SKILLS PROGRAMME DOCUMENT						
Skills Programme Title	**Hydrogen Fuel Cell System Practitioner**					
NQF Level	5	Credits	39	Duration in days	49	
Skills Programme ID	SP-230201					
Skills Programme Status	Approved			Start Date	End Date	
				07/02/2023	07/02/2028	
Last date for enrolment	07/02/2029		Last date for achievement		07/02/2032	

SKILLS PROGRAMME DETAILS

1.	**Title**	Hydrogen Fuel Cell System Practitioner
2.	**Sub Title**	Fuel Cell Engineer
3.	**NQF Level**	5
4.	**Duration**	49 days
5.	**Credits**	39 credits
6.	**Quality Assuring Body**	Quality Council for Trades and Occupations (QCTO)
7.	**Skills Programme Rationale**	South Africa is highly dependent on fossil fuels – mainly coal – for its electrical energy needs. Coal is a carbon intensive form of energy. Coal-fired power stations contribute innumerable tons of CO_2 to the atmosphere. In more recent times, a lot of effort, time and money has been put into exploiting South Africa's abundant energy sources, especially the sun and wind. Harnessing and exploiting renewable energy also stems from two very important factors. Firstly, the possibility of decreasing dependence on coal-fired power stations and thereby reducing the concomitant degradation of the environment and, secondly, the recurrent energy generation problems being experienced nationally. The rationale for developing a skills programme in hydrogen fuel cell systems is to build capacity in the operation and maintenance of hydrogen fuel cell systems. Hydrogen fuel cell technology is a new energy generation technology that will generate power without impacting negatively on the environment. It offers maximum efficiency, high reliability, and minimum pollution. It is one of the technologies needed to both generate low carbon emissions, as well as identifying, planning, and implementing the directions for harnessing the potential of renewable energy sources. No other courses or qualifications in the development of skills in operational management and maintenance of hydrogen fuel cell systems currently exist in South Africa. This will benefit the energy sector. The government is giving much more impetus to the renewable energy sector and hydrogen fuel cell technology practitioners will find gainful employment. Society will benefit in that the carbon footprint will be reduced. The qualified persons from this skills programme will be able to participate and grow the hydrogen economy – be it in the hydrogen fuel cell manufacturing companies in South Africa. This skills programme is part of the start-up of own hydrogen economy support structure services businesses.

		The skills obtained will enable the successful learner to kick-start hydrogen activities in the promising hydrogen hubs and will boost economic growth. Typical learners will be those already involved in either the hydrogen fuel cell technology, renewable energy, energy management or energy efficiency sectors or those wishing to pursue a career in the renewable energy sector and who meet the minimum requirements stated below. Also, typical learners targeted are those who are studying at TVET colleges in the fields of Electrical or Chemical Engineering. This programme is very specific. Acquisition of this skills programme will not authorise the learner to work on any other renewable or non-renewable technology. Also, this is a very brief skills programme. However, the learner will be able to work on sites that employ this technology, like mining, for example. The following bodies were consulted: • University of Pretoria • Bambili Energy • Southern African Energy Confederation • Water Research Commission • National Cleaner Production Centre of South Africa • Eskom • Solidarity (Labour) • CHIETA • EWSETA • CSIR	
8.	**Related registered qualification/s**	None	
9.	**Purpose**	A Hydrogen Fuel Cell System Practitioner installs, operates and maintains hydrogen fuel cell systems. The learner will be able to: • Prepare to install hydrogen fuel cell system • Install hydrogen fuel cell system • Operate the hydrogen fuel cell system • Maintain the hydrogen fuel cell system	
10.	**Content**	**<u>Knowledge/Theory Component</u>** All the modules below are compulsory. 1. 900144-000-00-KM-01, Health and safety regarding hydrogen fuel cell systems, NQF Level 3, Credits 3 2. 900144-000-00-KM-02, Global	**<u>Application Component</u>** All the modules below are compulsory. **Practical Skills Modules** 1. 900144-000-00-PM-01, Perform basic first aid and fire-fighting, NQF Level 3, Credits 4 2. 900144-000-00-PM-02,

