operating engineering systems or processes
   3.1 Planning processes for Implementation or Operations
      3.1.1 Develop business and stakeholder relationships
      3.1.2 Scope and plan
   3.2 Organising processes for Implementation or Operations
      3.2.1 Manage resources
      3.2.2 Optimisation of resources and processes
   3.3 Controlling processes for Implementation or Operations
      3.3.1 Monitor progress and delivery
      3.3.2 Monitor quality
   3.4 Close out Processes for Implementation or Operations
      3.4.1 Commissioning processes
<p>| 3.4.2 | Development of operational documentation |
| 3.4.3 | Handover processes |
| 3.5 | Maintenance and repair processes |
| 3.5.1 | Maintenance planning and scheduling |
| 3.5.2 | Monitor quality |
| 3.5.3 | Oversee repairs and/or implement remedial processes |
| 4 | Risk and Impact Mitigation |
| 4.1 | Impact and risk assessments |
| 4.1.1 | Impact assessments |
| 4.1.2 | Risk assessments |
| 4.1.3 | Mitigation Plans |
| 4.2 | Regulatory compliance processes |
| 4.2.1 | Health and Safety |
| 4.2.2 | Legal and regulatory |
| 5 | Managing Engineering Activities |
| 5.1 | Self-Management Processes |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.1</td>
<td>Manage own activities</td>
</tr>
<tr>
<td>5.1.2</td>
<td>Communicate effectively</td>
</tr>
<tr>
<td>5.2</td>
<td>Team Environment</td>
</tr>
<tr>
<td>5.2.1</td>
<td>Participate in and contribute to team planning activities</td>
</tr>
<tr>
<td>5.2.2</td>
<td>Manage people</td>
</tr>
<tr>
<td>5.3</td>
<td>Professional communication and relationships</td>
</tr>
<tr>
<td>5.3.1</td>
<td>Establish and maintain professional and business relationships</td>
</tr>
<tr>
<td>5.3.2</td>
<td>Communicates effectively</td>
</tr>
<tr>
<td>5.4</td>
<td>Exercising Judgement and Taking Responsibility</td>
</tr>
<tr>
<td>5.4.1</td>
<td>Ethical practices</td>
</tr>
<tr>
<td>5.4.2</td>
<td>Exercise sound judgement in the course of complex engineering activities</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Be responsible for decision making on part or all of complex engineering activities</td>
</tr>
<tr>
<td>5.5</td>
<td>Competency development</td>
</tr>
<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>