TVET SKILLS FOR RENEWABLE ENERGY AND GREEN HYDROGEN IN NAMIBIA

Annexure 4: Instrumentation and Control

Implemented by

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

IMPRINT

Published by the
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

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As of 09/2025

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GFA CONSULTING GROUP

CONTENTS

ACRONYMS

ASQA	Australian Skills Quality Authority
BESS	Battery Energy Storage
CCST	Certified Control Systems Technician
CMS	Coordinate Metrology Society
CoE	Centre of Excellence
GH2	Green Hydrogen
H2	Hydrogen
HMI	Human Machine Interface
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IRESEN	L'Institut de Recherche en Énergie Solaire et Énergies Nouvelles
ISA	International Association of Automation
KNQF	Kenya National Qualification Framework
NET	NIMT Engineering Trade
NIMT	Namibian Institute of Mining and Technology
NITA	National Industrial Training Authority (Kenya)
NQA	Namibia Qualifications Authority
NQF	National Qualifications Framework
NSI	Namibia Standards Institute
NTA	Namibia Training Authority
NUST	Namibia University of Science and Technology
NGHC	NUST Green Hydrogen Cluster
NOS	National Occupational Standards
NVC	National Vocational Certificate
NVQ	National Vocational Qualification
NYS	National Youth Service
MoA	Memorandum of Agreement
OEM	Original Equipment Manufacturer
OFPPT	L'Office de la formation professionnelle et de la promotion du travail
PAC	Programmable Automation Controllers
PLC	Programmable Logic Controller
PPP	Public-Private-Partnership
PV	Photovoltaic
RE	Renewable Energy
RQF	Regulated Qualifications Framework (UK)
RWTH	Rheinisch-Westfälische Technische Hochschule
SAQA	South African Qualifications Authority
SCADA	Supervisory Control and Data Acquisition
SIL	Safety Integrity Level
SIS	Safety Instrumented Systems
ToT	Training-of-Trainer
TVET	Technical and Vocational Education and Training
VDE	Verband der Elektrotechnik Informationstechnik e.V
VDMA	Verband Deutscher Maschinen-und Anlagenbau
WVTC	Windhoek Vocational Training Centre

1 ANALYTICAL REPORT

The objective of this report is to provide a comprehensive review of existing technical and vocational qualifications, including a gap and needs analysis, in order to meet the relevant skills requirements for the renewable and green hydrogen sectors in Namibia. This report focuses on qualifications in the fields of Instrumentation and Control systems related to green hydrogen, adapted from the initial title “ICT-Control Systems”.

1.1 Status Quo – Overview of Existing Training Measures and Training Providers

The initial focus of the assignment was on the area of Information and Communication Technology (ICT), emphasising control systems related to the renewable energy (RE) and green hydrogen (GH_2) sectors.

The first step involved carefully narrowing the focus by outlining the key areas within the GH_2 value chain. The subsequent segregation was then made:

i. the electrification process related to the production of green electricity; and

ii. the electrolysis process related to the production of GH_2.

Once this segregation was understood, it became clear that identifying the necessary skills also involves understanding instrumentation devices essential for the transportation and storage of hydrogen. The focus areas segmented in this report are illustrated in Figure 1. Based on discussions with various stakeholders during the mission in Namibia, it became evident that instrumentation and control is treated as a single topic. In contrast, in the global context, these are considered separate fields, each with its own unique pathway and skill sets.

In Namibia, these skills are combined due to the early stage of the local market, where advanced specialisation in either instrumentation or control is not currently in high demand.

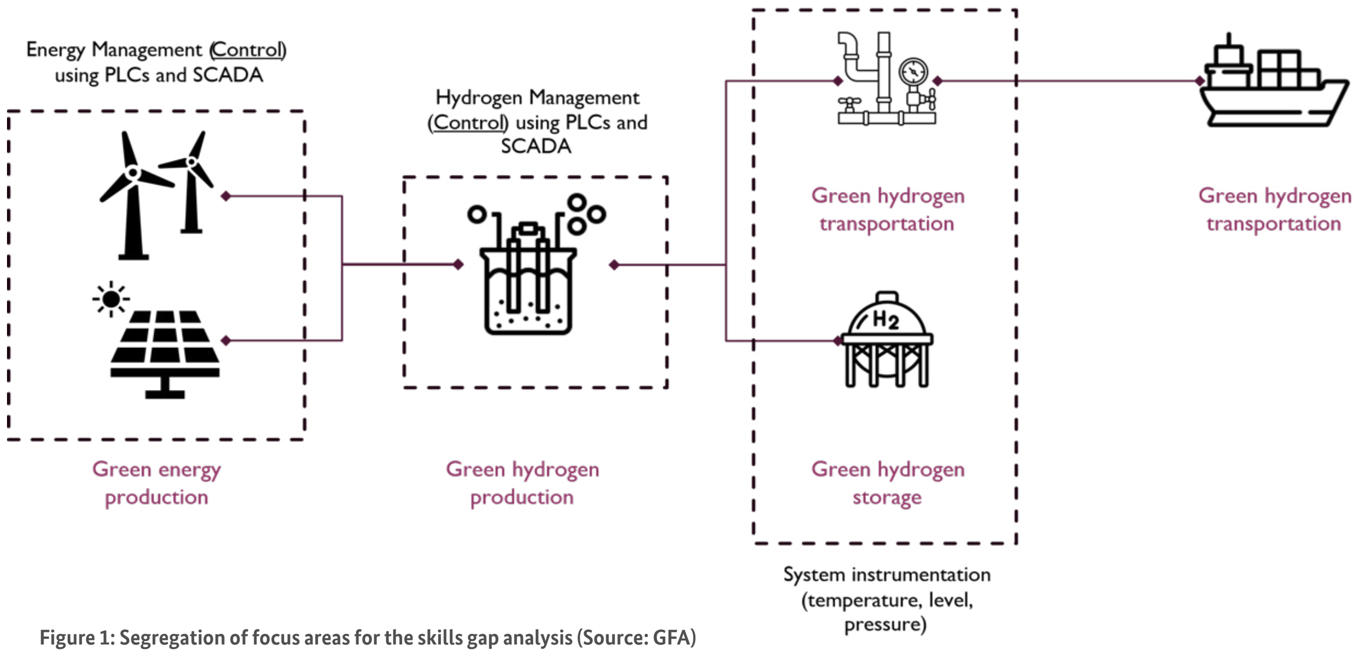
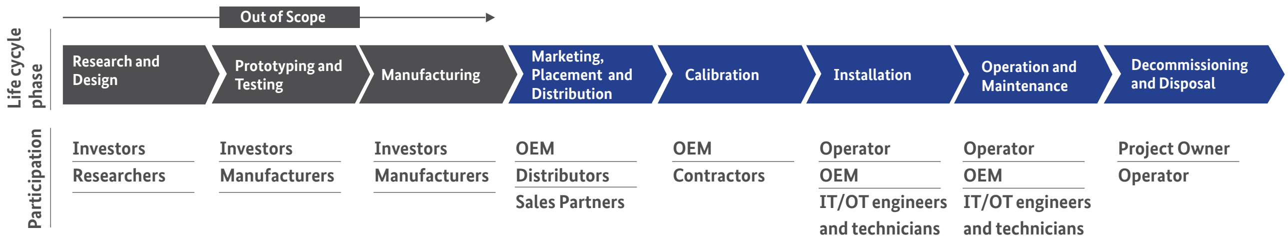


