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Sub discipline-Specific Training Requirements for Candidate Fire Protection System Rational Designers (Fire Specialists)

R-05-FPSRD-SC

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DEFINITIONS

Accredited qualification: A qualification awarded on successful completion of an accredited programme.

Alternative Route: In the case of Rational Designers, Alternative Route is the registration option for Fire Specialists who have completed recognised foreign equivalent educational requirements for registration as either a Professional Engineer or a Professional Engineering Technologist but are not registered with the Engineering Council of South Africa.

Assessor: A professionally registered person who carries out the Experience Appraisal assessment.

Benchmark Route: The normal process to attain registration that consists of the completion of an accredited, recognised or evaluated equivalent qualification and a well-structured and effectively executed programme of Training and Experience for the category of registration.

Competency area: The performance area where all the outcomes can be demonstrated at the level prescribed in a specific technology in an integrated manner.

Competency Assessment: A summative assessment of an individual's competency against the prescribed standard that is based on evidence from the individual's work, reports by qualified observers and other tests that may include a Professional Review.

Competency Standard: Statement of competence required for a defined purpose.

Continuing Professional Development: The systematic, accountable maintenance, improvement and broadening of knowledge and skills and the development of the personal qualities necessary for the execution of professional and technical duties throughout an engineering practitioner's career after professional registration.

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

Engineering Science: 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, to solve problems and to provide the knowledge base for engineering specialisations.

Experience Appraisal: is a documentary assessment of the applicant's evidence of competence.

Generic Baseline Competency: The competency for a professional category defined in terms of outcomes and including the expected level of performance that can be demonstrated in a range of occupational contexts.

Initial Professional Development: Systematic participation in the activities typical of Continuing Professional Development but carried out prior to professional registration.

Integrated Performance: An overall satisfactory outcome of an activity requires several outcomes to be satisfactorily attained; for example, a design will require analysis, synthesis, analysis of impacts, checking of regulatory conformance and judgement in decisions.

Knowledge area*:* An important subject area that forms part of the overall knowledge base needed for a certain competency.

Mentor: An ECSA registered person (Professional Engineer or Professional Engineering Technologist) who guides the competency development of a candidate in an appropriate category.

Moderator: A professionally registered person who carries out the moderation of the Experience Appraisal and Professional Review assessments.

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

Practice area: A distinctive area of knowledge and expertise developed by an engineering practitioner through the path of education, training and experience followed by competent and responsible application in practice.

Prescribed standards: The Competency Standards (outcomes) for the category and the discipline-specific requirements (if any) that must be satisfied by an applicant for registration.

Professional Review: is an integrative assessment of the applicant's competence, including professional attributes specified in the standard and sub discipline specific requirements for the category and the sub discipline via a comprehensive review of the applicant's evidence and an interview.

Range Statement: The required extent of or limitations on expected performance stated in terms of situations and circumstances in which outcomes are to be demonstrated in a particular competency area.

Reviewer: A professionally registered person who carries out the Professional Review assessment.

Standards: Comprise statements of outcomes to be demonstrated and the levels of performance and content baseline requirements in the context of engineering educational programmes

Substantial equivalence: (Applied to educational programmes). Two programmes while not meeting a single set of criteria are both acceptable for preparing their respective graduates to enter Training and Experience towards professional registration.

Supervisor: A person who oversees and controls engineering work performed by an applicant.

ABBREVIATIONS/ACRONYMS

ASIB	Automatic Sprinkler Inspection Bureau
BS	British Standard
C&U	Commitment and Undertaking
CPD	Continuing Professional Development
CRC	Central Registration Committee
EA	Experience Appraisal
ECSA	Engineering Council of South Africa
FPSRD	Fire Protection System Rational Designer
GCC	Government Certificate of Competency
IPD	Initial Professional Development
LPC	Loss Prevention Council
NFPA	National Fire Protection Association
PE	Professional Engineer
PN	Professional Engineering Technician
PR	Professional Review
Pr Cert Eng	Professional Certificated Engineer
Pr Eng	Professional Engineer
Pr Tech Eng	Professional Engineering Technologist
Pr Techni Eng	Professional Engineering Technician
PT	Professional Engineering Technologist
RD	Rational Design
SANS	South African National Standard
SC	Specified Category
VA	Voluntary Association

BACKGROUND

The illustration below defines the documents that comprise the Engineering Council of South Africa (ECSA) system for registration in specified categories. The illustration also locates the current document.

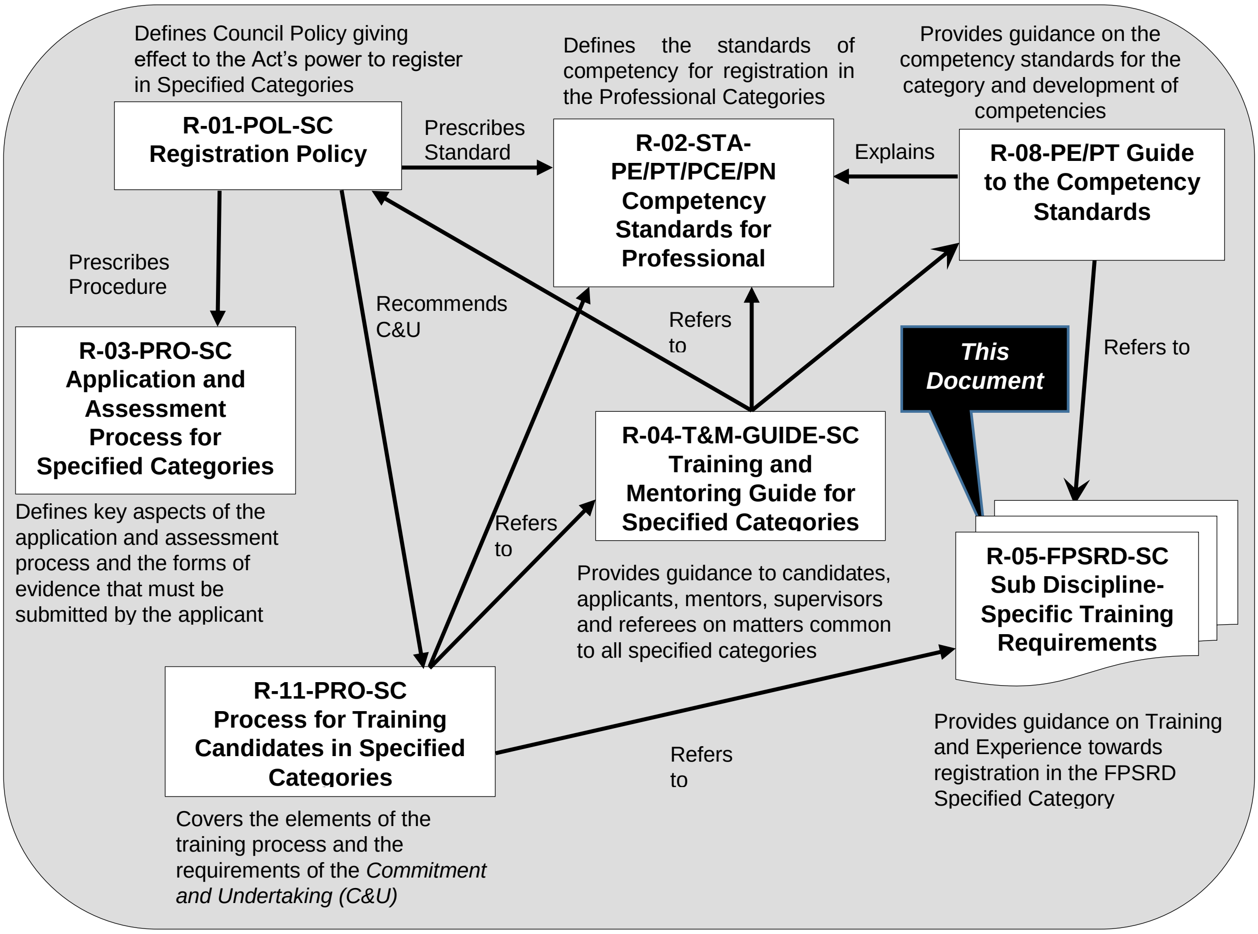

Figure 1: Documents defining the ECSA Registration System for Specified Categories (Rational Design)

1. PURPOSE OF THIS DOCUMENT

All persons applying for registration in the Specified Category of Fire Protection System Rational Designer (Fire Specialist) are expected to demonstrate the competencies specified in documents **R-02-STA-PE/PT/PCE/PN** through work performed at the prescribed level of responsibility, irrespective of the type of fire protection system. In addition, the subdiscipline-specific requirements set out in Section 8.5 below must be met.

This training requirements document supplements the generic Training and Mentoring Guide (document **R-04-T&M-GUIDE-SC**), the Guide to the Competency Standards for Registered Practitioners (document **R-08-PE/PT)** and the Process for Training Engineering Candidates towards Specified Category Registration (document **R-11-PRO-SC**).

In document **R-04-T&M-GUIDE-SC**, attention is drawn to the following sections:

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

The second set of documents (documents **R-08-PE/PT**) is applicable to Alternative Route applicants and provides both a high-level and an outcome-by-outcome understanding of the Competency Standards as an essential basis for this subdiscipline-specific training requirements document.

The third document (document **R-11-PRO-SC**) elaborates on the elements of the training process and the requirements of the Commitment and Undertaking (C&U).

These Requirements and the documents **R-04-T&M-GUIDE-SC**, **R-08-PE/PT** and **R-11-PRO-SC** are subordinate to the Policy on Registration (document **R-01-POL-SC**), the Competency Standards (document **R-02-STA-PE/PT/PCE/PN**) and the application process definition (document **R-03-PRO-SC**).

2. AUDIENCE

These Requirements are directed towards Candidates and their Supervisors and Mentors in the sub discipline of Fire Protection System Practitioners. The Requirements are intended to support a programme of training for specialist rational designers to gain experience incorporating good practice elements.

The Requirements are also directed towards the members of the engineering team, which consists of registered practitioners who accept full responsibility for their areas of work and adhere to the ECSA Code of Conduct, the Engineering Professions Act (No. 46 of 2000) (EPA).

Table 1: Different categories of registered practitioners in engineering team

Category	Authority	Underpinning Knowledge	Area of Responsibility
Professional Engineer – EPA Section 18(1)(a)(i)	Educated, trained and experienced to carry out complex-defined engineering work	Graduate Attributes acquired in education at NQF 8 level (560 credits)	Complex interaction between professions and disciplines; justify work outside codes, standards and procedures.
Professional Certificated Engineer – EPA Section 18(1)(a)(iii)	Educated, trained and experienced to carry out broadly defined engineering work	Graduate Attributes acquired in education at NQF 7 level (420 credits) and Government Certificate of Competency	Interaction with other professions and disciplines; authorisation required to work outside codes, standards and procedures after conducting research and investigation; legal responsibility (OHS Act).
Professional Engineering Technologist – EPA Section 18(1)(a)(ii)	Educated, trained and experienced to carry out broadly defined engineering work	Graduate Attributes acquired in education at NQF 7 level (420 credits)	Interaction with other professions and disciplines; authorisation required to work outside codes, standards and procedures after conducting research and investigation.
Professional Engineering Technician – EPA Section 18(1)(a)(iv)	Educated, trained and experienced to carry out well-defined engineering work	Graduate Attributes acquired in education at NQF 6 level (280 to 360 credits)	Mainly working within a single discipline; strict adherence to codes, standards and procedures; repetitive work.
Specified Category Practitioner – EPA Section 18(1)(c)	Educated, trained and experienced to carry out specifically defined engineering work	Graduate Attributes acquired in education at NQF 5 level (140 credits)	Working within a single discipline in a specific field; may be legally responsible for work.

