ENSURING THE
EXPERTISE TO GROW
SOUTH AFRICA

Guideline for the Introduction of a New Engineering Discipline

ENGINEERING COUNCIL OF SOUTH AFRICA
Tel: 011 607 9500 | Fax: 011 622 9295
Email: engineer@ecsa.co.za | Website: www.ecsa.co.za

ECSA

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ABBREVIATIONS

CHE	Council on Higher Education
CPD	Continuous Professional Development
DHET	Department of Higher Education and Training
ECSA	Engineering Council of South Africa
EPA	Engineering Profession Act, 46 of 2000
IEA	International Engineering Alliance
IPD	Initial Professional Development
NQF	National Qualifications Framework
PQM	Programme Qualification Mix
SAQA	South African Qualification Authority
VA	Voluntary Association

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DEFINITIONS

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

Endorsement: The endorsement of a programme by ECSA is an indication that there is **potential**, in the fullness of time, for that programme to be successfully accredited by ECSA after fulfilling the CHE and SAQA requirements. Endorsement is a confirmation from ECSA to the CHE that a programme has the necessary elements to be considered an engineering programme.

Engineering discipline: A generally recognised major subdivision of engineering, such as the traditional disciplines of Chemical, Civil or Electrical Engineering.

Graduate Attribute: A statement of the learning outcomes that a student must demonstrate at the exit level to qualify for an award of a qualification; these actions indicate the student's capability to fulfil the educational objectives.

International Engineering Alliance: A global organisation comprising members from 41 jurisdictions within 29 countries across 7 international agreements. These international agreements govern the recognition of engineering educational qualifications and professional competence.

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

Qualification: The formal recognition of a specified learning achievement that is usually awarded upon successful completion of a programme.

Standard: In the educational context, see Qualification Standards in documents E-02-PE / E-02-PT / E-09-PT / E-05-PT / E-02-PN / E-06-PN/E / E-08-PN / E-21-PN and in the registration context, see document Competency Standard R-02-STA-PE/PT/PCE/PN.

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Engineering sub-discipline (an engineering specialty): A generally recognised practice area or major subdivision within an engineering discipline, for example, Structural and Geotechnical Engineering within Civil Engineering.

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1. BACKGROUND AND INTRODUCTION

Recent research undertaken by the Engineering Council of South Africa (ECSA) found these possible emerging disciplines based on a survey and international benchmarking: Biomedical Engineering, Biosystems Engineering, Control, Automation and Instrumentation, Energy Systems Engineering, Environmental Engineering, Nano Engineering and Maritime Engineering. Currently, ECSA has no policy or guidelines that stipulate rules for introducing any new engineering discipline or sub-discipline that could emerge from the academic or industrial training of engineers, engineering technologists or engineering technicians.

The research further stresses that introducing emerging disciplines should be applicable, appropriate and acceptable within South Africa. The study also identifies engineering faculties at institutions of higher learning as key role players for undertaking appropriate research into emerging disciplines to support ECSA by updating the trends in engineering disciplines and the relevant categories.

2. PURPOSE

The purpose of this guideline is to assist ECSA with the roadmap to be followed when introducing and accepting new engineering disciplines.

3. RATIONALE

In terms of section 13(d) of the Engineering Professional Act, 46 of 2000, the Council may consult with the South African Qualifications Authority (SAQA) established by the South African Qualifications Authority Act, 58 of 1995, or anybody established by it and the Voluntary Associations (VAs) to determine competency standards for registration. ECSA has currently approved 11 disciplines of registration, as listed in **Section 3.1** below. ECSA continues to receive proposals from the profession's interested and affected parties to consider and recognise certain emerging disciplines.

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3.1 Existing ECSA engineering disciplines

The engineering disciplines recognised by ECSA are as follows:

- Aeronautical
- Agricultural
- Chemical
- Civil
- Computer
- Electrical
- Industrial
- Mechanical
- Mechatronics
- Metallurgical
- Mining.