Figure 1: Segregation of focus areas for the skills gap analysis (Source: GFA)

In defining the scope of the analysis to be carried out, the following assumptions were adopted as supported by information gathered during stakeholder engagements.

a) In the Namibian context, industrial instrumentation primarily involves the installation, use, and maintenance of instrumentation equipment. It generally does not include research, commercial development, or manufacturing of instruments or advanced control systems. The phases of the instrumentation and control system product life cycle covered in this report are illustrated in Figure 2.

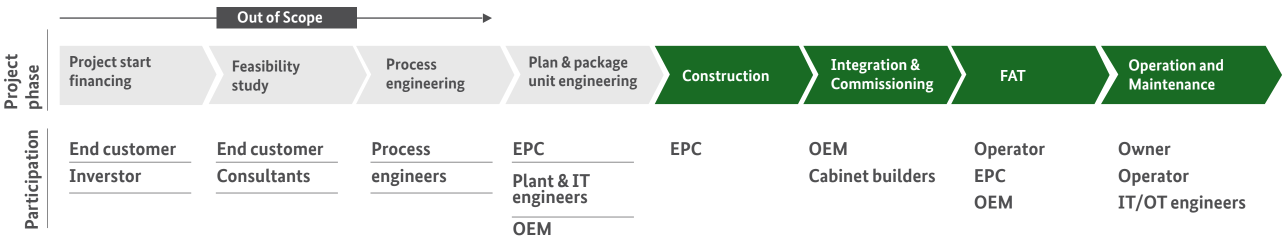
Figure 2: Instrumentation and Control System product life cycle scope definition



b) Instrumentation and Control System Technicians are primarily required for the construction, installation and operation phases of RE and GH_2 projects.

Therefore, the scope of skills to be analysed are those required for the project phases depicted in Figure 3 below.

Figure 3: Project phase scope for the analysis of skill needs



Currently, there is only one registered Technical and Vocational Education and Training (TVET) training provider in Namibia that offers dedicated qualifications in Instrumentation and Control systems. The Namibia Institute of Mining and Technology (NIMT) provides qualifications in Electrical Engineering (Instrumentation and Control) up to Level 3 at its NIMT Engineering Trade (NET) Campus in Arandis.

Additionally, the curricula for the National Vocational Certificates (NVCs) in Electrical Engineering (Instrumentation and Control) up to Level 5 have been developed by the Namibia Training Authority (NTA) and registered on the National Qualifications Framework (NQF).

It is important to note that no Namibian TVET training provider currently offers qualifications in Instrumentation and Control beyond NQF Level 3. While there is access to both formal and informal training in instrumentation, control systems, and SCADA (Supervisory Control and Data Acquisition), this training is primarily available in the following cases:

- External Trainers from foreign countries (mainly South Africa) offer commercially accredited or unaccredited training, usually over a one (1) week period or less, or up to several months. The accreditation is from the countries of origin, and the training is organised upon request from Namibian entities (as addressed in section 1.2). The relevant short courses are listed in Table 1.

- Academic institutions, such as the Namibia University of Science and Technology (NUST), participate in research or work exchange programs, where participants gain formal training with their host university or company. These programs are usually at graduate and post-graduate level, i.e. NQF Level 8 to 10. As stated in Section 1.2, research activities are focused on the application of GH2-specific processes, such as electrolysis and hydrogen/ammonia transportation and not in the development of instrumentation and control systems.

- Informal and non-accredited training in the form of structured on-the-job training and active knowledge transfer is provided by commercial entities for their staff. The training is carried out by experienced or specialised personnel (i.e., engineers, etc.).

- Qualifications in instrumentation, automation, control systems and SCADA above NQF Level 3 are accessible in South Africa at a number of institutions.

- Online courses are also available, with applications for accreditation through the Namibia Qualifications Authority (NQA) possible.

Table 1: Regional qualifications in Instrumentation, Automation and Control Systems

Training Type	Training Entity	Training Title	Country	Accreditation / Level
Academic	Various TVET Institutions, South Africa: Nelson Mandela University, Port Elizabeth College, Cape Peninsula University of Technology, Unisa, Berea Technical College, DAM Technical College and Springfield TVET College, Bloemfontein Technical College, Tshwane University of Technology, Majuba TVET College	National Certificate in Measurement, Control and Instrumentation	South Africa	SAQA NQF Level 2-5
		Further Education and Training Certificate: Measurement, Control and Instrumentation)	South Africa	SAQA NQF Level 4
		Occupational Certificate: Instrument Mechanic	South Africa	SAQA NQF Level 5
		Diploma in Engineering Technology in Instrumentation Engineering	South Africa	SAQA NQF Level 6
Short Course	Engineering Institute of Technology (EIT), Australia	Professional Certificate of Competency in Instrumentation, Automation & Process Control (3 months)	Online	N/A
	Siemens SITrain - SIEMENS PLC Training Centre at Nelson Mandela University	Industrial Automation Systems SIMATIC, Industrial Communications, Operator Control and Monitoring Systems SIMATIC HMI, Process Instrumentation, Process Control Systems SIMATIC PCS 7 and SIMATIC PCS neo	Online and in-person (at certified Siemens centre)	OEM specific training
	Rascals Automation Training and Solutions, Polytech Africa	PLCs, Industrial Networks, Human Machine Interface (HMI), SCADA, Distributed Control Systems, Switchgear	South Africa	N/A
	Schneider Electric	Programmable Automation Controllers (PACs), PLCs, Process Safety, Software, Process Control	Online, South Africa, Nigeria	OEM specific training
Other Relevant Academic Training	Various TVET Institutions South Africa: Northlink College, Unisa,	Various TVET Institutions South Africa: Northlink College, Unisa,	South Africa	SAQA NQF Level 2-4
		Occupational Certificate: Mechatronics Technician	South Africa	SAQA NQF Level 5
		Diploma in Mechanical Engineering in Mechatronics	South Africa	SAQA NQF Level 6