Finally, these Requirements apply to persons who

- have completed the educational requirements for registration as either a Professional Engineer or a Professional Engineering Technologist and are registered with the ECSA as such; or
- have completed recognised foreign equivalent educational requirements for registration as either a Professional Engineer or a Professional Engineering Technologist but are not registered with the ECSA **(Alternative Route Applicants)**;
- are registered as a Candidate Specified Category Rational Designer (Fire Specialist);
- have embarked on a process of acceptable training under a registered **C&U** with a Mentor guiding the professional development process at each stage; and
- intend to adhere to the ECSA Code of Conduct, prohibiting the undertaking of engineering work for which the registered person is not qualified, trained or experienced.

3. PERSONS NOT REGISTERED AS CANDIDATES OR NOT BEING TRAINED UNDER A COMMITMENT AND UNDERTAKING

All applicants for registration must present the same evidence of competence and be assessed against the same standards and requirements, irrespective of the development path followed. Application for registration as a Specified Category Rational Designer (Fire Specialist) is permitted without being registered as a Candidate Specified Category 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.

If the trainee's employer has no C&U, the trainee should establish the level of mentorship and supervision that the employer is able to provide. In the absence of an internal Mentor, the services of an external Mentor should be secured. The recognised Voluntary Association (VA) for the subdiscipline should be consulted for assistance in locating an external Mentor. A Mentor should be in place at all stages of the development process.

These Requirements are written for the recent registered Professional Engineer (Pr Eng) / Professional Engineering Technologist (Pr Tech Eng) who is training and gaining experience towards Rational Designer (Fire Specialist) registration. Mature applicants for Rational Designer (Fire Specialist) registration may apply the Requirements retrospectively to identify possible gaps in their development.

Applicants who have not enjoyed mentorship are advised to request an experienced Mentor (internal or external) to act as an application adviser while they prepare their application for Rational Designer (Fire Specialist) registration.

These Requirements 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 8.5**).

4. TRAINING OBJECTIVES

To achieve ECSA Rational Designer (Fire Specialist) registration, the training programme designed by the employer should achieve the following:

- Expose the applicant to Experience and Training, enabling him/her to apply engineering theory acquired during educational development to practical workplace situations for the prescribed period.
- Incorporate an increasing level of responsibility to enable the applicant to submit evidence in the Training and Experience reports of achieving the duration and the level detailed in **Section 8.1**. of this document (Degrees of Responsibility).
- Develop the engineering competency of the applicant to cover the discipline-specific requirements referred to in **Section 8.5** of this document (Compulsory Subdiscipline-Specific Requirements to be met during the Candidacy).

5. FIRE PROTECTION SYSTEMS

The definition of Fire Safety Engineering by the UK **Institution of Fire Engineers (IFE)** is as follows:

The application of scientific and engineering principles, rules (Codes), and expert judgement, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire.

The definition of Fire Protection Engineering by the **Society of Fire Protection Engineers (SFPE)** of the US is as follows:

> Fire protection engineering is the application of science and engineering principles to protect people and their environment from destructive fire and includes: analysis of fire hazards; mitigation of fire damage by proper design, construction, arrangement, and use of buildings, materials, structures, industrial processes, and transportation systems; the design, installation and maintenance of fire detection and suppression and communication systems; and post/fire investigation and analysis.

The SFPE Technical Competencies required are detailed in Appendix D.

The Engineering of Fire Protection Systems can be described as the application of science and engineering principles to protect people, property and their environments from the harmful and destructive effects of fire and smoke. It encompasses engineering that focuses on fire detection, suppression and mitigation and Fire Safety Engineering that focuses on human behaviour and maintaining a tenable environment for evacuation from a fire.

International Fire Engineers develop rational design methodologies, commencing with the people and occupancy at risk. Thereafter, rational Fire Engineering performance-based designs are developed based on theoretical academic knowledge and supported by design codes and standards where applicable. The latest experimental data obtained from the fire laboratories of institutions such as the Loss Prevention Council (LPC), FM Global, Old Mutual Insure and the National Fire Protection Association (NFPA) are also employed. This ensures that the Fire Engineering designs are subjected to rigorous review and approval processes to prevent global fire incidents and catastrophic failures. The primary objective is always the life safety of people but given the devastating effect on business and the cost of fires running into billions of rands/dollars annually, latest development in Fire Engineering design also focuses on property protection and fire prevention.

Various engineering design standards and codes exist internationally. One of the recognised standards is the BS 7974, which is referenced in the South Africa National Standard (SANS) 10400-T standard and is, therefore, applied in South Africa together with other appropriate international standards such as NFPA standards.

Note: Until SANS 10287 is updated, the application of the Automatic Sprinkler Inspection Bureau (ASIB) Twelfth Edition Rules or the BS12845 or the NFPA13 and 15 standards are recommended.

The role of the Rational Designer is to view the fire safety of a building in totality and to compile a safety plan describing the requirements regarding fixed installations. The detailed design of components could be handed over to specialists in each area.

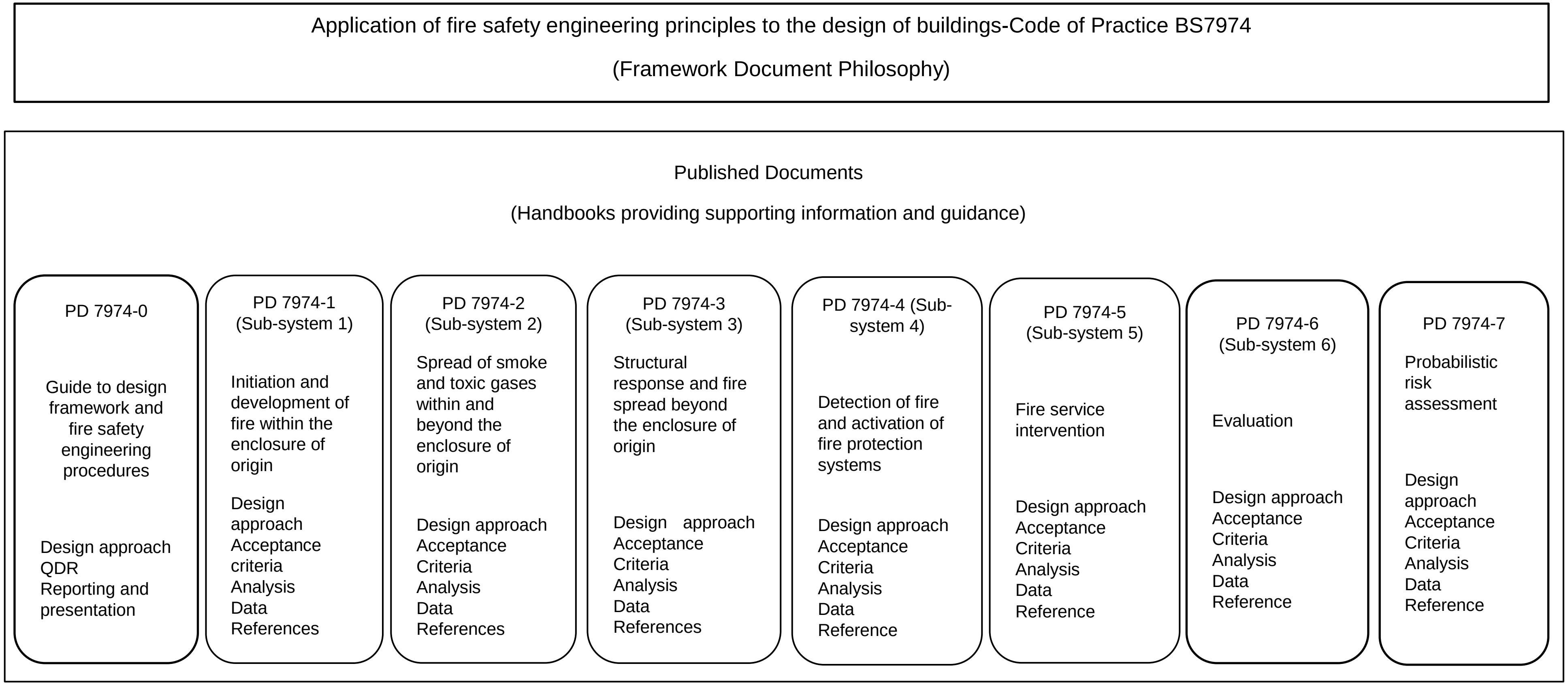

Figure 2: The structure of the code of practice and the Published Documents

The following engineering activities are the responsibilities of Fire Protection System Rational Designers (FPSRDs), and they require expert knowledge to be executed successfully. Individuals need to provide evidence of competence when being assessed in these fields to prove that they have acquired the necessary knowledge and expertise to perform these activities diligently and safely to mitigate the risks associated with fire hazards. These include the following:

- The design, production, checking, interpretation, evaluation and approval of fire plans, including rational fire protection system design.

- The inspection of building work regarding the compliance of rational fire protection system design in relation to public buildings, buildings of public entertainment, stadiums, tunnels and other structures in terms of the Safety in Building Control, the National Building Regulations and Building Standards Act (No. 103 of 1977) and Regulations A24 and A19.

- The implementation of acceptable standards for fire protection system engineering regarding fixed-fire installation.

- The design of hydraulically calculated pipe work for sprinkler or water protection systems together with the required water supply tanks, low electrical current circuitry for fire protection systems, inert gas flow calculations, airflow calculations to prevent over pressure and for smoke control design, calculations for safe evacuation of the public and/or workers, and fire detection design calculations such as back-up battery and system power consumption calculations.

- The assessment of the suitability and safety of equipment for high- and low-pressure installations of liquid petroleum gases, flammable liquids and flammable or dangerous gases together with the installation of the required fire protection systems, including the cable types and equipment for electrical systems in explosive and flammable liquid or flammable vapour areas and the assessing of the intrinsic safety equipment needed for electrical equipment installed in hazardous areas.

- The evaluation and testing of installation work and procedures for many and varied fire engineering- and fire-protection systems.

- The inspection, approval, commissioning, signing off and subsequent maintenance of different fire systems and once installed, the assurance that they interface seamlessly, thereby providing the correct level of life safety and proper protection.

Fire Protection System Rational Designers are required to

- understand the nature and characteristics of fire, the mechanisms of fire spread and the control of fire;
- understand the chemical reactions and latent effects and defects due to the combination of building materials and substances at excess temperatures;
- understand how fires originate, spread within and outside structures and are detected, controlled and/or distinguished;
- anticipate the behaviour of materials, structures, property and the environment to fire;
- understand the interactions and integration of fire safety systems and similar facilities; and
- make use of all the above and other required knowledge to understand the practice of fire protection systems.

The Engineering of Fire Protection Systems, therefore, relies on various engineering disciplines to achieve the final aim. The theoretical knowledge that is required to perform the analysis and design of fire protection systems is embedded in these disciplines. The fundamental knowledge, education, training and experience of professionals working in these disciplines feed into the field of Engineering of Fire Protection Systems. Most of these persons are presently performing work prescribed by the National Building Regulations and Building Standards Act (No.103 of 1977) as amended, the Occupational Health and Safety Act (No. 85 of 1993) (OHS Act), SANS Standards or Codes of Practice and other Acts that regulate safety under the Flammable Substances Regulations. The work being conducted by such persons influences the health and safety of persons inside buildings such as occupants, clients or workers involved with the building together with the structures in question and the community at large.