		Energy, CO2 trends, and sustainable fuel alternatives, NQF Level 4, Credits 2 3. 900144-000-00-KM-03, Basics of electricity, NQF Level 4, Credits 2 4. 900144-000-00-KM-04, Hydrogen fuel cell system technology, NQF Level 5, Credits 6 5. 900144-000-00-KM-05, Installation, operation and maintenance of hydrogen fuel cell systems, NQF Level 5, Credits 5 Total Credits: 18	Conduct 240V single phase electrical wiring activities on panels, NQF Level 4, Credits 2 3. 900144-000-00-PM-03, Conduct site inspection and plan the deployment of a hydrogen fuel cell system, NQF Level 5, Credits 2 4. 900144-000-00-PM-04, Install, operate and monitor a hydrogen fuel cell system, NQF Level 5, Credits 4 5. 900144-000-00-PM-05, Maintain a hydrogen fuel cell system, NQF Level 5, Credits 2 **Work Experience Modules** • 900144-000-00-WM-01, Processes to conduct site inspection and plan the deployment of a hydrogen fuel cell system, NQF Level 5, Credits 1 • 900144-000-00-WM-02, Processes to install, operate and monitor a hydrogen fuel cell system, NQF Level 5, Credits 4 • 900144-000-00-WM-03, Processes to maintain a hydrogen fuel cell system, NQF Level 5, Credits 2 Total Credits: 21
11.	**Minimum entry requirements**	NQF Level 4, with mechanical, electrical, or chemical engineering competencies	
12.	**Exit Level Outcomes and Associated Assessment Criteria**	**Exit Level Outcome (ELO) 1** Prepare to install hydrogen fuel cell system ***Associated Assessment Criteria*** • Historical and current energy systems are discussed in terms of energy demand, carbon emissions, climate change and energy resource depletion • The types of renewable energy and the various renewable technologies developed thus far are described • The importance of harnessing renewable energy sources is explained • The types of hydrogen fuel cell systems are differentiated in terms of their components and their functions, and their process flows • The integration of the hydrogen fuel cell sub-systems without losing valuable power/ efficiency is discussed	

		• The future hydrogen-based economy is discussed, and the operation of the hydrogen fuel cell system and generation of usable power are explained • The method of conducting a site inspection is described and the purpose is explained • All health and safety aspects relevant to the hydrogen fuel cell system are explained and demonstrated **Exit Level Outcome (ELO) 2** Install hydrogen fuel cell system ***Associated Assessment Criteria*** • The procedures for installing a hydrogen fuel cell system are explained • A hydrogen fuel cell system is installed according to manufacturer's specifications and site inspection observations • The operation of the installed system is tested and any problems and deviations are dealt with according to manufacturer's specifications • The concepts of load management or deployment planning as they pertain to hydrogen fuel cell systems are explained • All safety aspects pertaining to electrical and installation safety are adhered to • All safety aspects pertaining to methanol and pressurised hydrogen gas bottles are observed **Exit Level Outcome (ELO) 3** Conduct post hydrogen fuel cell system installation activities ***Associated Assessment Criteria*** • The purpose for fuel testing is explained and the method is described • Fuel is tested according to manufacturer's instructions • A range of tests are conducted according to manufacturer's instructions (fuel test, methanol-water appearance test; methanol-water specific gravity test; methanol-water miscibility test, methanol-water boil down test) • The purpose of maintenance is explained and the aspects that constitute maintenance are described • A hydrogen fuel cell system is maintained according to manufacturer's specifications • The methods for checking and investigating errors, and for troubleshooting hydrogen fuel cell systems are described • Errors on a hydrogen fuel cell system are checked and investigated according to manufacturer's instructions • Troubleshooting is conducted on a hydrogen fuel cell system according to manufacturer's instructions • The purpose of monitoring a hydrogen fuel cell system is explained and the method is described • The basic parameters of a hydrogen fuel cell system are monitored and deviations are analysed and corrected according to manufacturer's instructions • Safety aspects pertaining to refuelling, testing, maintenance, troubleshooting and monitoring are adhered to