1.2 Stakeholder Mapping and Needs Analysis

Various stakeholders were engaged to gather data on the key skills needed for instrumentation and control systems in the GH_2 value chain. These stakeholders shared their current needs, challenges, and future objectives related to their involvement in the GH_2 industry. They are categorised into four (4) groups, as illustrated in Figure 3.

Academic / Training Institutions

Green H_2 Pilot Project Operators

Industry Professionals

Industry Partners / Developers

Figure 3: Stakeholder grouping for the skills needs assessment.

The key findings from the engagements with the respective categories of stakeholder are summarised below:

Academic and Vocational Training Institutions

Namibia Institute of Mining and Technology (NIMT): The NIMT was selected as a stakeholder as they are currently the only Namibian accredited TVET training provider offering training in Instrumentation and Control at NQF Levels 1 to 3.

- The existing curriculum content excludes instrumentation for GH_2 systems, as the trainers themselves do not have training/exposure to hydrogen production.
- The training equipment is outdated (by at least 20 years), and well behind currently applied technology in the Namibian industry, let alone in advanced facilities such as hydrogen plants.
- There is a severe lack of trainers possessing the required knowledge for instruction.
- The training facilities can only accommodate a limited number of trainees and classrooms are currently filled to capacity, with rotation being employed to maximise trainee intake.

Namibia University of Science and Technology (NUST): The NUST was selected as a stakeholder due to it offering accredited Engineering qualifications at NQF Level 6 and has entered into a Memorandum of Agreement (MoA) with the National Youth Service (NYS) to roll out TVET programmes at the NYS Rietfontein Satellite Campus.

- NUST currently provides exit levels at NQF Level 6 for technicians in engineering fields.
- Over 20 NUST students as part of the NUST Green Hydrogen Cluster (NGHC) and staff have gone overseas for upskilling and post-graduate studies in GH_2, including studies in the application of technologies and development of processes (electrolysis efficiency, proton exchange membranes, hydrogen microgrids, hydrogen transportation).
- NUST has a wide network and formalised collaboration with international entities in GH_2 related research and development for academic programs and internship training with industry partners, e.g., VDE (Verband der Elektrotechnik Informationstechnik e.V) Institute, RWTH (Rheinisch-Westfälische Technische Hochschule), Aachen University and the German Engineering Federation (VDMA), etc.
- NUST is involved with train-the-trainer initiatives, bridging skills gaps between technicians and engineers.

Windhoek Vocational Training Centre (WVTC): The WVTC was selected as a stakeholder due to their longstanding provision of accredited Electrical/Electronic TVET training which are relevant to the electrification and energy management aspects of this report. With well-established staff and infrastructure, the institution is well-positioned as a potential partner for providing Instrumentation and Control courses.

- Specific content in operational technology and advanced technology used in GH_2 industries is not yet incorporated into course content.
- Trainers have not been exposed or trained on specialised GH_2 instrumentation and control, e.g., on PLCs, where the focus primarily lies on qualifying for Electrical General and Electronics up to NQF Level 3.

- The training equipment is outdated (by at least 20 years) which limits the training capacity.

Private Sector and Industry Professional Bodies

Namibia Power Corporation (NamPower): NamPower was selected as a stakeholder due to their longstanding position as an employer of instrumentation and SCADA professionals working in electrification and energy management.

- Qualifications for N4-6 are primarily obtained in South Africa on a proactive basis. The company has positions requiring instrumentation/automation qualifications from NQF Level 3 to 8 requiring experience in SCADA. To be eligible, individuals must obtain these qualifications and acquire the skills proactively.
- On-the-job training and courses abroad have been used to upskill the team, primarily in South Africa, as listed in Table 1.
- NamPower believes that the TVET training offered in Namibia does not equip trainees sufficiently for instrumentations, power generation control systems and SCADA at transmission level.
- NamPower primarily rely on online forums and training to solve arising problems (e.g., Reddit, Siemens PLC forums).

Hopsol Africa:

- The team of engineers are responsible for specialist activities, e.g., operating the renewable photovoltaic (PV) control systems.
- Technicians specialising in instrumentation, control systems and SCADA are not sought, given the size of the existing RE projects and the nature of the plants in which unplanned outages are unexpected.
- HOPSOL manages 7 sites, 2 engineers are sufficient to carry out advanced tasks and specialist technicians N4-N6 are not required. Technicians/artisans (mainly Electrical General) are upskilled and trained in-house to monitor, control and do first-line maintenance at solar and battery energy storage sites.

Industry Partners and Project Developers

Namibia Private Sector GH_2 Task Force and Zhero:

- Further work needs to be done to clarify the skills needed for the Namibian green industry. This includes determining the real demand for specific skills and preparing the training sector to sustainably meet demand.
- Collaboration is lacking between entities working to fill GH2skills gaps.
- There is a lack of synergy between industry skills demands and the qualifications produced locally. This needs to be addressed.

Cleanergy Solutions Namibia:

- The team of engineers are responsible for specialist activities, e.g., operating the renewable PV control systems and electrolysers.
- Technicians/artisans up to NQF Level 3 are either trained in-house or using external trainers. The H_2 Academy is focused on offering STEM programs for high school learners; however, training is yet to commence.
- Cleanergy Solutions Namibia is primarily looking for more specialised engineers in electrolysers and hydrogen production, as most technical work is performed by the contractors or Original Equipment Manufacturers (OEMs) and therefore engineers are not exposed to the skills required at technician level.
- **Contractors and OEMs:** CMB.Tech, Belgium (hydrogen and ammonia storage, transport and use); SMA Solar Technology AG, Germany (electrolysers, battery energy storage systems (BESS), solar inverters and energy management.