Buildings are becoming larger and more complex with less compartmentalisation. The result is that more people are being placed at risk from fire. There is little technical guidance using time-based calculations to address the important relationship between the time required for escape and the time available for escape and the interaction of equipment such as sprinkler systems, detection and ventilation.

Competent FPSRDs (Fire Specialists) registered by the ECSA should be able to contribute to furthering the education, development and training regarding Fire Engineering practice to ensure competency and the acceptance of work responsibility. Participating in ECSA's candidacy scheme with the associated C&U, adhering to ECSA's Continuing Professional Development (CPD) requirements and complying with the ECSA Code of Conduct will improve the service to the public and promote the standing of these Practitioners.

In the National Building Regulations, a *competent person* is defined as follows:

> [A] person who is qualified by virtue of their education, training, experience and contextual knowledge to make a determination regarding the performance of a building or part thereof in relation to a functional regulation or to undertake such duties as may be assigned to them in terms of these regulations.

Furthermore, these Regulations look to SANS 10400 to define a competent person so that a building control officer or an owner may readily identify who is competent to perform the various duties that need to be undertaken to implement the National Building Regulations effectively.

SANS 10400-T defines a *competent person in Fire Engineering* as follows:

> [A] person who is registered in terms of the Engineering Professions Act, 2000 (Act No. 46 of 2000) as either a Professional Engineer or a professional Engineering Technologist and has suitable experience in fire chemistry, fire dynamics and fire safety design using system performance requirements and design verification methods.

Competent Persons in Fire Engineering are required to

1) Prepare rational designs as an alternative to the application of the deemed to satisfy rules contained in SANS 10400-T.

2) Determine the acceptability of erecting a thatched *lapa* against an existing building.

A *Competent Person* who is not necessarily a Professional Engineer or a Professional Engineering Technologist is required in terms of SANS 10400 to

1) design, install or maintain a fixed automatic fire-fighting system that is designed in accordance with SANS 306-4, Fire extinguishing installations and equipment on premises – Part 4: Specification for carbon dioxide systems SANS 14520-1/ISO 14520-1, Gaseous fire extinguishing systems – Physical properties and system design – Part 1: General requirements, and SANS 10287, Automatic sprinkler installations for fire-fighting purposes;

2) install, maintain and service fire extinguishers in accordance with SANS 1475-1, The production of reconditioned fire-fighting equipment – Part 1: Portable and wheeled (mobile) rechargeable fire extinguishers, and SANS 10105-1, The use and control of fire-fighting equipment – Part 1: Portable and wheeled (mobile) fire extinguishers;

3) supervise the installation and construction of liquid fuel tanks and associated equipment in accordance with SANS 10089-3, The petroleum industry – Part 3: The installation of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations, and SANS 10131, Above-ground storage tanks for petroleum products;

4) design, install, test and maintain pressurised emergency routes in accordance with EN 12101-6, Smoke and heat control systems – Part 6: Specification for pressure differential systems – Kits; and

5) design, install and maintain a fire detection system and alarm system in accordance with SANS 10139, Fire detection and alarm systems for buildings – System design, installation and servicing.

Structured training of *Competent* FPSRDs (Fire Specialists) resulting in ECSA registration provides a means of certifying the basic competencies of those engaged in aspects of Fire Engineering in a manner that owners of buildings and building control officers can readily identify who is competent to perform specific tasks and establish the credentials of such persons. In addition, the fire and safety outcomes of the National Building Regulations would be improved through such training since the outcomes are reliant on people having the necessary skills and experience to make judgements in applying the relevant national fire safety standards.

Fire protection systems consist of Fire Detection, Alarm and Detection, Fixed Gaseous Systems and Water-Based Systems (see Appendix B).

Once the regulatory requirements have been identified and a fire safety strategy with the regulatory authorities has been developed and agreed upon with the regulatory authorities, this must be translated into a physical fire protection system by designing and specifying the products and equipment together with their correct installation, commissioning, maintenance and operation. Parties involved in the development of the fire safety strategy such as the building owner, architect, insurers, fire safety engineer, main contractor and/or fire protection contractor may influence the design of the fire protection system. Consequently, a design specification originally drawn up by the architect implementing the fire safety strategy may subsequently be changed by other participants in the design. This is a necessary part of the process that is required to improve the design that is emanating from the fire safety strategy.

It follows that the design, manufacture, use, maintenance, inspection and testing of fire protection systems must be in accordance with accepted prescribed regulations and standards, and audits to verify this at fixed intervals must be undertaken. The responsible Rational Designer appoints equipment specialist practitioners to assist in the design, installation, commissioning, testing and inspection of specific equipment. The required well-administered record of work performed and inspections undertaken must be recorded. In addition, inspections must be carried out timeously to avoid incidents that endanger the workforce and the public.

Fire Protection System Rational Designers who are registered with the ECSA are allocated a registration number after assessment, with a portfolio of evidence kept on file and a letter detailing their competency. All stakeholders, including manufacturers, equipment suppliers and maintainers, building owners and building inspectors, agree that being ethically bound through registration after evaluation is of tremendous advantage to the industry.

The ECSA approved the Fire Practitioners Specified Categories for design and installation according to SANS standards and guides. Fire Protection System Rational Designers are deemed competent under the National Building Regulations and Building Standards Act (No. 103 of 1977) since they are registered as Pr Eng and Pr Tech Eng and have the education and training to do complex, broadly defined and well-defined fire rational designs that require interdependence of multiple performance-based parameters for fire safety. The Fire Practitioners will be appointed as a FORM 3 according to Table C.1 SANS 10400-A (Annexure C of SANS 10400-A).

Table 2: Appointment of competent persons

Annex C
(informative)

Appointment of competent persons

This part of SANS 10400 relies upon competent persons to perform specific tasks. Competent persons (fire engineering) are required to

a) undertake rational designs in accordance with the requirements of BS 7974 (see 4.1.1(b) and annex B);

b) rationally assess the acceptability of erecting a lapa against an existing building (see 4.12.2.3); and

c) rationally design refuges (see 4.16.8).

Competent persons who might or might not be competent persons (fire engineering) are required to perform a number of other activities. These are set out in table C.1.

Table C.1 — Responsibilities assigned to competent persons other than competent persons (fire engineering)

Clause	Responsibility
4.2.7, 4.4, 4.8.2, 4.16.4, 4.26.1, 4.36.1 and 4.48.6	Design, install and maintain an automatic sprinkler system in accordance with the requirements of SANS 10287.
4.12.2.5	Design and install a lightning protection system in accordance with the requirements of SANS 10313 and SANS 62305-3.
4.25	Design, install, test and maintain the pressurization of emergency routes, mechanical smoke or heat control systems, and components in accordance with the requirements of EN 12101.
4.31.1, 4.31.2, 4.31.3, 4.43.2, 4.48.3 and 4.48.6	Design, install and maintain a fire detection and alarm system in accordance with the requirements of SANS 10139.
4.36.1	Design, install and maintain a fixed automatic fire-fighting system that is in accordance with the requirements of SANS 306-4 or SANS 14520-1.
4.37.3	Install, maintain and service portable fire extinguishers in accordance with the requirements of SANS 1475-1 and SANS 10105-1.
4.52.4	Direct the construction and installation of a tank in accordance with the requirements of SANS 10089-3.
4.53.1.1	Design, erect and protect liquid petroleum gas storage in accordance with the requirements of SANS 10087-3.
4.52.4 and 4.53.1.3	Direct the installation of a diesel fuel tank and associated equipment in accordance with the requirements of SANS 10131.
4.55.1	Perform a rational assessment of building materials and components to determine their fire resistance.

6. TRAINING IMPLICATIONS ON THE NATURE AND ORGANISATION OF THE INDUSTRY

Fire Protection System Rational Designers (Fire Specialists) may be employed in both the private and public sector.

In the private sector, FPSRDs would typically be involved in contracting or in supplier or manufacturing/installation organisations. Engineering contractors are responsible for project implementation, and activities include planning, construction, forensic investigation, and 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, although in some departments, construction is also performed. Fire Protection System Rational Designers (Fire Specialists) are required at all levels of the public sector, including national, provincial and local government level, state-owned enterprises (SOEs), and public utilities. Fire Protection System Rational Designers (Fire Specialists) in the public sector are largely involved in overseeing implementation, operations and the maintenance of infrastructure.

An extension of the public sector includes tertiary academic institutions and research organisations.

Specific fire protection systems

Depending on the particular requirements for fire protection, Candidate Fire Protection System Rational Designers (Fire Specialists) will select one or more of the fire protection systems for the purpose of registration. This will be the knowledge base for the training of the <u>Candidate</u> Fire Protection System Rational Designer (Fire Specialist) through the full career path of the <u>Registered</u> Fire Protection System Rational Designer (Fire Specialist). The present systems identified by the ECSA are listed and described in **Appendix B**, with the applicable SANS or other standard given if available.

Ability to provide complete training

Depending on where the candidate is employed, there may be situations in which the in-house opportunities are not sufficiently diverse to develop all the competencies required in all the groups noted in Section 6.2 and if applicable, in **Appendix E**. For example, the opportunity for developing problem-solving competence (including design and developing solutions) and for managing engineering activities (including implementing and constructing solutions) may not both be available to the Candidate. In such cases, employers are encouraged to appoint an external Mentor.

It is common practice that where an organisation is not able to provide training in certain areas, secondments are arranged with other organisations so that the Candidate is able to develop all the requirements (and competencies in the case of an Alternative Route applicant) required for registration. These secondments are usually of a reciprocal nature so both employers and their respective employees mutually benefit from the other party. Secondments between consultants and contractors and between the public and private sector should be possible.

Problem-solving is the core of engineering. It is a logical thinking process that requires FPSRDs (Fire Specialists) to apply engineering principles to diagnose and solve complex, broadly defined and well-defined Fire Engineering problems systematically. This process involves the analysis of fire protection systems and the integration of various elements in engineering as applied to fire protection systems through the application of basic and engineering sciences.

The problem-solving experience may be obtained in any of the work categories presented in the following sections.

6.1 Design or development

Examples of acceptable design or development include the following:

- Modifications after obtaining approval to complex, broadly defined and well-defined fluid systems on fire protection systems

- Modifications after obtaining approval to complex, broadly defined and well-defined minor parts of mechanical and electrical components on fire protection systems
- Modifications after obtaining approval to complex, broadly defined, well-defined procedures and commissioning, testing and inspection procedures on fire protection systems
- Modifications after obtaining approval to complex, broadly defined and well-defined structures on fire protection systems

6.2 Operations

Operations deals mainly with the maintenance, performance and functionality of fire protection systems and the monitoring of implemented and proven solutions to ensure smooth system operation. In addition, this category of work also involves continuous improvement initiatives for optimising the operational efficiencies. In performing the abovementioned work, FPSRDs (Fire Specialists) use the knowledge and experience they have obtained in the management of operations, which includes the ability to assess design work against the following criteria:

- Conformance to design specifications, health and safety regulations
- Ease of fabrication and assembly
- Constructability
- Maintainability
- Conformance to environmental requirements
- Ergonomic considerations
- Life-cycle costs
- Alternative solutions

6.3 Research and development

This type of work may be performed in research and product development centres of business organisations or academic institutions. Candidate FPSRDs must participate in research and development work that is predominantly of a mechanical, electrical and civil engineering nature. The work must include the application of the various aspects of mechanical/electrical/civil engineering, including product or system testing under controlled experimental conditions.