13.	**Continuous Assessment & Final Supervised Assessment (FISA)**	**Continuous Assessment** The SDP must ensure that all learners are enrolled with the QCTO at the start of training (within 5 days) in the format required by the QCTO. Continuous assessment is set by the SDP in accordance with the outcomes provided. This may consist of a variety of methods, e.g. practical or written assessments, assignments, projects, demonstrations, presentations or any other form of assessment to assist the learner in the learning process. During training, it is mandatory for formal summative assessments to take place at the end of each module/topic. These results must be formally recorded, and be available for monitoring and/or evaluation by the QCTO. **Final Integrated Supervised Assessment (FISA)** All learners gain entrance to the Final Integrated Supervised Assessment by successfully completing all formal summative assessments conducted by the SDP. **Format of FISA:** A practical and written assessment integrating the relevant Exit Level outcomes, with simultaneous verbal assessment of embedded knowledge by the assessor before, during or after the FISA. All FISAs must be supervised, and virtual FISAs must be recorded throughout the assessment. All Exit Level Outcomes must be covered in the FISA. In the FISA, the learner must demonstrate applied knowledge and skills to prove that the competencies of the Skills Programme have been achieved. The FISA may not contain any assessments used in the "Continuous Assessment" process (thus no re-assessment). Special considerations should be made for candidates with special learning needs. **Standards for Final Integrated Supervised Assessment (FISA)**: The learner should be provided with a brief/job card/task to demonstrate what the learner should show, know or produce in a product, relevant to the Exit Level Outcomes and the purpose of the Skills Programme. This is the section where the learner must show applied competency (what the learner must be able to do, and to what expected standard) The FISA INSTRUMENT (Written case study, scenario or brief/task [similar to a job card]) must be developed and moderated by the SDP and conducted in a supervised environment. It is assessed by means of a RUBRIC developed by the SDP for this purpose: In the Written Component, learners must be given real-life scenarios in which they must demonstrate that they have applied knowledge/skills in the following:

		• Historical and current energy systems in terms of energy demand, carbon emissions, climate change and energy resource depletion • Types of renewable energy and the various renewable technologies developed thus far • Importance of harnessing renewable energy sources • Types of hydrogen fuel cell systems in terms of their components and their functions, and their process flows • Integration of the hydrogen fuel cell sub-systems without losing valuable power/ efficiency • The future hydrogen-based economy and the operation of the hydrogen fuel cell system and generation of usable power are explained • Method of conducting a site inspection and explain the purpose • Health and safety aspects relevant to the hydrogen fuel cell system • Procedures for installing a hydrogen fuel cell system are in order to respond to challenges/issues/problems in the scenarios. Candidates must be provided with the assessment question paper and equipment in order to perform the above. An answer sheet/book with responses/answers to all above should be produced by a candidate. The pass mark is 70% The maximum time for the above is 3 hours. Candidates must prove that they can install a hydrogen fuel cell system by: • Installing a hydrogen fuel cell system according to manufacturer's specifications and site inspection observations • Testing the operation of the installed system and any problems and deviations are dealt with according to manufacturer's specifications • Explaining the concepts of load management or deployment planning as they pertain to hydrogen fuel cell systems • Adhering to all safety aspects pertaining to electrical and installation safety • Observing all safety aspects pertaining to methanol and pressurised hydrogen gas bottles Candidates must be provided with the assessment question paper/instruction sheet, tools and equipment in order to perform the above. An assessment rubric should be completed by the assessor indicating whether the learner is competent or not. Candidates must be competent on all assessment criterion on the assessment rubric

		The maximum time for the above is 5 hours. Candidates must prove that they can conduct post hydrogen fuel cell system installation activities by: • Explaining the purpose for fuel testing and describe the method • Testing fuel according to manufacturer's instructions • Conducting a range of tests according to manufacturer's instructions (fuel test, methanol-water appearance test; methanol-water specific gravity test; methanol-water miscibility test, methanol-water boil down test) • Explaining the purpose of maintenance and describe the aspects that constitute maintenance • Maintaining a hydrogen fuel cell system according to manufacturer's specifications • Describing the methods for checking and investigating errors, and for troubleshooting hydrogen fuel cell systems • Checking and investigating errors on a hydrogen fuel cell system according to manufacturer's instructions • Conducting troubleshooting on a hydrogen fuel cell system according to manufacturer's instructions • Explaining the purpose of monitoring a hydrogen fuel cell system and describe the method • Monitoring the basic parameters of a hydrogen fuel cell system and analyse and correct deviations according to manufacturer's instructions • Adhering to safety aspects pertaining to refueling, testing, maintenance, troubleshooting and monitoring Candidates must be provided with the assessment question paper/instruction sheet, tools and equipment in order to perform the above. An assessment rubric should be completed by the assessor indicating whether the learner is competent or not. Candidates must be competent on all assessment criterion on the assessment rubric The maximum time for the above is 3 hours. Whilst conducting the above practical, strategic, well-timed questions should be asked of the learner to assess embedded knowledge gained during the skills programme, as well as critical thinking and problem-solving skills: for e.g. • "Why.....?" • "What would happen if …?" • "When ….. is done, what would the result be?" • "How would you deal with …..?" • Etc. The marking rubric/compliance checklist used to assess these competencies must include a section for the assessor/facilitator used in