HyIron Green Technologies:

- Engineers, contractors and suppliers are responsible for specialist activities. Technicians specialising in instrumentation, control systems and SCADA above NQF Level 3 are not sought at present.
- Specialisation for NQF Levels 4 to 6 is not seen as beneficial going forward for operations and maintenance, but would be sought by automation contractors and suppliers.
- Current TVET graduates do not have sufficient practical knowledge to effectively carry out specialised GH_2 activities (installation and commissioning of utility-scale energy management and GH_2 equipment, etc.). Industry-relevant practical experience is required during TVET training to expose trainees to these products and processes.
- Formalised up-skilling is planned to run internally to equip TVET level staff to carry out certain duties in operations and maintenance.
- **Contractors and OEMs:** PERIC Hydrogen Systems, China (electrolysers, hydrogen transport, storage and delivery); JinkoSolar, China (solar inverters and energy management).

The main Namibian companies providing product services in SCADA, instrumentation and automation within the scope of this report are listed, but not limited to the following:

- Central Technical Supplies (Pty.) Ltd (CTS)
- ECOGROUP (ECOPROJECTS Automation Solutions, ECOTECH Automation Products), Industrial Automation and Engineering (IAE)
- Megatron Engineering Namibia
- Protecton Engineering Namibia
- Systems Automation and Management (Namibia)

The stakeholders and companies offering TVET qualifications in Instrumentation and Control Systems/Automation qualifications above NQF Level 3, retrievable by desktop study, came from the Cape Peninsula University of Technology, Bloemfontein Technical College, and Tshwane University of Technology.

Other institutions in South Africa offering TVET qualifications in Instrumentation and Control are the Berea Technical College, DAM Technical College and Springfield TVET College.

The list is not exhaustive, and a verified, extensive list of training providers for the field of Instrumentation and Control could only be obtained via desktop study and could not be verified during the course of the assignment.

1.3 International Benchmarking in relation to Instrumentation and Control Systems

This section outlines relevant international certification, standards and certifying bodies for GH_2 related Instrumentation and Control. The certifications are drawn from existing international industrial and process control qualifications. These qualifications are currently being augmented in developed countries with a focus on leveraging the GH_2 economy.

For example, Germany and the USA have adapted areas related to functional safety of instrumentation with regard to hydrogen through amended training programs aligned with IEC 61511 (Germany) and ISA-84 (USA). Further details are represented in Table 2. Hydrogen plant technicians must be competent in subjects like the operation and commissioning of instrumentation devices and control systems in hazardous environments, with particular attention to functional safety and calibration of equipment.

There are four (4) main systems that are present in a hydrogen facility in the focus area of instrumentation and control qualifications. Standards are derived off the base of these systems:

- Electrolysers and compressors
- Pressure, temperature, and flow monitoring
- SCADA/PLC/HMI systems
- Emergency shutdowns and alarm systems

Service technicians for these systems must adhere to safety conditions, maintain systems according to functional system integrity requirements (SIL) and global performance standards, especially when operating within high-pressure, hazardous, and with varied automated alarm systems.

In accordance with best practices in relation to standards and certifications of system technicians, new qualifications are adapted and augmented by existing industrial qualifications. For instance, this includes certifications related to automation systems and those focused on the production of grey hydrogen.

The international certificates mainly focus on these core areas, which are aligned to recognised global standards:

- Control and automation loop tuning using PLCs and SCADA → aligned with ISA-95 and IEC 62264
- Measurement and calibration of flow, pressure level, etc. → aligned with IEC 61298 and 60534
- Functional safety requirements of alarms and fail-safe systems → aligned with IEC 61511 and 61508
- Hazardous area work → aligned with IEC 60079

The following table describes in detail these four (4) areas next to its relevance, certification and scope of validity.

Table 2: Overview of relevant certification in the areas of relevance to GH2 Instrumentation and Control

Area	Relevance	Certification	Comments	Recognition
Hazardous Area Work	Working in hydrogen environments involves risks of explosion and ignition. Technicians must be certified to work safely in explosive atmospheres, such as e.g., zones 0–2, especially during installation, inspection, and maintenance of instrumentation and control devices.	CompEx (Ex01–04)	Originated in the UK. Currently globally recognized for technicians working in hazardous gas zones.	UK/Global
		IECEx CoPC	Internationally recognized ensuring compliance with IEC 60079	Global
		ATEX	Mandatory in the EU for technicians working in explosive areas. The certificate covers hydrogen-related facilities such as electrolyser halls and refuelling stations. Aligned with EU Directive 2014/34/EU	EU
Functional Safety (Process Control)	Hydrogen production and storage systems require fail-safe control systems. Technicians must understand and maintain safety loops, safety integrity levels (SIL) levels, and shutdown systems to prevent accidents.	TÜV Rheinland/TÜV SÜD Functional Safety Technician	Focused on IEC 61511 and 61508 standards and known for rigorous industrial safety certification.	Europe/Global
		ISA / IEC 61511 Safety Technician	Offers North American-aligned training in safety instrumented systems and SIL loop maintenance.	US/Global
Control and Automation Systems	SCADA, PLCs, and HMIs are critical to hydrogen plant operations. Technicians must be certified or undergone proper TVET training in the setup, maintenance, and troubleshooting of these systems.	ISA – Certified Control Systems Technician (CCST)	ISA is widely considered as industry standard body when it comes to control and automation certification. The CCST certification emphasizes instrumentation maintenance and diagnostics.	US/Global
Calibration & Measurement	Hydrogen processes rely on sophisticated sensors that require the highest degree of precision for flow, pressure, and purity. Technicians must understand how to properly calibrate instrumentation devices to ensure optimal system performance and compliance with safety standards	OEM Certifications	Delivered by manufacturers (e.g., Siemens, Emerson); ensures technicians are qualified for device-specific calibration.	Global
		Certified Calibration Technician	Designed to validate expertise in measurement science and practices, and considered industry practice following guidelines of the Coordinate Metrology Society (CMS) and EURMAT	US/Global

Regarding local or government certificates aligned with national qualification programs, four relevant international standards from Australia, the UK, South Africa, and Canada have been identified.