7. DEVELOPING COMPETENCY: DOCUMENTS R-08-PE/PT

7.1 Contextual knowledge

Applicants are required to demonstrate in-depth knowledge and the ability to use and interface various aspects of Engineering Science fundamentals through verifiable performance in providing engineered solutions to practical complex and broadly defined problems experienced in their operating work environment. In addition, applicants must develop the skills required to demonstrate the use of applicable engineering knowledge in optimising the efficiency of operations.

Candidate FPSRDs must be able to demonstrate that they have been actively involved in a mechanical and electrical workshop environment and building construction site, participating in the execution of practical work that is required to demonstrate competence in the installation, commissioning, operation and maintenance of fire protection systems in the built environment.

What is a sufficiently complex and broadly defined engineering problem?

The definition of *complex and broadly defined engineering activities* is presented in **Appendix A**.

As part of demonstrating the application of theoretical knowledge, applicants must incorporate calculations with clearly defined inputs of the formulae used and detailed interpretation of the results obtained. Applicants must demonstrate how the calculated results have been used to provide the solution to the problem at hand and indicate the benefit to the project or the operating work environment.

Candidate FPSRDs (Fire Specialists) must gain experience in solving a variety of problems in their work environment, and the solution to these problems must involve the use of fundamental engineering knowledge obtained at a university or from an ECSA-recognised institute of higher learning. The problems that require a scientific and engineering approach in their solution are often encountered in the required work on fire protection systems. Throughout their training years, Candidates must actively seek opportunities to gain experience in the areas of defining, investigating, analysing and developing solutions to real-life engineering problems encountered at the workplace on fire protection systems.

7.2 Functions performed

Special consideration in the Fire Protection System group and each specific type of system or speciality must be given to the competencies specified in the following groups as described in the Degree of Responsibility scales in document **R-04-T&M-GUIDE-SC, Table 4**.

A. Knowledge-based problem-solving

A.1 Identify potential projects and opportunities:

Use personal experience and knowledge and an understanding of the employer's commercial position and available Fire Engineering resources to identify potential projects or opportunities and consider their technical viability.

Demonstrate ability to define in-house rational fire safety design and to use this capability together with related expertise of other specialists to provide a total solution.

A.2 Conduct appropriate research and undertake design and development of engineering solutions:

Demonstrate ability to research best practices in rational design methods and necessary fire safety technologies to optimise the design and operation of fire protection systems.

Demonstrate value and benefits of potential new solutions to clients and the Fire Engineering industry.

A.3 Manage engineering activities:

Manage rational fire safety design by performing the activities indicated below.

Evaluate the broad range of hazards and protection schemes required to develop a workable, integrated solution to a fire safety problem.

Assisted by specialist practitioners, prepare the following design documents for fire protection systems (conceptual and detailed engineering documents):

- Hazard and risk analyses
- Performance-based design analyses
- Integrated building systems analyses
- Layout of fire protection systems
- Necessary calculations for all fire protection systems
    - Developing commissioning and acceptance requirements
    - Monitoring the installation of fire protection systems
    - Commissioning of technology and handing over of comprehensive Operating Manuals
    - Training on the Emergency Evacuation Policy and the Operations Manual done as part of the transfer of the Fire Safety Solution to the owner, including compliance and occupancy certification from all specialists and the Local Fire Authority

A.4 Maintain and extend a sound theoretical approach to enabling the introduction of new and advanced technology and other relevant developments:

- Identify and accept limits of personal knowledge and have a clear appreciation of how to extend capabilities by exploiting available sources of information and additional experience.
- Be conversant with key information resources for latest developments in the field of Fire Safety Engineering.
- Remain abreast of key developments in the field of Fire Engineering such as changes in Regulations or in Fire Engineering practices and be aware of key research/experimental programmes that are likely to have an influence in the field. Changes in Regulations or industry practices will have an impact on the National

Building Regulations and Building Standards Act (No. 103 OF 1977), SANS 10400 T&W etc. and the BS, EN and NFPA international fire codes and standards.

A.5 Engage in the creative and innovative development of engineering technology and continuous improvement systems to design an optimised fire rational design that will perform equally well or better than pure code-related rules:

- Seek stakeholder input and involvement in determining the functional objectives of the planned fire safety system and the related risks that must be mitigated. Thereafter, apply Rational Fire assessment or design based on South African Regulations and by-laws or apply international standards and design norms to deliver effective and safe fire solutions that meet the objectives.
- Apply the latest local and international research knowledge for the most appropriate and effective fire safety designs (passive and active systems).
- Identify constraints and explore opportunities for the development and transfer of technology while remaining aware of issues relating to the value of intellectual property.
- Demonstrate a willingness and ability to extend one's knowledge base into related fire disciplines or fields to broaden and deepen knowledge regarding Fire Engineering and Science and people and building safety.
- Lead total fire safety Rational design by applying own special skills and effectively co-operating with fire specialists in related engineering and technical disciplines to provide a comprehensive and optimised fire safety solution.

A.6 Fire protection analysis:

The following comprise part of the Rational design process:

- A basic understanding of hazard analysis, risk analysis and engineering analysis techniques in addition to fire sources, growth rate, fire smoke dynamics and risk and fire structural stability.
- A working knowledge of codes and standards, occupancy and hazard classifications, fire-test methods, and the interpretation of fire-test data.

- Engineering methods (i.e. computational fluid modelling and other engineering calculations) and the use of applicable codes and standards (South African SANS, BS, EN, NFPA, etc.).
- Typically, the Rational Fire Design Code BS 7974 is used as a design framework for fire engineers.

A.7 Fire protection management:

Demonstrate the capability to develop and implement management processes and systems for maintenance and sustained operations of fire protection systems and implemented design solutions. For operating fire safety systems, define and solve problems emanating from system failures and develop sustainable operational and maintenance practices.

A.8 Fire science and human behaviour:

Demonstrate, as an important rational design criterion, a basic knowledge of human response principles as related to evacuation procedure, human response to fire cues and timed egress analysis, including occupation-related situations, hospitals, disabled people, etc. In addition, ensure this is fully incorporated into active and passive fire solutions to ensure the safety of people and the protection of lives.

A.9 Active fire protection systems:

Demonstrate rational design ability through applying the most appropriate fire protection techniques in the solutions to identified fire risk areas.

Provide single or integrated solutions of an automatic or manual nature in fire and smoke detection and smoke ventilation, fire suppression and control (i.e. sprinklers, gaseous, foam, etc.), fire-fighting equipment, fire extinguishers, firehose reels and fire hydrants (type and location for application of occupancies).

A.10 Passive building systems:

Demonstrate a working knowledge of the principles of building construction as they relate to fire protection, including construction types, construction materials, interior finish, structural fire resistance, compartmentalisation, vertical openings and the protection of openings.

Additionally, demonstrate the ability to assess the adequacy of the means of egress, considering exits, occupancy, occupant loads, emergency lighting, and the marking of the means of egress and the ability to engage in electronic drafting for the design of the system.

Water-based suppression systems:

a) selection of type of system and components;
b) classification of the hazard and commodities to be protected;
c) establishment of the density/flow and design area size;
d) determination and confirmation of the available water supply;
e) preliminary system layout and hydraulic calculations to verify adequacy of proposed water supply arrangements;
f) analysis to identify concerns regarding structural support systems (as appropriate); and
g) analysis to identify the concerns regarding water quality that would affect the proposed systems (as appropriate).

Fire detection systems:

a) selection of type of system and components;
b) identification of location of fire detection panel location;
c) identification of interface(s) required with fire safety functions, other fire detection systems and other building systems; and
d) identification of location of all initiating devices and notification appliances.

Special hazard suppression systems:

a) selection of type of system and components;
b) classification of the hazard area and hazards to be protected, including fire barrier wall requirements and fire dampers;
c) determination of the minimum design concentration, normal cylinder storage temperature, cylinder location, and control panel location;
d) identification of system interfaces and customer requirements; and
e) creation of a system input/output matrix.

B. Management and communication

B.1 Plan for effective project implementation; meet all legal and regulatory requirements and protect the health and safety of persons during his or her complex engineering activities:

- Identify the factors affecting project implementation.
- Prepare and develop project proposals and negotiate contractual arrangements with customers, suppliers and partners to secure the employer's commercial position.
- Analyse and organise the provision of resources required to execute the work.
- Recognise and address the reasonably foreseeable social, cultural and environmental effects of complex engineering activities.
- Comply with international, national and local laws, Regulations, by-laws and standards relating to fire safety and emergency services to ensure end-to-end sustainable fire safety solutions.

B.2 Plan, budget, organise, direct and control tasks, people and resources:

- Set work objectives and priorities including milestone outputs, project deadlines, quality standards and budgets.
- Organise project teams and exercise leadership over other engineers and technical and other personnel as appropriate.
- Monitor and/or audit tasks to ensure that work is executed as planned and determine appropriate corrective actions.

B.3 Lead teams and develop staff to meet changing technical and managerial needs:

- Agree on objectives and work plans with teams and individuals.
- Contribute to the identification of the training needs of teams and individuals to respond to changing technical and managerial requirements and to further their professional progression.
- Develop external and work experience-related training plans for teams and individuals and identify and procure appropriate training activities and resources.

- Undertake reviews of training effectiveness.

B.4 Bring about continuous improvement through quality management:

- Promote quality throughout the organisation and its customer and supplier networks.
- Contribute to the development of systems for quality management and foster the acceptance of the principles of quality control throughout the organisation.
- Perform work according to appropriate quality standards and apply quality control and assurance techniques.

B.5 Demonstrate personal and social skills and conduct engineering activities ethically:

- Establish fire-engineering teams capable of working towards collective goals and create, maintain and enhance effective working relationships.
- Be aware of the needs and concerns of others.
- Develop the team, the individuals within the team and yourself to enhance performance.
- Provide for negotiation, conflict resolution and counselling within the team and provide a conduit through which ideas, convictions and attitudes can be exchanged and conveyed.
- Demonstrate confidence and flexibility in dealing with new and changing interpersonal situations.

B.6 Communicate in English with others at all levels:

- Develop good personal relationships that are appropriate to the level of communication being used and communicate effectively in a manner that the circumstances of the project dictate.
- Ensure effective two-way communication in discussions and be prepared to liaise with colleagues, peers and experts within and beyond the employer's organisation.
- Respond effectively and efficiently to all received communication howsoever it is received.

B.7 Present and discuss proposals:

- Select the most appropriate medium for clarifying the objectives of Fire Engineering design and select the most suitable method of communication using words, images, audio and video as necessary.
- Communicate fluently in written and oral expression at an experienced professional standard and prepare and present lectures, reports and published papers at a professional level.
- Include feedback results to improve the proposals.

C. Identifying and mitigating the impacts of engineering activities

C.1 Undertake engineering activities in a way that contributes to sustainable development and exercise sound judgement during complex engineering activities:

- Promote the considerations and actions required in engineering practice to improve, sustain and restore the environment and take a standpoint on critical items.
- Encourage the wise use of non-renewable resources through waste minimisation, recycling and the development of alternatives where possible.
- Strive to achieve the beneficial objectives of Fire Engineering design through minimising the consumption of raw materials and energy and designing sustainable management procedures.
- Account for life-cycle implications with respect to how Fire Engineering designs will affect the environment.
- Understand and secure stakeholder involvement in sustainable development.
- Use resources efficiently and effectively.