All the abovementioned engineering disciplines have sub-disciplines/multi-disciplines. The engineering discipline of practitioners is determined by their tertiary education qualification and the discipline under which ECSA registers them.

3.2 Identified need

The need for undertaking consolidated research into the emerging registration disciplines and categories was necessitated by the global socio-economic and technology trends and recent proposals submitted by various interested and affected parties within the engineering profession requesting specific engineering disciplines to be considered and recognised by ECSA.

ECSA has conducted research into emerging registration disciplines. If a new discipline is proposed to Council for adoption and approval, it must fulfil all the requirements presented in this guideline.

A database of existing registration categories and disciplines compared to other international engineering regulatory bodies under the three accords: Washington, Dublin and Sydney, as well

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as the emerging disciplines, is outlined in **Table 3**. The database was created in a format to allow future updates as and when required.

Introducing new disciplines should be applicable, appropriate and acceptable within the South African context. Engineering faculties at institutions of higher learning should be encouraged to undertake appropriate research into emerging disciplines and support ECSA by updating the trends in engineering disciplines.

3.3 The need to align ECSA with International Best Practice

Previous ECSA research has shown that due to changes in technology and the environment brought about by climate change, some international engineering bodies under the Washington, Sydney and Dublin Accords have now introduced several new engineering disciplines outside the traditionally known engineering disciplines. ECSA standards and guidelines need to be aligned with international standards for easy recognition of engineering qualifications and registrations of these.

4. PRE-REQUISITES FOR REGISTRATION OF NEW DISCIPLINE

The proposed **Figure 1**: Flow diagram on the acceptance of a new engineering discipline by ECSA is outlined below. For the new discipline to be considered, it should at least satisfy the following:

1. The institution of higher learning should have the Programme Qualification Mix (PQM) and its policy in place. A PQM is a list of approved learning programmes and qualifications that will be subsidised by the Department of Higher Education and Training (DHET). The quality section and senate of the institution usually handle the PQM.

2. Registration of private tertiary or higher education institutions lies with DHET for evaluation eligibility for endorsement. ECSA only evaluates programmes for endorsement from institutions that are registered with the DHET.

3. If the programme leads to professional registration, ECSA should be brought into the process for endorsement. The process of endorsement outlined in **E-PRO-END-001** should at least

address registration with the DHET, programme purpose, feasibility/viability, knowledge areas, graduate attribute, admission requirement, curriculum content, staff and infrastructure implications. *If not, the discipline should be rejected, and PQM may offer the programme as non-engineering.*

4. The Council on Higher Education (CHE) should advise the DHET and provide recommendations. The CHE can then institute its comprehensive evaluation against its qualification standards.

5. The DHET should provide authorisation. *If not, reject and close the process.*

6. The SAQA should then register the programme on National Qualification Framework (NQF). The complexity level and associated NQF level should be clearly defined for the applicable level descriptor and registration category.

7. The ECSA accreditation process can then follow once the programme is being offered; the programme should be subject to accreditation to evaluate if it has met prescribed standards.

8. Professional registration is subject to applicants satisfying the education requirement and the competency of the prescribed standards. ECSA then registers applicants as candidates post qualification and professionals when applicants satisfy registration requirements outlined in the policy on registration in professional categories **R-01-POL-PC**.

New engineering disciplines or sub-disciplines should only be implemented if academic programmes in institutions of higher learning support them. A summary of the consideration process for the creating a new discipline is outlined in **Table 1**: Summary of the consideration process for the creation of a proposed discipline below:

Table 1: Summary of the consideration process for the creation of a proposed discipline

Registration policy for new discipline as approved by council				
		Yes	**No**	**Comment**
1	Is PQM and policy in place?			