It is important to note that these programs primarily focus on instrumentation requirements for process control, rather than specifically for GH_2. As previously mentioned, governments are still in the early stages of adapting their qualification frameworks to include hydrogen-related skills.

Australia: The Australian Certificate IV in Instrumentation and Control (UEE42211), NQF Level 4, with 280 credits, provides competencies to select, install, set up, test, fault find, repair, maintain and commission systems and devices for measurement and recording of physical/chemical phenomena and related process control systems. This qualification is for the Vocational Education and Training (VET) sector regulated by the Australian Skills Quality Authority (ASQA).

The UK: The UK has a nationally recognised Regulated Qualifications Framework (RQF), which includes National Vocational Qualifications (NVQs). These are competency-based qualifications or National Occupational Standards (NOS) that define the specific competencies required for particular job roles.

The qualifications emphasise the application of knowledge across a broad range of work activities conducted in diverse contexts, many of which are complex and non-routine. They typically involve a high degree of responsibility, autonomy, and often require supervising or guiding others.

There are five levels of NVQs, ranging from Level 1, which focuses on basic work activities, to Level 5 for senior management. Most of these qualifications are offered by the City and Guilds of London Institute (City & Guilds) , which is a leading UK certification body for vocational education. This provides trainees with opportunities to learn via practical, work-related tasks designed to develop skills and knowledge to do a job effectively and are achieved through assessment and training in England, Wales, Northern Ireland and Scotland.

South Africa: The South African Qualifications Authority (SAQA) has developed the Occupational Certificate: Instrument Mechanician to meet the needs of a production environment in the manufacturing, engineering, technology, energy, mining, chemical, mechanical and other associated industries.

Instrument Mechanicians are highly sought after, as trade industries rely on highly precise measuring and monitoring equipment to regulate process variables, track production, manage energy consumption and ensure correct measurement and control - contributing to the safe and efficient operation of plants. The qualification has horizontal articulation with the National Certificate in Measurement, Control and Instrumentation at NQF Level 5.

Kenya: Kenya's skills development framework is governed by the Kenya National Qualifications Framework (KNQF). The development of hydrogen-specific certifications, including those related to instrumentation and control, is still underway. However, there are relevant qualifications within the national TVET system.

For example, programs such as (i) Instrumentation and Control Engineering and (ii) Oil Pipeline Instrumentation are offered at KNQF Levels 3 to 6 and are overseen by the TVET Curriculum Development, Assessment, and Certification Council (CDACC). Looking ahead, Kenya's Green Hydrogen Strategy and Roadmap (2023) outline several initiatives to enhance local capacity. These include (i) developing dedicated hydrogen curricula up to KNQF Level 6; (ii) training TVET trainers; and (iii) integrating green hydrogen modules, with an emphasis on control systems, into engineering education.

Regarding the second initiative, efforts focus on establishing Centres of Excellence (CoEs), improving apprenticeship and on-the-job training through National Industrial Training Authority (NITA) institutions, and fostering public-private partnerships (PPPs) with project developers.

Morocco: Morocco's skills development system is governed by its National Qualifications Framework (NQF), which spans eight levels covering vocational and higher education pathways. Similar to all African countries, specific hydrogen qualifications with focus on instrumentation and control are not yet developed. Examples of current general competencies in this domain include the 2-year program in automation and industrial instrumentation, under L'Office de la formation professionnelle et de la promotion du travail (OFPPT).

As part of the National Green Hydrogen Roadmap, Morocco calls for the integration of GH_2 content into technical and vocational training. The strategy explicitly promotes capacity building for technicians and engineers, including training-of-trainer (ToT) initiatives, public-private collaboration on workforce planning, and certification pathways for operators and instrument specialists. One ofthe key initiatives resulting from the strategy saw light in 2022, where Institut de Recherche en Energie Solaire et Energies Nouvelles (IRESEN), Mohammed VI Polytechnic University (UM6P), and OCP Group signed an agreement to se t up the GREEN H_2A platform.

The platform covers (i) the creation of green hydrogen training; and (ii) the coordination between universities, TVET institutions, and industry to ensure alignment of content with industrial needs, particularly in plant commissioning, instrumentation setup, and automation operations.

Canada: The Canadian instrumentation qualifications follow the apprenticeship model, which emphasises hands-on work under the supervision of a journeyman while including a substantial component of classroom training and testing.

The training programmes identified relate to Instrumentation and Control technicians who repair, calibrate, maintain and install complex industrial measurement and control systems used in various process-control applications. They diagnose instruments and system faults using pneumatic, electrical and electronic testing devices as well as precision measuring instruments.

Through the in-school curriculum, this program gives students the opportunity to gain theoretical knowledge and the practical training necessary to complement on-the-job training.

1.4 Skills Gap Analysis in the Field of Instrumentation and Control Systems

A comprehensive review of Instrumentation and Control System qualifications at NQF Levels 1 to 6 within Namibia and the region was conducted. The unit standards for the NVC in Electrical Engineering (Instrumentation and Control), currently available at NQF Levels 1 to 5, were analysed to assess their relevance and content. Since NIMT is the only institution offering instruction at NQF Levels 1 to 3, graduates from this program have been identified as the primary target group for the recommended short courses aimed at addressing the identified skills gaps.

The review highlights the key modules and concepts currently presented at NIMT to meet the outcomes outlined in the relevant unit standards. Additionally, the curriculum content was evaluated in relation to the benchmarks proposed in the previous section.

Table 3: Assessment of NIMT curriculum content for the NVC in Electrical Engineering (Instrumentation and Control) at NQF Level 1 to 3.