		this session to make a note of competencies shown, (or not shown), as well as the questions that were asked, and a summary of the learner's answers, and state whether these are of the acceptable standard or not. The marking rubric/compliance checklist compiled should contain specific areas marked with an asterisk (*) as compulsory sections in order for the learner to be declared C (Competent). Compulsory sections are when the safety of the candidate or others would be affected if incorrectly completed. Learners who complete this skills programme will accumulate credits towards the relevant full or part qualification. The Credit Accumulation and Transfer (CAT) Policy may apply to these learners. **Submission of final results** Final results must be submitted to the QCTO in the required format, within 21 days of the date of the FISA, together with the following: • Completed QA Verification Report on the FISA (QCTO template: relevant sections). • A copy of the final Assessment Instrument used, as well as the marking guideline / rubric.
14.	**Recognition of Prior Learning (RPL)**	• Learners will gain access to the skills programme through RPL for access as provided for in the QCTO RPL Policy. RPL for access is conducted by accredited education institution, skills development provider or workplace accredited to offer that specific skills programme. • Learners who have acquired competencies in skills programme will be credited for such topics through RPL. • RPL for access to the Final Supervised Assessment: Accredited providers and approved workplaces must apply the internal assessment criteria specified in the skills programme document to establish and confirm prior learning and achievement of required competencies for the skills programme.
15.	**Work Opportunities/further learning**	Learners will be able to work as Hydrogen Fuel Cell System Practitioners in a variety of environments like mining, industry etc. Learners may have the opportunity of pursuing further studies in renewable energy at higher education institutions (HEIs).
16.	**Skills Development Provider Accreditation Requirements**	**For Knowledge Modules:** *Physical Requirements:* • Providers must have a training facility with all the resources to deliver the learning as set out in all modules. Resources must include training manuals which cover the full spectrum of theory in all modules, and other relevant documentation.

		• Adequate and equipped training venue to accommodate the number of learners, as prescribed by the OHS Act • Access to internet, computers, library and/or e-learning facilities • Learning environment conducive to delivery of training • Assessment documentation and standards approved by the AQP *Human Resource Requirements:* • Facilitators/lecturers must have acquired the relevant training in these modules and must be registered for first aid and fire-fighting. • Facilitators/lecturers must have experience with assessment and moderation in the subject matter of all modules. • Facilitator/learner ratio 1:20 *Legal Requirements:* • Compliance with relevant legislation • Accreditation with the appropriate quality assurance body **For Practical Modules:** *Physical Requirements:* • Providers must have a training facility with all the resources to deliver the learning as set out in this document. Resources must include training manuals which cover the full spectrum of practical activities in this module, and other relevant documentation. • Adequate area to accommodate the number of learners, as prescribed by the OHS Act. • Adequate area or space to carry out the practical skills • Access to internet, computers, library and/or e-learning facilities *Human Resource Requirements:* • Facilitators/lecturers must have acquired suitable training in first aid and fire-fighting • Facilitators/lecturers must have experience with assessment and moderation in these aspects. • Facilitator/learner ratio 1:4 (maximum) *Legal Requirements:* • Compliance to Safety Health Environmental Risk and Quality (SHERQ) • Compliance to OHS Act and relevant labour legislation laws **For Work Experience:** *Physical Requirements:* • Appropriate area for conducting the work experience activities • All the equipment required for the activities *Human Resource Requirements:*

		• Person with either appropriate qualifications in hydrogen fuel cell systems or someone with at least three years' experience in the installation, operating, monitoring and maintaining of hydrogen fuel cell systems • Mentor/learner ratio 1:4 *Legal Requirements:* • Compliant with Safety, Health, Environmental, Risk and Quality (SHERQ) requirements • Compliant with Compensation for Occupational Injuries and Diseases Act (COIDA) requirements

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