C.2 Manage and apply safe systems of work:

- Account for potential professional risks and liabilities and accept responsibility for them should they transpire.
- Consider and implement the appropriate occupational health, safety and welfare requirements as necessary.

- Develop and implement appropriate hazard identification and risk management systems.
- Manage, evaluate and improve these systems.

C.3 Advanced and Specialised Major Hazard Installation Fire Protection (industrial, liquid fuels, chemicals) for industrial fire safety registration only:

- Demonstrate the ability to assess special hazard systems, draft risk-based rational fire safety designs, co-operate with industry Chemical Engineering specialists to determine risk, operation and mitigations and provide innovative Fire Engineering calculations and solutions to make it safe for the public and sustainable for the environment.
- Demonstrate the ability to interpret, modify and apply multiple international design codes and technologies appropriate to the project.
- Demonstrate excellent safety and engineering judgement based on many years of Fire Engineering experience.

This category is intended for advanced and deep-fire specialists to carry out rational fire safety design based on risk assessment and explosive and fire analysis by a registered major hazard risk assessor.

C.4 Manage implementation of design solutions and evaluate their effectiveness:

- Prepare documented proposals that clearly identify and describe the fire safety solutions that have been engineered to satisfy the functional objectives of the project.
- Ensure that any testing or proving requirements are discussed and that any potential problem areas are highlighted, with options for modifications or adaptions identified as necessary.
- Take corrective action to overcome the shortcomings or omissions that are identified with the proposals.

- Determine the impact on Fire Engineering design solutions of factors such as construction, installation, commissioning, life-cycle implications, technical support, training of users and shifting user needs.
- In consultation with affected parties, evaluate the issues that affect them and how resolution of these issues will influence Fire Engineering design.

D. Judgement and responsibility

D.1 Comply with relevant Codes of Conduct:

- Comply with the ECSA Rules of professional conduct.
- Apply professional skill in the interests of the employer and client for whom you act in professional matters.
- Give evidence, express opinions or make statements in an objective manner based on adequate knowledge.
- Work constructively within all relevant legislation and regulatory frameworks, including social and employment legislation.

D.2 Exercise responsibilities in an ethical manner:

- Demonstrate where you have applied ethical principles as described in the Engineering Council Statement of Ethical Principles.
- Demonstrate where you have applied or upheld ethical principles as defined by your organisation or company in its company or brand values.

E. Independent learning

E.1 Carry out and record CPD necessary to maintain and enhance competence in own areas of practice:

- Undertake reviews of own development needs.
- Plan how to meet personal and organisational objectives.
- Carry out planned (and unplanned) CPD activities.
- Maintain evidence of competence development.
- Evaluate CPD outcomes against any plans made.

- Assist others with their CPD.

E.2 Undertake sufficient professional development activities to maintain and extend his or her competence:

- Enrol in regular short courses and conduct reading on Fire Engineering.
- Coach Candidate Fire Engineers.
- Participate in research and/or SANS Fire Standards work groups.
- Network internationally to find Fire Safety Solutions relevant to South Africa in terms of water scarcity and an emerging economy.

7.3 Industry-related statutory and other requirements

Candidates are expected to have a working knowledge of the following regulations, Acts and standards and how they affect their working environment:

- OHS Act – Occupation Health and Safety Act (No. 85 of 1993), as amended by Act No. 181 of 1993
- Environment Conservation Act (No. 73 of 1989) as amended by Act No. 52 of 1994 and Act No. 50 of 2003
- Building Regulations – National Building Regulations and Building Standards Act (No. 103 of 1977) as amended by Act No. 49 of 1995
- Industry-specific work instructions, including manufacturer instructions applicable to specific fire equipment types
- FM Global data sheets
- SANS and other international standards such as ISO, EN, DIN or NFPA (refer to **Appendix B)**.

Many Acts not listed here may also be pertinent to the work environment of a Candidate FPSRD. The Candidate FPSRD is expected to have a basic knowledge of the applicable Acts and to investigate whether any Acts are applicable to a particular work environment.

8. PROGRAMME STRUCTURE AND SEQUENCING

8.1 Best practice

There is no ideal training programme structure or unique sequencing that constitutes best practice.

The training programme for each Candidate FPSRD will depend on the work opportunities available at the time for the employer to assign to the candidate.

It is suggested that Candidate FPSRDs work with their Mentors to select appropriate equipment types in order to gain exposure and eventually to select and understand the design, installation, commissioning, maintenance and/or inspection of the selected fire protection system(s).

The training programme should be such that the Candidate FPSRD progresses through the levels of work capability described in document **R-04-T&M-GUIDE-SC** so that by the end of the training period, the Candidate FPSRD can perform individually and as a team member, meeting the discipline-specific requirements (and the engineering outcomes for Alternative Route applicants) at the level required for registration and exhibiting the Degree of Responsibility E.

The nature of work and the Degrees of Responsibility defined in document **R-04-T&M-GUIDE-SC** are indicated below in Table 3 and in **Appendix C**.

Table 3: Degrees of Responsibility

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

The Mentor and the Candidate FPSRD must identify the level of responsibility at which an activity is compliant with and demonstrates the various Requirements and if applicable, the outcomes. Evidence of the Candidate's activities is recorded on the appropriate system such that it meets the Requirements and, if applicable, the Training Elements indicated in **Appendix C**. The ECSA will specify the applicable recording system in the Application for Registration form (usually a Subdiscipline-Specific Requirement Report and for Alternative Route applicants, an Engineering Report, with the associated calculations, sketches, installation schedules, maintenance schedules, commission results, etc. for each selection that is applied for).

8.2 Realities

Generally, irrespective of the system type(s), it is unlikely that the period of training will be three years, the minimum time required by the ECSA. Typically, it will be longer and will be determined by the availability of functions in the actual work situation amongst other concerns.

Each candidate will effectively undertake a unique programme in which the various activities carried out at the discipline-specific level are linked to the generic competency requirements indicated in documents **R-08-PE/PT** and the **Compulsory Subdiscipline-Specific Requirements** that are to be met during the Candidacy.

8.3 Consideration for generalists, specialists, researchers and academics

The ECSA documents **R-08-PE/PT** adequately describe what would be expected of persons whose formative development has not followed a conventional path, for example, academics, researchers, specialists and those who have not followed a candidate-training programme.

The overriding consideration is that irrespective of the route followed, the applicant must provide evidence of competence against the **Subdiscipline-Specific Requirements** and in the case of Alternative Route applicants, against the **Standard**.

8.4 Moving into or changing the Candidacy programme

This guide assumes that the Candidate FPSRD enters a programme after ECSA Professional Registration or after completion of foreign educational requirements that are recognised to be equivalent for registration. The latter are Candidates who are not registered with the ECSA as a Professional Engineer or a Professional Engineering Technologist but who are continuing with the programme until ready to submit an application for registration. The guide also assumes that the Candidate FPSRD is supervised and mentored by persons who meet the requirements in document **R-04-T&M-GUIDE-SC**. In the case of a person changing from one candidacy programme to another or moving into a candidacy programme from a less structured environment, it is essential that the following steps are completed:

- The Alternative Route Candidate FPSRD must complete the Training and Experience Summary (TES) and the Training and Experience Reports (TERs) 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 development of the Candidate FPSRD in view of past experience and the opportunities and requirements of the new programme and plan at least the next phase of the Candidate's programme.
- The Candidate FPSRD must complete the Subdiscipline-Specific Requirements Report (SDSRR-FPSRD) on elements already covered during the first part of the Candidacy.

8.5 Compulsory Subdiscipline-Specific Requirements to be met during the Candidacy

There is a critical need in the industry to identify people who are able to conduct the essential operations associated with the efficient and safe design, installation, commissioning, maintenance and inspection of fire protection systems. Fulfilling this need will lead to competence in the field of work and thereby add value to the industry and improve the economy of the country. It will also lead to a balanced society in which learners will understand how the work they do fits into the greater engineering industry.

During Candidacy, **all Candidates**, assisted by Mentors and Supervisors, must ensure that they are conversant with the practical knowledge set out in form **SDSRR-FPSRD** (part of the Application for Registration form) and described in **Section 7** above, and submit evidence as such in the form of a Sub discipline-Specific Requirements Report (**SDSRR-FDSRD**).

During Candidacy, **Alternative Route Candidates** (refer to second paragraph in **Section 2: Audience**) must ensure that they are conversant with the practical knowledge set out in form **ER-SC** (part of the Application for Registration form) and submit evidence as such in the form of an Engineering Report (**ER-SC**).

REVISION HISTORY

Revision Number	Revision Date	Revision Details	Approved By
Draft A	12 May 2019	Initial attempt at FPSRD DSTG based on R-05-FPSP	Rational Design Working Group
Draft B	25 July 2019	For consideration and recommendation for broader consultation	RPSC
Draft C	29 November 2019	Consideration of comments by working group	Working Group
Revision 0	9 June 2020	Round robin approval	RPSC members
Revision 0	18 June 2020	Final Approval	RPSC
Revision 0	20 August 2020	Ratification	Council

The Sub Discipline-Specific Training Requirements for

Candidate Fire Protection System Practitioners

Revision 0 dated 20 August 2020 and consisting of 62 pages is developed for adequacy by the Business Unit Manager and is approved by the Executive: Research, Policy and Standards (RPS).

.... 21/08/2020

Business Unit Manager — Date

.... 24/08/2020

Executive: RPS — Date

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

Appendix A: Engineering problems

Complex engineering activities are characterised by several or all of the following:	
a)	Require in-depth, fundamental and specialised engineering knowledge
b)	Are ill-posed or under- or over-specified, requiring identification and refinement
c)	Are high-level problems and include component parts or sub-problems
d)	Are unfamiliar or involve infrequently encountered issues
e)	Are not obvious and require originality or analysis based on fundamentals
f)	Are outside the scope of standards and codes
g)	Require information that is complex, abstract or incomplete from a variety of sources
h)	Involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties
i)	Require judgement in decision-making in uncertain contexts
j)	Have significant consequences in a range of contexts

Broadly defined engineering activities are characterised by several or all of the following:	
a)	Require coherent and detailed engineering knowledge underpinning the technology area
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 that are solved in well-accepted but innovative ways
e)	Can be solved by structured analysis techniques
f)	May be partially outside standards and codes; justification must be provided to operate outside
g)	Require information from the practice area and source interfacing with the practice area that is incomplete
h)	Involve a variety of issues that may impose conflicting needs and constraints; technical, engineering and interested or affected parties
i)	Require judgement in decision-making in the practice area, considering interfaces with other areas
j)	Have significant consequences that are important in the practice area but may extend more widely

Appendix B: TYPES RECOGNISED FOR REGISTRATION AS A FIRE PTROTECTION SYSTEM RATIONAL DESIGNER

SPECIFIC FIRE PROTECTION SYSTEM TYPES RECOGNISED FOR REGISTRATION AS A FIRE PTROTECTION SYSTEM RATIONAL DESIGNER (EQUIVALENT STANDARD / CODE OF PRACTICE ALSO APPLICABLE)		
No.	**Description of Equipment Type**	**Applicable Standard**
1.	Fire alarm and detection	SANS 10139:2012 Fire detection and alarm systems for buildings – System design, installation and servicing. SANS 50054:2009 and EN 54:1996 Fire detection and fire alarm systems. NFPA 72 Fire detection systems
2.	Passive fire protection	BS 576: Parts 20 to 24 – Resistance to fire. The ability of a product to prevent the spread of flame and/or smoke and where relevant, to maintain mechanical stability. Resistance to fire tests to assess the ability of a product to perform in a particular manner when used in specific circumstances. BS 5950: Part 8 – Fire safety engineered design solutions. SANS 10400: Parts T and W – Fire Protection and Fire Installation respectively.
3.	Aerosol fire extinguishing	SANS 15779:2012 and ISO 15779:2011 – Condensed aerosol fire extinguishing systems. Requirements and test methods for components and system design, installation and maintenance. SANS 331 – Fire Extinguishing Aerosol Systems.
4.	Water sprinkler	SANS 10287 Automatic sprinkler installations for fire-fighting purposes. NFPA 13 Sprinkler systems. NFPA 15 Deluge systems. BS12845.
5.	Powder fire extinguishing	SANS 7202:2012 and ISO 7202:2012 Fire protection – Fire extinguishing media – Powder
6.	Foam fire extinguishing	SANS 7203:2013 and ISO 7203:2011 Fire extinguishing media – Foam concentrates. NFPA 11 Standard for low, medium and high expansion foam. NFPA 16.
7.	Electrical smoke control	EN 54-20 Class A, B and C. NFPA 72 National Fire Alarm and Signaling Code.