Module	Consultant's Assessment	Level
Construction and Wiring of PLCs: (Introduction and symbols)	Theory content is adequate; however, practical training resources must be updated to reflect industry practice.	Level 1
Measuring Instruments	Theory content does not include all GH_2 instrumentation. Practical training resources must be updated to reflect industry practice and equipment.	Level 1
Measurement: Pressure, Flow, Level, Temperature, Density	Theory content does not include all GH_2 instrumentation. Practical training resources must be updated to reflect industry practice.	Level 2
Automatic Control	Theory content provides basic understanding of control systems. Practical training resources must be updated to reflect industry practice.	Level 2
Programmable Logic Control	Theory content provides basic understanding of PLC function but does not include sufficient PLC programming software or SCADA system exposure. Practical training resources must be updated to reflect industry practice.	Level 2
Measurement: Pressure and Vacuum, Temperature	Theory content does not include all GH_2 instrumentation. Practical training resources must be updated to reflect industry practice and equipment.	Level 3
Telemetering (Transmission)	Theory content provides a fundamental understanding of telemetry but does not include networks, communication and plant level cyber security. Practical training resources must be updated to reflect industry practice.	Level 3
Automatic Control and Valves	Theory content provides adequate understanding of control types. GH_2 processes are to be added to curricula. Practical training resources must be updated to reflect industry practice.	Level 3
Analysers	Theory content provides fundamental understanding. Practical training resources must be updated to reflect industry practice.	Level 3
Intrinsic safety	Theory content does not include GH_2 specific hazards and must be updated to provide an adequate background. Specific certified GH_2 safety training to be implemented.	Level 3
Intrinsic safety	Theory content does not include GH_2 specific hazards and must be updated to provide an adequate background. Specific certified GH_2 safety training to be implemented.	Level 3

Generally, RE and GH_2 are not yet integrated into the existing TVET curricula. As a result, trainees have limited exposure to RE power generation equipment and no exposure to GH_2 technology. An exception is the NVC in Solar Equipment Installation and Maintenance.

However, the practical training equipment available at the two visited institutions does not adequately reflect current industry practices. Consequently, trainees and graduates require supplementary training within industry settings to effectively fulfil their roles.

2 RECOMMENDATIONS FOR NECESSARY TRAINING MEASURES IN INSTRUMENTATION AND CONTROL

While the gap analysis identified several deficiencies across the qualification from NQF Levels 1 to 6, it is recommended that the short-term focus should be on upskilling at NQF Level 3. A gradual transition should then be implemented in the medium- and long-term to achieve NQF Levels 4 to 6, thereby fully closing the identified gaps.

These findings corroborate earlier conclusions presented in the report "ENHANCING EMPLOYABILITY Skills Needs and Gap Analysis in Namibia's PtX Sector and Recommendations for a Skills Development Programme". The earlier study concluded that extensive advanced training measures (at NQF level 6) would not be necessary in the short term, given the sector's early stage of development and the limited capacity of the market to absorb highly specialised technicians at this stage.

Additionally, beyond curriculum development, there is a critical need for upgrading training equipment at local training centres to align with current industry standards. This equipment is essential to ensure that training effectively imparts the necessary knowledge and skills to technicians. As highlighted earlier in this report, physical inspections revealed that most training equipment is outdated by approximately 20-30 years, which significantly impairs its ability to reflect and support today's industry practices.

2.1 Brief Outline of the Recommended Short Courses

Six (6) courses/modules are recommended for the Instrumentation Technicians, designed to equip candidates with the skills necessary for the installation, removal, calibration, maintenance (including fault-finding), and repair of instruments and control systems.

The program shall be made up of the following Modules (arranged according to priority):

1. Introduction to Instrumentation in Green Hydrogen Systems

- **Description:** Learn how process control is ensured in hydrogen industries and how the main instruments measure the key process variables (pressure, temperature, flow, position and gas)
- **Exit level:** NQF Level 3
- **Target group:** Electricians with NQF level 2
- **Equipment:** Pressure, temperature, flow and level sensors
- **Estimated duration:** ~2-3 weeks

2. Introduction to Programmable Logic Controllers (PLC)

- Description: Understand the fundamentals of PLC hardware and software, and programming PLCs using different techniques, e.g., ladder logic, function block diagram (petri nets), and state flow
- **Exit level:** NQF Level 3
- **Target group:** Electricians with NQF level 2
- **Equipment:** PLCs, Human Machine interface (HMI), Profibus (communication), laptops, wiring
- **Estimated duration:** ~2-4 weeks

3. Calibration and testing instrumentation equipment

- **Description:** Technicians must understand how to correctly calibrate instrumentation devices to ensure optimal system performance and compliance with safety standards
- The calibration needs to be aligned closely with local metrology requirements, i.e., Namibia Standard Institution (NSI)
- **Exit level:** NQF Level 3
- **Target group:** Electricians with NQF level 2
- **Equipment:** Same as (1)
- **Estimated duration:** ~4 weeks

4. Installation and Removal of instruments and components as per OEM specifications

- **Description:** Technicians must understand how to correctly install equipment as per OEM and standards set by the plant operator
- The installation is OEM /manufacturer-dependent and training is typically provided through them
- **Exit level:** NQF Level 3
- **Target group:** Electricians with NQF level 2
- **Equipment:** Same as (1)
- **Estimated duration:** ~2 weeks

5. Fault-finding on instrumentation equipment and systems

- **Description:** Technicians must understand and maintain safety loops, safety integrity levels (SIL) levels, and shutdown systems to prevent accidents
- Should be aligned with IEC 61511
- **Exit level:** NQF Level 4 and 5
- **Target group:** Electricians with NQF level 3
- **Equipment:** N/A (to be provided at certified training institutions, e.g., TÜV)
- **Estimated duration**: ~4 days

6. Occupational Health and Safety legislation

- **Description:** Technicians must be certified to work safely in explosive atmospheres, such as e.g., zones 0–2, especially during installation, inspection, and maintenance of instrumentation and control devices.
- This will also be aligned with relevant certification, e.g., CompEx (Ex01–04), IECEx CoPC, or ATEX Certification
- **Exit level:** N/A
- **Target group:** Must for all levels
- **Equipment:** N/A (to be provided at certified training institutions, e.g.,TÜV)
- **Estimated duration:** ~2-4 days

2.2 Existing Upskilling Training Measures

Based on the gap analysis and the observation that, aside from NIMT, no other entity in Namibia offers foundational training in instrumentation and control, current upskilling efforts are primarily focused on providing modern equipment to replace outdated systems in facilities nationwide. Additional upskilling initiatives will consist of training-of-trainer programs aimed at qualified trainers who have acquired advanced knowledge of instrumentation and control systems through individual initiatives.

However, upskilling trainers on new equipment is not expected to be critical in the near term, as the underlying technology is anticipated to remain consistent for the next 5 to 7 years.

2.3 Brief outline of Skills/Competencies required

All proposed training will be focused on electrical and electronics technicians who have completed basic training and achieved a minimum qualification at NQF Level 3.