Registration policy for new discipline as approved by council				
		Yes	**No**	**Comment**
2	Is the institution registered with DHET?			
3	Is endorsement from ECSA in place?			
4	Did CHE advise or provide recommendations to the Department?			
5	Is DHET authorisation in place?			
6	Did SAQA register the programme on the NQF?			
7	Is ECSA accreditation in place to evaluate if it has met the prescribed standard?			
8	Is the programme leading to the candidate and professional registration?			
9	Concise explanation of why the proposed discipline is not accommodated in the professional registration disciplines already established.			

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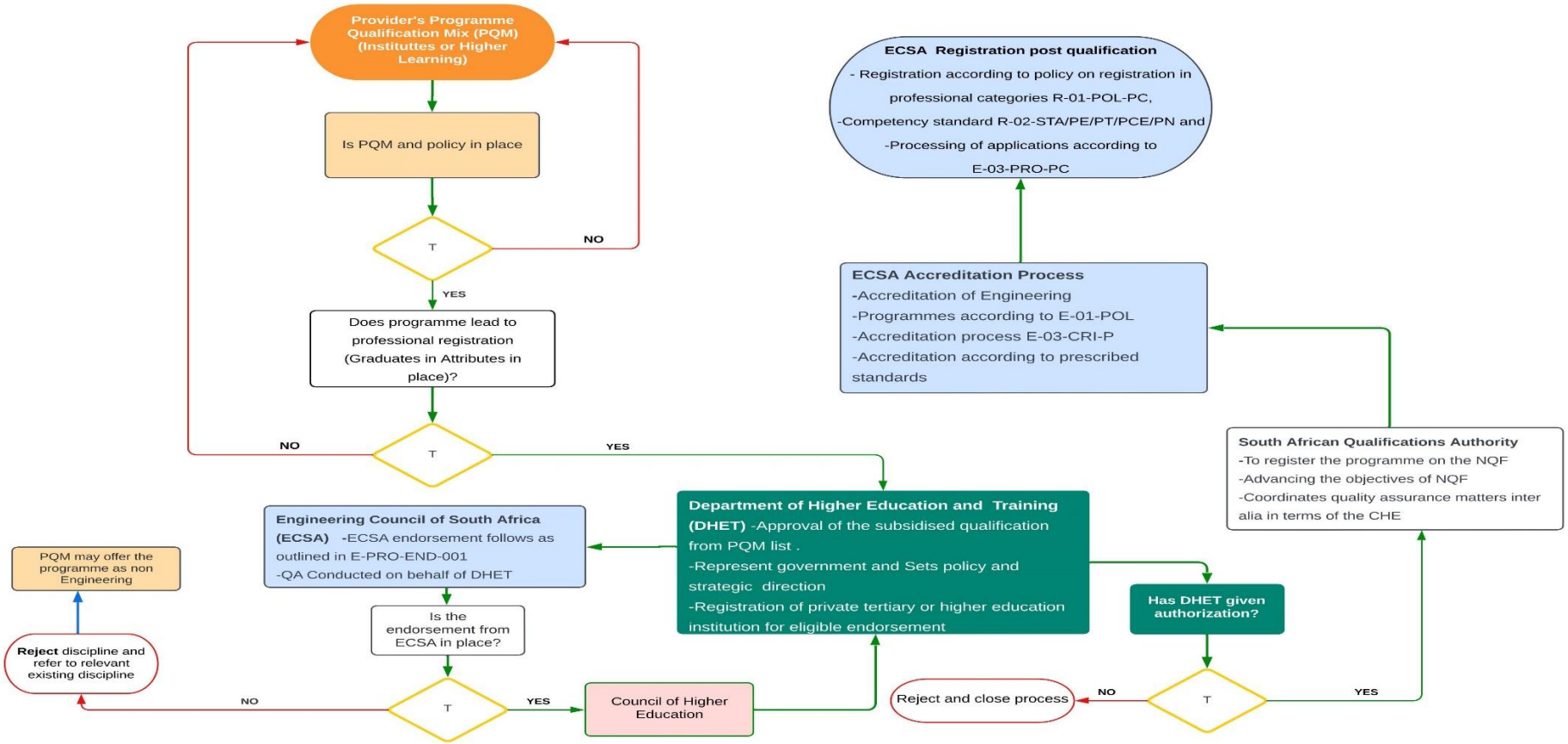