8.	Mechanical smoke control	EN 54-20 Class A, B and C. NFPA 72 National Fire Alarm and Signaling Code.
9.	Mechanical fixed gaseous fire extinguishing	SANS 14520 and ISO 14520 Gaseous fire extinguishing systems. SANS 369-2:2004 Code of Practice – Mechanical actuation of gaseous total flooding and local application extinguishing systems. SANS 306-4 Specification for carbon dioxide systems.
10.	Electrical fixed gaseous fire extinguishing	SANS 14520 and ISO 14520 Gaseous fire extinguishing systems. SANS 369-1:2004 Code of Practice: Electrical actuation of gaseous total flooding extinguishing systems. SANS 306-4 Specification for carbon dioxide systems.

The Application Forms for Registration are included here for convenience.

APPENDIX C: Form SDSRR-FPSRD

Subdiscipline-Specific Requirements Report for Fire Engineering Rational Designer (Fire Specialist) applicants registered with the ECSA in a Professional Category or eligible for registration

Surname and initials:

Use this form to report on the applicant's personal knowledge as a *Competent Person in Fire Engineering* about Rational Design as per SANS 10400-T using about 100 words per applicable Requirement. For each selection, attach to this report the actual applicable design calculations, sketches, etc. done by the applicant under the supervision of an ECSA-registered person.

REPORT RATIONAL DESIGNER		
1.	**Knowledge-based problem-solving**	
Item	Requirements	Report
1.1	Identifies potential projects and opportunities.	
1.2	Conducts appropriate research and undertakes design and development of engineering solutions.	
1.3	Manages part or all of one or more complex engineering activities. Communicates clearly with others during his/her engineering activities with fire technologies.	
1.4	Maintains and extends a sound theoretical approach in enabling the introduction of new and advanced technology and other relevant developments.	
1.5	Engages in the creative and innovative development of engineering technology and continuous improvement systems to design an optimised fire rational design that will perform equally well or better than pure code related rules.	
1.6	Fire Protection Analysis.	
1.7	Fire Protection Management.	
1.8	Fire Science and Human Behaviour.	
1.9	Active Fire Protection Systems.	
1.10	Passive Building Systems.	

2.	**Management and communication**	
Item	**Requirements**	**Report**
2.1	Plans for effective project implementation. Meets all legal and regulatory requirements and protects the health and safety of persons during his/her complex engineering activities.	
2.2	Plans, budgets, organises, directs and controls tasks, people and resources.	
2.3	Leads teams and develops staff to meet changing technical and managerial needs.	
2.4	Brings about continuous improvement through quality management.	
2.5	Demonstrates personal and social skills. Conducts engineering activities ethically.	
2.6	Communicates in English with others at all levels.	
2.7	Presents and discusses proposals.	
3.	**Identifying and mitigating the impacts of engineering activities**	
3.1	Undertakes engineering activities in a way that contributes to sustainable development. Exercises sound judgement during complex engineering activities.	
3.2	Manages and applies safe systems of work.	
3.3	Determine Advanced and Specialised Major Hazard Installation Fire Protection (industrial, liquid fuels, chemicals) for industrial fire safety registration only.	
3.4	Manages implementation of design solutions and evaluates their effectiveness	
4.	**Judgement and responsibility**	
4.1	Complies with relevant Codes of Conduct.	
4.2	Exercises responsibilities in an ethical manner.	
5.	**Independent learning**	
5.1	Carries out and records the Continuing Professional Development that is necessary to maintain and enhance competence in own areas of practice.	
5.2	Undertakes sufficient professional development activities to maintain and extend his/her competence.	

Signature of Applicant: ______________________________ Date:

Signature of Mentor/Supervisor: _______________________________

Name of Mentor/Supervisor (Print): Tel. No.:

APPENDIX D: Form ER-SCFPSRD Rational Design: Alternative Route

ENGINEERING REPORT

Name of Applicant:

Use this form to report on a recent engineering task, part of a project or complete project to which the applicant has made a significant contribution. Use approximately 100 words per competency indicator (criterion) under Outcomes 1 to 11 below. The report may cover conceptualisation, design and analysis, specification, tendering and adjudication, manufacturing, project and construction management, commissioning, maintenance, measurement and testing or planning at a specifically defined level. In addition, provide a sample of relevant calculations, drawings, etc. as an addendum limited to two A4 pages.

Use Appendix B of the Discipline-Specific Training Guide document **R-05-FPSRD-SC** to assist in the interpretation of the criteria.

Brief description of work done (<30 words)	
Date of work done	

OUTCOMES AND COMPETENCY INDICATORS	
Outcome 1: Define, investigate and analyse complex / broadly defined / well-defined engineering problems encountered in the applicant's work	
1.1 State how the applicant understood the activity agreed upon with the client (or supervisor).	
1.2 Describe how the applicant analysed and clarified information, drawings, codes, procedures, etc.	
Outcome 2: Design, develop, plan or practise solutions to complex / broadly defined / well-defined engineering problems (tasks) encountered in the applicant's work	
2.1 Describe how the applicant developed and analysed alternative approaches to do the work. Impacts and sustainability checked (Calculations attached).	
2.2 State the final solution to perform the work, client or the applicant's supervisor in agreement.	
Outcome 3: Comprehend and apply knowledge embodied in established specific engineering practices and knowledge specific to the field in which the applicant practises	
3.1 State the high-level academic engineering standard procedures and systems that the applicant used to execute the work, and how	

high-level academic engineering theory was applied to understand and/or verify these procedures.	
3.2 Present the applicant's theoretical calculations and/or reasoning on why the application of this theory was considered correct. (Attach actual examples).	
Outcome 4: Manage part or all of one or more complex / broadly defined / well-defined engineering activities embodied in the applicant's work	
4.1 State how the applicant managed him or herself and the priorities, processes and resources in doing the work (e.g. present as a bar chart).	
4.2 Describe the applicant's role and contribution in the work team.	
Outcome 5: Communicate clearly with others in the course of the applicant's engineering activities (rational design engineering work)	
5.1 State how the applicant presented his/her point of view and compiled reports after completion of the work.	
5.2 State how the applicant compiled and issued instructions to subordinates working on the same task.	
Outcome 6: Recognise the reasonably foreseeable social, cultural, environmental and sustainability effects of the applicant's complex / broadly defined / well-defined / specifically defined engineering activities	
6.1 Describe the social, cultural and long-term sustainability and environmental impact of the engineering activity.	
6.2 State how the applicant communicated mitigating measures to affected parties and acquired stakeholder engagement.	
Outcome 7: Meet all legal and regulatory requirements, protect the health and safety of persons and adhere to sustainable practices in the course of the applicant's complex / broadly defined / well-defined engineering activities	
7.1 List the major laws and regulations, safety requirements, standards and sustainability practices applicable to this particular activity.	
7.2 State how the applicant demonstrated risk management, used safe and sustainable materials, components and systems and obtained advice where necessary.	
Outcome 8: Conduct engineering activities ethically in executing the applicant's work	
8.1 State how the applicant identified ethical issues in addition to the	

affected parties and their interests and what was done when a problem arose.	
8.2 Confirm that the applicant is conversant and in compliance with the ECSA Code of Conduct and why this is important in his/her work.	
Outcome 9: Exercise sound judgement in the course of complex / broadly defined / well-defined engineering activities encountered in the applicant's work	
9.1 State the factors applicable to the work and their interrelationships and state how the applicant applied the most important factors.	
9.2 Describe how the applicant foresaw work consequences and evaluated situations in the absence of full evidence.	
Outcome 10: Be responsible for making decisions on part or all of one or more complex / broadly defined / well-defined engineering activities included in the applicant's work	
10.1 Show how the applicant used high-level theoretical calculations to justify decisions taken in doing engineering work. (Attach actual calculations).	
10.2 State how the applicant took responsible advice on any matter falling outside his/her education and experience.	
10.3 Describe how the applicant took responsibility for his/her work and evaluated any shortcoming in his/her output.	
Outcome 11: Undertake sufficient independent learning activities to maintain and extend the applicant's competence	
11.1 State the strategy that the applicant independently adopted to enhance his/her development.	
11.2 State the philosophy of the applicant's employer regarding the applicant's development.	
Evidence of the applicant's competency development plan and independent learning ability must be given in the Initial Professional Development Report, Form IPD-SC.	

Signature of Applicant: ______________________________ **Date:**

Signature of Mentor/Supervisor: ______________________________

Name of Mentor/Supervisor (Print)__________________**Tel. No.:** ____

Appendix E: Training Elements

These Requirements are written for the recent graduate who has completed recognised foreign equivalent educational requirements for registration as either a Professional Engineer or a Professional Engineering Technologist but who is not registered with the Engineering Council of South Africa but is training and gaining experience towards registration (Alternative Route). Mature applicants for registration may apply these requirements retrospectively to identify possible gaps in their development.

Synopsis: A Candidate (Specified Category) Rational Designer (Fire Specialist) should achieve specific competencies at the prescribed level during his/her development towards registration and at the same time accept more and more responsibility as experience is gained. The outcomes achieved and established during the Candidacy phase should form the template for all engineering work performed after 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 approaches to the work and thereafter select the best and present to the recipient.
3. Apply theoretical knowledge to justify decisions taken and processes used.
4. Understand one's role in the work team and plan and schedule work accordingly.
5. Issue complete and clear instructions and report comprehensively on work completed.
6. Be sensitive to 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 the ECSA Code of Conduct.
9. Display sound judgement by considering all factors and their interrelationship, consequences and evaluation when all evidence is not available.
10. Accept responsibility for own work by using theory to support decisions, seeking advice when uncertain and evaluating shortcomings.
11. Become conversant with employer's training and development programme and develop own lifelong development programme within this framework.