The entry competencies required are:

- Basic electrical systems covering basics of electrical components (resistors, capacitors, inductors)
- Control valves covering positioners and actuators
- Basic measurements instruments (pressure, level, temperature
- Basic electronics covering logic gates, microcontrollers

2.4 Training Options and Opportunities

Based on Table 1 (overview of recommended international certifications), we highlight hereafter an exemplary list of training providers that provide certification in these topics (not exhaustive)

Table 4: Exemplary list of training providers that provide certification in the topics related to the review on international best practice (recall Table 1)

Topic	Institution	Certification	Link	Qualification	Description
Hydrogen Safety	TÜV Rheinland or TÜV SÜD	N/A	Link	TVET level 5-6	Hydrogen Safety Training Program specially designed for professionals and managers who wish to gain knowledge and understanding of hydrogen technologies, dangers of hydrogen, and protective measures. Exposes participants to IEC 60079 requirements
Functional Safety	TÜV Rheinland	Safety Instrumented Systems - FS Technician	Link	TVET level 6	Address persons, who want to get an overview about the fundamentals of the standards IEC 61508 and IEC 61511 and their interpretation for safety related instrumentation systems.
	ISA	ISA/IEC 61511 Safety Certificates	Link	TVET level 6	Focuses on the requirements for the specification, installation, and justification of safety instrumented systems (SIS) for the process industries incl. hydrogen
Control Systems	ISA	Certified Control Systems Technician (CCST)	Link	TVET level 3-6	There are three levels of certification offered for control systems technicians. All certification levels provide a non-biased, third-party, objective assessment and confirmation of an automation technician's knowledge of and experience with project start-up, commissioning, loop-check, project organization, planning and documentation.
	OEM Training	Siemens, Emerson, Schneider, and ABB	• Siemens SITrain • Schneider Training • Emerson Services and Training • ABB university	TVET level 3	OEMs offer PLCs/SCADA systems programming under programs related to their training centres distributed across the globe
Measurement and calibration	OEM Training	Siemens, Emerson, Schneider, and ABB	• Siemens SITrain • Schneider Training center • Emerson Services and Training • ABB university	TVET level 3	OEMs offer measurement and calibration under programs related to their training centres distributed across the globe
	ASQ		Link	TVET level 3	A Certified Calibration Technician tests, calibrates, maintains, and repairs electrical, mechanical, electromechanical, analytical, and electronic measuring, recording and indicating instruments and equipment for conformance to established standards

2.5 Recommendations for Potential Partnerships

It is recommended to establish communication channels for potential partnerships with International Society of Automation (ISA) certified training providers to facilitate the introduction of CCCT certification in Namibia. Collaboration with Namibian training providers such as NIMT, WVTC, NUST, and UNAM can be pursued to utilise their facilities and support the upgrading of training materials and equipment.

Until Namibian entities engage in the manufacturing and development of instrumentation products and control systems, the integration of instrumentation and control fields up to NQF Level 6 is, at this stage, considered advantageous.

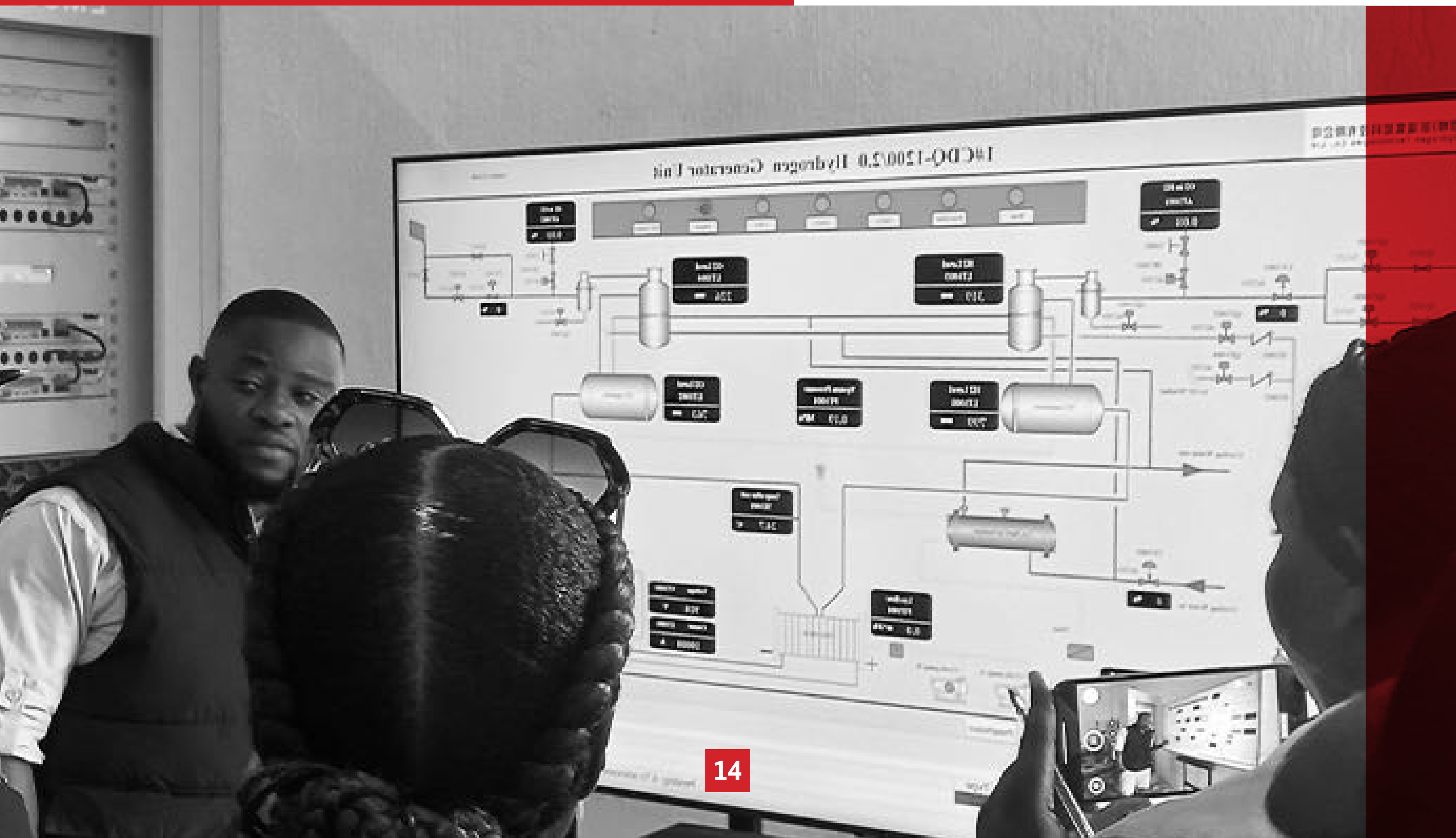
The Namibian industry has not expressed a specific demand for specialisation or separation of these fields, nor does it anticipate that the development of local GH_2 projects will generate such a need in the foreseeable future.