Figure 1: Flow diagram on the acceptance of a new engineering discipline by ECSA

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5. FURTHER CONSIDERATIONS FOR THE INTRODUCTION OF A NEW ENGINEERING DISCIPLINE

5.1 Feasible quantum required for endorsement of the new engineering discipline

An emerging discipline in this context is defined as a discipline appearing as a sub-discipline and/or overlapping sub-discipline (multi-discipline) (e.g., *Environmental Engineering in Civil & Chemical Engineering or Process Engineering in Chemical and Industrial Engineering*), which is recognised by international benchmarking as a standalone discipline. A base qualification and competency standards must be developed to support any proposed new discipline.

Should a proposed discipline meet the characteristics of an emerging discipline, a proposal for establishing a base qualification and competency standards is brought forward and recommended to ECSA for endorsement. Endorsement is a confirmation from ECSA to the CHE that the programme has the necessary elements to be considered an engineering programme and has basic engineering elements. The **E-03-CRI-P** criteria for Accreditation of Engineering Programme come into effect after the institution has received the endorsement for a programme. The institution should follow the process outlined in **E-PRO-END-001**, Process of Endorsement of Programmes, to be endorsed to offer the programme.

5.2 Feasible quantum required for registrations in various categories

Stakeholders to the proposed discipline must be engaged through a public participation process to which ECSA is a party. The feasibility of the proposed category must be linked to the registration cost of an applicant as incurred by the Registration Business Unit and auxiliary service.

The registration process for various categories, as described in **R-03-PRO-PC**, indicates the following process and the numbers of peers involved in the multiple steps:

In the initial stages, peers may handle an application more than once, which does not comply with **R-03-PRO-PC**. Therefore, until sufficient practitioners are registered within the category and trained by the Registration Business Unit, engineering professionals registered in other categories

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with the required in-depth understanding of the fundamentals and practices in the proposed category will be permitted to act.

Therefore, experienced registered assessors from a pool of assessors who are registered in other disciplines and various categories are identified to assist with building capacity for the new discipline. The overarching document **R-01-POL-PC**, *Policy on Registration in Professional Categories*, is very explicit in terms of the process of registration. To attain registration in a professional category, an applicant must demonstrate that they meet the category's educational requirements and demonstrate competent performance against the prescribed standards (**R-02-STA-PE/PT/PCE/PN**) for registration in the category.

5.3 Training and mentoring opportunities

Table 2 indicates the type of programme, the purpose of the programme that is the foundation for the area of practice and the applicable International Engineering Alliance (IEA) agreement. The relevant education standard is outlined in Section 7, Schedule 1: Standards applicable to programmes accredited by ECSA, **E-03-CRI-P**. New disciplines should also follow the same type of programmes to satisfy "Stage 1" of the education requirement for each applicable registration category.

Table 2: Constituent educational accords of International Engineering Alliance

Agreement	Purpose of programme is to provide the educational foundation for
Washington Accord	Engineering practice at the professional level
Sydney Accord	Engineering technologist practice
Dublin Accord	Engineering technician practice
No Accord	Specified category practice

The potential mentoring opportunities and work-integrated learning opportunities for candidates requires careful consideration. The pool of peers available to the Registration Business Unit will invariably be limited initially, with the prospect of expanding mentoring and work-integrated learning opportunities. Training and mentoring guide for professional categories **R-04-T&M-**

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Guide-PC, for mentoring together with the applicable discipline-specific training guide for candidates (**R-05-Series**) should be utilised.