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

Competency Standards for Registration as a Specified Category Rational Designer	Explanation and Responsibility Level
1. Purpose This standard defines the competence required for registration as a Specified Category Rational Designer. Definitions of terms having particular meaning within this standard are given in the text, at the beginning of the document.	Discipline-Specific Training Guides (DSTGs) give context to the purpose of the Competency Standards. Registered Rational Designers operate within the nine disciplines recognised by the ECSA. Each discipline can be further divided into subdisciplines and finally into specific workplaces or competency areas. The DSTGs are used to facilitate experiential development towards ECSA registration and assist in compiling the required portfolio of evidence (specifically the Engineering Report in the application form). **Note:** The training period must be used to develop the competence of the trainee towards achieving the standards presented below at the responsibility level indicated (mainly Level E: Performing). (Refer to Table 4 in document **R-04-SC**).
2. Demonstration of Competence Competence must be demonstrated within *complex / broadly defined / well-defined* ***engineering problems*** by integrated performance of the outcomes defined in Section 3 below at the level defined for each outcome. Required contexts and functions may be specified in the applicable Subdiscipline-Specific Training Requirements.	Engineering activities can be approximately divided into the following: 5% Complex (Professional Engineers) 5% Broadly defined (Professional Engineering Technologists) 10% Well-defined (Professional Engineering Technicians) 15% Specifically defined (Registered Specified Categories including Rational Designers) 20% Skilled Workman (Engineering Artisan) 45% Unskilled Workman (Artisan Assistants) The activities can be in-house or contracted out; evidence of integrated performance can be submitted irrespective of the situation.
Activities include planning; investigation and problem resolution; improvement of materials, components, systems or processes, engineering operations, maintenance, project management, development and commercialisation.	For Candidate Rational Designers (Fire Specialists), research, development and commercialisation happen frequently in some work areas and are seldom encountered in others.

3. Outcomes to be satisfied	Explanation and Responsibility Level
Group A: Engineering Problem-Solving	
Outcome 1: Define, investigate and analyse *complex / broadly defined / well-defined* engineering problems (tasks).	**Responsibility Level E** Analysis of an engineering problem means the 'separation into parts possibly with comment and judgement'.
Competency Indicators: A structured analysis of specifically defined rational design problems typified by the following performances within the competency area is expected: 1.1 State how <u>you</u> interpreted the work instruction received, checking with your client or supervisor if your interpretation is correct 1.2 Describe how <u>you</u> analysed, obtained and evaluated further clarifying information and if the instruction was revised as a result.	To perform an engineering task, a Rational Designer (Fire Specialist) will typically receive an instruction from a senior person (customer) to do the task and must conduct the following: 1.1 Ensure that the instruction is complete, clear and within his/her capability and that the person who issued the instruction agrees with his/her interpretation. 1.2 Ensure that the instruction and information to do the work is fully understood and complete, including the engineering theory needed to understand the task and to carry out and/or check calculations and the acceptance criteria. If needed, supplementary information must be gathered, studied and understood.
Range Statement: The problem (task) may be part of a larger engineering activity or may be stand-alone. The design problem is amenable to solution by specific techniques practised regularly. This outcome is concerned with the understanding of a problem: Outcome 2 is concerned with the solution.	**Please refer to section 6 to 9 of the Subdiscipline-Specific Training Requirements document above.**
Outcome 2: Design or develop (plan) sustainable solutions to *complex / broadly defined / well-defined* engineering problems (tasks).	**Responsibility Level C** Design means 'drawing or outline from which something can be made'. Develop means 'come or bring into a state in which it is active or visible'.
Competency Indicators: This outcome is normally demonstrated after a problem analysis, as defined in Outcome 1. Working systematically to synthesise a solution to a *complex / broadly defined / well-defined* problem typified by the following performances is expected: 2.1 Describe how <u>you</u> designed or developed and analysed alternative approaches to do the work. (Impacts and sustainability checked. Calculations attached). 2.2 State your final solution to perform the work, client or supervisor in agreement.	The task given must be fully understood and interpreted and solutions developed (designed) to execute. Synthesis of a solution means 'the combination of separate parts, elements, substances, etc. into a whole or into a system' by the following: 2.1 More than one way to conduct an engineering task or to solve a problem should always be developed (designed), and a costing and impact assessment for each alternative must be included. All the alternatives must meet the requirements set out by the instruction received, and the theoretical calculations to support each alternative must be done and submitted as an attachment. The alternatives must be within the imposed legal boundaries. 2.2 In some cases, the Candidate Rational Designer (Fire Specialist) will not be able to support proposals with the complete theoretical calculation to substantiate every aspect and in these cases, he/she must refer his/her alternatives to a Professional for scrutiny and support. The alternatives and the recommended alternative must be convincingly detailed to win customer support for the alternative that is recommended. Selection of alternatives may be based on tenders submitted, with the summited alternatives deviating from those specified.

Range Statement: The solution conforms to specific established methods, techniques or procedures within the *complex / broadly defined / well-defined* competency area. Engineering should not only look to decrease impacts but also to restore and regenerate through design.	Applying theory to *complex / broadly defined/ well-defined engineering* work is done in a way that has been used before, probably developed by experienced Professionals in the past and documented in written procedures, specifications, drawings, models, examples, etc. Candidate Rational Designers (Fire Specialists) must seek approval and engineering verification for any deviation from these established methods.
Outcome 3: Comprehend and apply knowledge embodied in established specific engineering practices and knowledge specific to the field in which he/she practises.	**Responsibility Level E** Comprehend means 'to understand fully'. The jurisdiction in which a Specified Category Rational Designer (Fire Specialist) practises is given in **section 6 to 9** of the applicable **Subdiscipline-Specific Training Guide DSTG** above**.**
Competency Indicators: This outcome is normally demonstrated in the course of the design, investigation or operations confined to the competency area. 3.1 State which high-level engineering standard procedures and systems <u>you</u> used to execute the work and how high-level theory was applied to understand and/or verify these procedures. 3.2 Give <u>your</u> theoretical calculations and/or reasoning on why the application of this theory is considered correct (Actual examples).	Design (development) work for Candidate Rational Designers (Fire Specialists) is mainly to utilise, configure, certify, test, verify, etc. manufactured components or proven engineering or management systems, and to design (develop) work using an existing design (development) as an example. Candidate Rational Designers (Fire Specialists) apply existing codes, policies and procedures in their design (developmental) work. Investigations are on specifically defined incidents, and condition monitoring and operations are mainly on controlling, maintaining and improving engineering systems and operations. 3.1 The understanding of specifically defined procedures and techniques must be based on fundamental mathematical, scientific and engineering knowledge. Specific procedures and techniques applied to do the work accompanied by the underpinning theory must be given. 3.2 Calculations confirming the correct application and utilisation of equipment and/or systems listed in the Subdiscipline-Specific Training Guide above must be done on practical *complex / broadly-defined/ well-defined* activities. Reference must be made to standards and procedures used and how they were derived from theory.
Range Statement: Applicable knowledge includes the following: (a) Technical knowledge that is applicable to the practice area irrespective of location and supplemented by locally relevant knowledge, for example, established properties of local materials. (b) A working knowledge of interacting disciplines confined to the competency area. Codified knowledge in related areas such as finance, statutory, safety, management and sustainability. (c) Jurisdictional knowledge includes legal and regulatory requirements together with prescribed codes of practice.	(a) The specific location of the task to be executed is the most important determining factor in the layout, design and utilisation of equipment and/or systems. A combination of educational knowledge and practical experience must be used to substantiate decisions taken, including a comprehensive study of the laws, policies, procedures, standards, environment, manpower, materials, components and projected customer requirements and expectations. (b) Despite having a working knowledge of interacting disciplines, Candidate Rational Designers (Fire Specialists) must appreciate the importance of working with specialists such as Civil Engineers on structures and roads, Mechanical Engineers on fire protection equipment, Architects on buildings and Electrical Engineers on communication equipment. The codified knowledge in the related areas means understanding and working to the requirements set out by specialists in areas such as those mentioned. (c) Jurisdictional in this instance means 'having the authority', and Candidate Rational Designers (Fire Specialists) must adhere to the terms and conditions associated with each task undertaken. They may even be appointed as the 'responsible person' for specific duties in terms of the OHS Act.

Outcome 4: Manage part or all of one or more *complex / broadly defined / well-defined* engineering activities.	**Responsibility Level E** Manage means 'control'.
Competency Indicators: The display of personal and work process management abilities within the competency area is expected: 4.1 State how <u>you</u> managed yourself, priorities, processes and resources in doing the work (e.g. bar chart) 4.2 Describe <u>your</u> role and contribution in the work team.	In engineering operations and projects, Candidate Rational Designers (Fire Specialists) will typically be given the responsibility to carry out specific tasks and/or complete projects. 4.1 Resources are usually subdivided based on availability and are controlled by a work breakdown structure and scheduling to meet deadlines. Quality, safety and environmental management are important aspects. 4.2 Depending on the task, the Candidate Rational Designer (Fire Specialist) can be the manager, team leader or a team member and can supervise appointed contractors.
Outcome 5: Communicate clearly with others in the course of his/her *complex / broadly defined / well-defined* engineering activities.	**Responsibility Level E**
Competency Indicators: Demonstrates effective communication by the following: 5.1 State how <u>you</u> presented your point of view and compiled reports after completion of the work. 5.2 State how <u>you</u> compiled and issued instructions to entities working on the same task.	5.1 Refer to Range Statement for outcomes 4 and 5. Presentation of point of view mostly occurs in meetings and discussions with the immediate supervisor. 5.2 Refer to Range Statement for outcomes 4 and 5.
Range Statement for outcomes 4 and 5: Management and communication in *complex / broadly defined / well-defined engineering* involves the following: (a) Planning activities (b) Organising activities (c) Leading activities (d) Implementing activities (e) Controlling activities Communication relates to technical aspects and wider impacts of professional work. Audiences include peers, other disciplines, clients and stakeholders. Appropriate modes of communication must be selected. The Specified Category Practitioner is expected to perform the communication functions confined to the competency area reliably and repeatedly.	(a) Planning means 'the arrangement for doing or using something, considered in advance'. (b) Organising means 'put into working order; arrange in a system; make preparations for'. (c) Leading means to 'guide the actions and opinions of; influence; persuade'. (d) Implementing means to 'carry an undertaking, agreement or promise into effect'. (e) Controlling means the 'means of regulating, restraining, keeping in order; check'. Candidate Rational Designers (Fire Specialists) participate in writing or adhere to specifications for the purchase of materials and/or work to be done, make recommendations on tenders received, place orders and variation orders, write work instructions, report back on work done, draw, correct and revise drawings, compile test reports, use operation and maintenance manuals to write or apply work procedures, write inspection and audit reports, write commissioning reports, prepare and present motivations for new projects, compile budgets, 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, report on environmental impact and sustainability, etc.