As the RE and GH_2 industries expand, there will be increasing demand for technicians skilled in instrumentation, automation, and control systems, with exposure to RE technologies and proficiency in current industry practices.

Therefore, it is strongly recommended to define industry requirements for instrumentation and control in consultation with industry stakeholders. These requirements should be incorporated into both short courses and reviewed existing curricula and qualifications, aligned with international standards.

It is further recommended that training providers update their instrumentation and control training materials at least every three years or more frequently, to ensure alignment with ongoing industry advancements.

Additionally, partnerships can be established with German companies active in hydrogen technology, such as Siemens through SITrain, focusing on instrumentation and control systems.



Literature and documents used

- All documents are referenced directly in directly in the text. A list of all references is below.
- References to listed TVET institutions providing the selected qualifications and courses in Table 1 are shown below Table 6 references to listed TVET institutions providing the selected qualifications and courses listed in table 1

- https://compexcertification.com/ex01-ex04-gas-and-vapours/
- https://www.iecex.com/certification-of-personnel-competencies-scheme/overview/
- https://webstore.iec.ch/en/publication/62417
- https://single-market-economy.ec.europa.eu/sectors/mechanical-engineering/equipment-potentially-explosive-atmospheres-atex_en
- https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0034
- https://www.tuv.com/landingpage/en/training-functional-safety-cyber-security/detail-pages/zertifikate/fs-technician.html
- https://www.isa.org/certification/certificate-programs/safety-certificates
- https://www.isa.org/certification/ccst
- https://www.asq.org/cert/calibration-technician
- https://training.gov.au/TrainingComponentFiles/UEE11/UEE42211_R1.pdf
- https://www.asqa.gov.au/
- https://www.cityandguilds.com/
- https://allqs.saqa.org.za/showQualification.php?id=94701
- https://unevoc.unesco.org/home/Dynamic+TVET+Country+Profiles/country=MAR
- https://olms.ofppt.ma/course/index.php?categoryid=472
- https://www.ofppt.ma/ar
- https://www.mem.gov.ma/Lists/Lst_rapports/Attachments/36/Feuille%20de%20route%20de%20hydrog%C3%A8ne%20vert.pdf
- https://iresen.org/
- https://um6p.ma/
- https://www.mem.gov.ma/Lists/Lst_rapports/Attachments/36/Feuille%20de%20route%20de%20hydrog%C3%A8ne%20vert.pdf
- https://www.ocpgroup.ma/press-release-article/iresen-um6p-and-ocp-group-have-signed-agreement-set-green-h2a-platform
- https://www.publications.gc.ca/collections/collection_2021/edsc-esdc/Em15-3-25-2020-eng.pdf
- https://ptx-hub.org/wp-content/uploads/2023/08/International-PtX-Hub_202308_Namibia-PtX-skills-needs-assessment.pdf
- https://www.nsi.com.na/metrology/

Table 5 references to listed TVET institutions providing the selected qualifications and courses listed in table 1

Entity	Course Reference	Highest Level
Nelson Mandela University	National Certificate in Mechatronic Engineering - https://eleceng.mandela.ac.za/eleceng/media/Store/documents/Prospectus/Prospectus-Faculty-of-EBET.pdf	Level 5
Port Elizabeth TVET College	National Diploma in Electrical Engineering (Light Current) - https://www.pecollege.edu.za/r191-electrical-engineering/	Level 6
Cape Peninsula University of Technology	Diploma in Engineering Technology in Electrical Engineering (Instrumentation) - https://prospectus.cput.ac.za/index.php/course-details?q=D2ETEX&f=140 Advanced Diploma in Mechanical Engineering (Mechatronics) - https://prospectus.cput.ac.za/index.php/course-details?q=ADMECH&f=140	Level 7
Unisa	National Diploma: Engineering (Electrical - Process Instrumentation) https://w2.unisa.ac.za/CW/SITES/CORPORAT/DEFAULT/REGISTER/UNDERGRA/FIND_YOU/ALL_QUAL/NATION-9.HTM	Level 6
Berea Technical College,	National Diploma in Electrical Engineering (Instrumentation) https://www.btc.edu.za/diploma-electrical-engineering-instrumentation/ National Diploma: Light Current / Instrumentation - https://www.btc.edu.za/diploma-electrical-engineering-light-current-instrumentation/	Level 6
DAM Technical College	National Diploma: Electrical Engineering - Instrument Technician - https://damtraining.com/instrument-technician-n4-n6/	Level 3
Springfield TVET College	National Diploma in Electrical Engineering (Instrumentation) - http://springfieldtvet.co.za/Courses/ElectricalEngineeringDiploma.aspx	Level 6
Tshwane University of Technology	National Diploma/Advanced Diploma in Electrical Engineering (Instrumentation) - https://tut.ac.za/images/prospectus/Part4_FEBE_Prospectus_2025.pdf	Level 7
Majuba TVET College	National Diploma in Electrical Engineering (Instrument Mechanician) - https://www.majuba.edu.za/artisan-courses/instrument-mechanician/	Level 6
Vaal University of Technology	National Diploma, Extended Diploma, Advanced Diploma in Electrical Engineering (Process Control Engineering) - https://vut.ac.za/wp-content/uploads/2025/06/Prospectus-2025-FET-FINAL_18-Oct-24.pdf	Level 7
Central University of Technology	National Diploma in Engineering Technology in Electrical Engineering (Instrumentation) - https://www.cut.ac.za/department/electrical-electronic-and-computer-engineerin	Level 6