5.4 Initial Professional Development and Continuing Professional Development

Initial Professional Development (IPD) and Continuing Professional Development (CPD) as per ECSA requirements and policies.

6. ECSA DATABASE AND INTERNATIONAL BENCHMARKING

Table 3: ECSA Database and International benchmarking

Disciplines	Sub-disciplines/multi-discipline
Aeronautical Engineering	Aeronautical Certification Engineering
	Aeronautical Design Engineering
	Aeronautical Flight Test Engineering
	Aeronautical Research Engineering
	Aeronautical Systems Engineering
	Aircraft Electronic Systems Engineer
	Propulsion System Engineer
Agricultural Engineering	Agricultural Energy Engineering
	Agricultural Product Processing Engineering
	Agricultural Renewable Energy Engineering
	Agricultural Structure and Facility Engineering
	Agricultural Waste Handling and Management
	Agri-Produce Process Engineering
	Aquaculture Engineering
	Hydrology and Agricultural Water-Use Management
	Irrigation Engineering
	Natural Resources Engineering (soil and water conservation)

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Chemical Engineering	Alternative Waste Treatment Engineering
	Biological Engineering
	Bioprocess Engineering
	Biomolecular Engineering
	Corrosion Engineering
	Energy Management Engineering
	Environmental Engineering
	Food Engineering
	Hydrometallurgical Engineering
	Materials Engineering
	Mineral Processing Engineering
	Oil and Gas Engineering
	Petrochemical Engineering
	Pharmaceutical Engineering
	Piping Engineering
	Plant Engineering
	Polymer Engineering
	Process Control Engineering
	Process Design Engineering
	Process Engineering
	Production Engineering
	Production Engineering
	Pulp & Paper Engineering
	Pyrometallurgical Engineering
	Sustainable Energy Engineering
Civil Engineering	Architectural Engineering
	Bridge Engineering

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	Construction Engineering
	Surveying Engineering
	Building Engineering
	Dam Engineering
	Environmental Engineering
	Forensic Engineering
	Geotechnical Engineering
	Geological Engineering
	Geomatics Engineering
	Glass Engineering
	Hydraulic Engineering
	Infrastructure Management Engineering
	Municipal Engineering
	Pavement Engineering
	Rural/Urban Infrastructure Engineering
	Solid Waste Engineering
	Structural Engineering
	Tailings Engineering
	Thatch Engineering
	Transportation Engineering
	Water Engineering
Computer Engineering	Automation and Control Engineering
	Automotive Engineering
	Back-end Software Engineering
	Computer Engineering (hardware and software)
	Computer Hardware Design Engineering
	Internet Engineering
	Computer System Design Engineering

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	Computer Vision Engineering
	Cyber Security engineering
	Data Engineering
	Data Security Engineering
	Wireless Engineering
	Fibre Optics Engineering
	Front-end Software Engineer
	Network Engineering
	Network Planning Engineering
	Network Security Engineer
	Network Security Engineering
	Web Security Engineering
Electrical Engineering	Bioinformatics Engineering
	Broadcast Engineering
	Clinical Engineering
	Communications Engineering
	Communications Engineering
	Continuous Improvement Engineering
	Control and Instrumentation Engineering
	Lighting Engineering
	Digital Signal Processing Engineering
	Electrical Design Engineering
	Electrical Drive Engineering
	Electrical Power Generation Engineering
	Energy Management Engineer
	Illumination Engineering
	Power Distribution Engineering
	Power Electronics Engineering

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	Power System Design Engineering
	Power Systems Engineering
	Power Systems Protection Engineering
	Power Transmission Engineering
	Renewable Energy Engineering
	Telecommunications Engineering
Industrial Engineering	Continuous Improvement Engineering
	Engineering Management
	Enterprise Resource Management Engineering
	Fabrication Engineering
	Food Engineering
	Industrial Efficiency Engineering
	Industrial Engineering
	Industrial Machinery Engineering
	Innovative Manufacturing Engineering
	Innovation Engineering
	Manufacturing Logistics Engineering
	Manufacturing Technology Engineering
	Operations Management Engineering
	Procurement Engineering
	Production Engineering
	Quality Assurance Engineer
	Quality Control and Assurance Engineering
	Quality Engineering
	Quality Management Engineering
	Reliability Engineering
	Risk engineering
	Safety Engineering