Group C: Risk and Impact Mitigation	Explanation and Responsibility Level
Outcome 6: Recognise the reasonably foreseeable social, cultural, environmental and sustainability effects of *complex / broadly defined / well-defined* engineering activities.	**Responsibility Level D** 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". Sustainable is defined in the definitions below.
Competency Indicators: This outcome is normally displayed in the course of analysis and the solution of problems within the competency area: 6.1 Describe the social, cultural, environmental impact and long-term sustainability of the engineering activity 6.2 State how <u>you</u> communicated mitigating measures to affected parties and acquired stakeholder engagement.	6.1 Engineering significantly affects the environment (e.g. servitudes, expropriation of land, excavation of trenches with associated inconvenience, borrow pits, dust and obstruction, street and other crossings, power dips and interruptions, visual and noise pollution, malfunctions, oil and other leaks, electrocution of human beings, detrimental effect on animals and wild life, dangerous rotating and other machines and demolishing of structures). 6.2 Mitigating measures taken may include environmental impact studies, environmental impact management, community involvement and communication, barricading and warning signs, temporary crossings, alternative supplies (ring feeders and bypass roads), press releases and compensation paid.
Outcome 7: Meet all legal and regulatory requirements, protect the health and safety of persons and adhere to sustainable practices in the course of his/her *complex / broadly defined / well-defined* engineering activities.	**Responsibility Level E**
Competency Indicators: 7.1 List the major laws and regulations applicable to this particular activity and how sustainability practices and health and safety matters were handled. 7.2 State how <u>you</u> obtained advice regarding risk management for the work and elaborate on the risk management system applied.	7.1 The OHS Act is supplemented by a variety of parliamentary Acts, regulations, local authority by-laws, standards and codes of practice. Places of work may have standard procedures, instructions, drawings and operation and maintenance manuals available. Depending on the situation (emergency, breakdown, etc.), these documents are consulted before work is commenced and during the activity. 7.2 It is advisable to attend a Risk Management (Assessment) course and to investigate and study the materials, components and systems used in the workplace. The Candidate Rational Designer (Fire Specialist) seeks advice from knowledgeable and experienced specialists if any doubt exist that safety and sustainability cannot be guaranteed.
Range Statement for outcomes 6 and 7: Impacts and regulatory requirements include the following: (a) Impacts to be considered are generally those identified within the established methods, techniques or procedures used in the specific practice area.	(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 the impact of construction in a rural area.) The methods, techniques and procedures will differ accordingly and are identified and studied by the Candidate Rational Designer (Fire Specialist) before starting the work.

(b) Regulatory requirements are prescribed. (c) Apply prescribed risk management strategies. (d) Effects to be considered and methods used are defined. (e) Prescribed safe and sustainable materials, components and systems. (f) Prescribe maintenance protocols. (g) Persons whose health and safety are to be protected are both inside and outside the workplace.	(b) The Safety Officer and/or the Responsible Person appointed in accordance with the OHS Act usually confirms or checks that the instructions are in line with regulations. The Candidate Rational Designer (Fire Specialist) is responsible to make certain that this is done and if not, to establish which regulations apply and ensure that they are observed. Usually, the people working on site are strictly controlled w.r.t. health and safety, but the Candidate Rational Designer (Fire Specialist) checks that this is done. Tasks and projects are mainly carried out where contact with the public cannot be avoided, and safety measures such as barricading and warning signs must be used and maintained. (c) Risks are mostly associated with elevated structures, subsidence of soil, electrocution of human beings, moving parts on machinery, fraud and corruption, and theft. Risk-management strategies are usually designed by more senior staff but are understood and applied by the Candidate Rational Designer (Fire Specialist). (d) Effects associated with risk management are mostly well known if not obvious, and the methods used to address, these effects are clearly defined. (e) Usually, the safe and sustainable materials, components and systems are prescribed by Registered Professionals or other specialists. It is the responsibility of the Candidate Rational Designer (Fire Specialist) to use his/her knowledge and experience to check and interpret what is prescribed and to report anything with which he/she is not satisfied. (f) Draw up maintenance systems and procedures from the Codes of Practice and the Manufacturer's Instructions. (g) Staff working on the task or project and persons affected by the engineering work being carried out.
Group D: Act ethically, Exercise judgement and Take responsibility and	**Explanation and Responsibility Level**
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'.
Competency Indicators: Sensitivity to ethical issues and the adoption of a systematic approach to resolving these issues is expected: 8.1 State how <u>you</u> identified ethical issues and affected parties and their interests and indicate the actions <u>you</u> took when a problem arose. 8.2 Confirm that <u>you</u> are conversant and in compliance with the ECSA Code of Conduct and why this is important in your work.	Systematic means 'methodical; based on a system'. 8.1 Ethical problems that can occur include tender fraud, payment bribery, alcohol abuse, sexual harassment, absenteeism, favouritism, defamation, fraudulent overtime claims, fraudulent expenses claimed, fraudulent qualifications and misrepresentation of facts. 8.2 The ECSA Code of Conduct as per the ECSA website is known and observed. Give applicable examples.
Outcome 9: Exercise sound judgement in the course of *complex / broadly defined / well-defined* engineering activities.	**Responsibility Level E** Judgement means 'good sense: ability to judge'.

Competency Indicators: Exhibition of judgement is expected by the following**:** 9.1 State the factors applicable to the work, their interrelationship and how <u>you</u> applied the most important factors. 9.2 Describe how <u>you</u> foresaw work consequences and evaluated situations in the absence of full evidence.	9.1 The extent of a project or task given to a Candidate Rational Designer (Fire Specialist) is characterised by the number of factors and their resulting interdependence. The Candidate Rational Designer (Fire Specialist) will seek advice if educational and/or experiential limitations are exceeded. Examples of the main engineering factors that were applied must be given. 9.2 Taking risky decisions will lead to equipment failure, excessive installation and maintenance costs, damage to persons and property, bankruptcy, poor service delivery, etc. Give examples.
Range Statement for outcomes 8 and 9: Judgement is expected both within the application of the candidate's category, specific methods and techniques and specific procedures and in assessing their immediate impacts. Judgement in decision-making involves (a) taking limited risk factors into account, some of which may be ill-defined; **or** (b) taking consequences in the immediate work contexts into account; **or** (c) taking the identified set of interested and affected parties with defined needs into account.	In engineering, about 15% of the activities can be classified as *specifically defined.* In such activities, the Candidate Rational Designer (Fire Specialist) uses standard procedures, codes of practice, specifications, etc. Judgement must be displayed to identify any activity falling outside the range of the Rational Designer (Fire Specialists) as defined above: (a) Seeking advice when risk factors exceed his/her capability. (b) Consequences outside the immediate work contexts (e.g. long-term) not normally handled. (c) Interested and affected parties with defined needs outside the parameters of the Candidate Rational Designer (Fire Specialist) to be taken into account.

Outcome 10: Be responsible for making decisions on part or all of one or more *complex / broadly defined / well-defined* engineering activities.	**Responsibility Level E** Responsible means 'legally or morally liable for carrying out a duty; for the care of something or somebody in a position where one may be blamed for loss, failure, etc.'
Competency Indicators: Responsibility is displayed by the following performance: 10.1 Show how <u>you</u> used high-level theoretical calculations to justify decisions taken in doing engineering work. (Attach actual calculations). 10.2 State how <u>you</u> sought responsible advice on any matter falling outside your own education and experience. 10.3 Describe how <u>you</u> took responsibility for your own work and evaluated any shortcomings in <u>your</u> output	10.1 The calculations, for example, fault levels, load calculations, losses, and return on investment are done to ensure that the correct material and components are used 10.2 The Candidate Rational Designer (Fire Specialist) does not operate on tasks outside the Rational Designer (Fire Specialists) range and consults professionals if elements of the tasks to be done are beyond his/her education and experience (e.g. power system stability, legal actions). 10.3 This is, in the first instance, continuous self-evaluation is to ascertain that the task given is done correctly, on time and within budget. Continuous feedback to the originator of the task instruction and corrective action if necessary forms an important element.

Range Statement: Responsibility must be discharged for significant parts of one or more *complex / broadly defined/ well-defined* engineering activities.	The responsibility is mostly allocated within a team environment, with increasing designation as experience is gathered.
Note 1: Responsibility for the evaluation of work in a supervisory capacity	

Group E: Initial Professional Development (IPD)	Explanation and Responsibility Level
Outcome 11: Undertake sufficient independent learning activities to maintain and extend competence.	**Responsibility Level D**
Competency Indicators: Self-development typically managed by the following: 11.1 Provide the strategy that <u>you</u> adopted independently to enhance the professional development (IPD report). 11.2 Be aware of the philosophy of the employer regarding professional development.	11.1 If possible, a specific field of the subdiscipline is chosen, available developmental alternatives are established, a programme is drawn up (in consultation with employer if costs are involved), and available options are investigated to expand knowledge into additional fields. 11.2 Record keeping must not be left to the employer or to any other person. The trainee must manage his/her own training independently, taking initiative and being in charge of experiential development towards Rational Designer (Fire Specialist) registration. Knowledge of the employer's policy and procedures on training is essential.
Range Statement: Professional development involves the following: (a) Taking ownership of own professional development. (b) Planning own professional development strategy. (c) Selecting appropriate professional development activities. (d) Recording professional development strategy and activities while displaying independent learning ability.	(a) This is <u>your</u> professional development, not that of the organisation for which you are working. (b) In most places of work, training is seldom organised by a training department. It is the responsibility of the Candidate Rational Designer (Fire Specialist) to manage his/her own experiential development. Candidate Rational Designers (Fire Specialists) frequently find themselves at a standstill and are left doing repetitive work. If self-development is not self-driven, success is unlikely. (c) Preference must be given to engineering development rather than developing soft skills. (d) Developing a learning culture in the workplace environment of Candidate Rational Designers (Fire Specialists) is vital to their success. Information is readily available, and most senior personnel in the workplace are willing to mentor if approached.

APPENDIX F: Academic and Experiential Competencies (Society of Fire Protection Engineers of the United States)

The objective is for a practitioner to gain a comprehensive understanding of the competencies that are considered core to the profession. A practitioner must understand fire protection principles and the application of these principles in the engineering analysis and design of fire safety measures. Only by understanding these core subjects will the professional achieve the minimum knowledge base that is considered necessary for the professional practice of fire protection engineering.

When practising fire protection engineering, it is considered extremely important to work within the scope of one's professional and technical competency, as is true in any engineering discipline. Understanding one's technical and professional limitations is an integral part of professional ethics related to the practice of engineering. Such ethical standards are in place to help ensure that professionals undertake and complete only the tasks that they are competent to perform.

A Fire Protection Engineer is often required to include and rely on the expertise and competency of other professionals (e.g. engineers in other disciplines, architects and scientists) as part of delivering a competent analysis / competent design (i.e. building design, infrastructure design or other). The other members of the team have a similar expectation of the Fire Protection Engineer. This shared expectation – that each team member is qualified and competent in his/her respective discipline – is fundamental to engineering a fire-safe world.

Table A1 shows a summary of the recommended minimum technical competencies and knowledge areas.

Table A1: Technical competencies

Minimum Competency	Fire Science	Human Behaviour and Evacuation	Fire Protection Systems	Fire Protection Analysis
Knowledge areas	-Heat transfer -Fire chemistry -Fire dynamics	-Human behaviour and physiological response to fire -Egress and life-safety design concepts	-Passive systems -Active systems -Fire detection and alarms -Fire suppression	-Performance-based design -Smoke management -Evacuation analysis -Structural fire protection -Risk management -Numerical methods and computer fire modelling -Building and fire regulations and standards

The minimum technical competencies are foundationally essential, but they will not generally translate to expertise in all the areas. Possession of expertise in all of the areas of minimum technical competency is not practical and probably not possible for an individual over the course of a professional life. The individual Fire Protection Engineer will develop expertise in particular areas of practice and may gain only a basic understanding of the other areas. It is understood that depending on the individual's current competence and specific area of expertise, individuals will concentrate on only some of these core competencies when developing their expertise.