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	Sports Engineering
	Supply Chain Engineering
	Value Engineering
Mechanical Engineering	Diesel Engineering
	Fire Protection and Detection Engineering
	Fluid Mechanics Engineering
	Forensic Engineering
	Heating and Ventilation Engineering
	Hydraulic Engineering
	Machine Design and Development Engineering
	Machine Learning Engineering.
	Maintenance Management Engineer
	Marine Engineering
	Mechanisation Engineering
	Ocean Systems Engineering
	Offshore Engineering and Naval Architecture Engineering
	Photonics Engineering
	Piping Engineer
	Plant and Factory Engineer
	Plant and Factory Engineering
	Plant Engineering
	Power Generation Engineer (Mechanical Systems)
	Pressurised Vessels Engineering
	Robotics & Artificial Intelligence Engineering
	Robotics and Production Automation Engineering
	Rotating Equipment Plant Engineer
	Structural Steel Engineering

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	Thermodynamics Engineering
	Welding Engineering
	Wet Services Engineering
Mechatronics Engineering	Electromechanical Engineering
	Electronic Design Engineering
	Biomedical Engineering
	Electronic Engineering
	Electronic Warfare Engineer
	Electronics Engineering
	Embedded Systems Engineering
	Mechanisation Engineering
	Mechatronic Engineering
	Microelectronic Engineer.
	Microwave Engineering
	Electromechanical Engineering
	Instrumentation Engineering
	Integrated Circuit Design Engineering
	Mobile Radio Engineering
	Processing and Communications Systems Engineer
	Radar Engineering
	Radio and Telecommunications Engineering
	Radio Frequency Design Engineering
	Railway Signal Engineering
	Satellite Transmission Engineering
	Signalling and Communications Engineering
	Solutions Architect Engineering
	Specialist Telecommunications (ICT) Engineer

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	Systems Engineering
	Telecommunication Engineering
	Television Engineering
	Transportation Systems Engineer
Metallurgical Engineering	Glass Engineering
	Ceramic Engineering
	Process Metallurgical Engineering
	Corrosion Engineering
	Hydrometallurgical Engineering
	Materials Engineering
	Mineral Processing Engineering
	Petrochemical Engineering
	Physical Metallurgical Engineering
	Pyrometallurgical Engineering
	Foundry Engineering
	Method Engineering
	Sand Processing Engineering
	Powder Metallurgical Engineering
Mining Engineering	Rock Engineering and Strata Control
	Rock Engineering
	Mine Planning and Design Engineering
	Mineral Asset Valuation Engineering
Possible Emerging Disciplines	Biomedical Engineering
	Biosystems Engineering
	Control, Automation and Instrumentation
	Energy Systems Engineering
	Environmental and Water Engineering
	Marine Engineering

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	Maritime Engineering
	Nanoengineering
	Naval Architecture
	Railway Engineering

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	Revision Date	Revision Details	Approved By
Draft A	31 March 2023	A complete report from the Research Business Unit	EL Nxumalo
Draft B	04 April 2023	Customization to ECSA format and preparation for approval by RPSC	EL Nxumalo
Rev. 0	13 April 2023	Consideration and approval	RPSC
Rev. 0	02 June 2023	Consideration and approval	Council

Guideline for the introduction of a new engineering discipline

Revision 0, dated 13 April 2023, consisting of 24 pages was reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research, Policy and Standards **(RPS)**.

2023/06/19

Business Unit Manager — Date

2023/06/19

Executive: RPS — Date

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