National Vocational Certificate Level 3 in Micro Hydro Power Plant Technology

CBT Curriculum

National Vocational & Technical Training Commission
5th Floor, Evacuee Trust Complex
Sector F-5/1, Islamabad
Tel: +92 51 904404
Fax: +92 51 904404
Email: info@navttc.org

Author:
Mr. Ruediger Wolf (CEO TEN Namibia South Africa)

Reviewed by:
Mr. Akbar Ali (MHP Consultant PEDO Peshawar) , Ms. Tuba Ahmad (Design Engineer Hydrolink Taxila) , Mr. Intikhab Alam (Project Development Officer MHP Chitral) , Mr. Aftab Ahmad (Coordinator Zaif Foundation Swat) , Mr. Fazal Rabi (CEO Hydrolink Engineering Taxila) , Mr. Chaudhry Usman (Design Engineer Chitral Engineering Taxila) , Mr. Inayat Ur Rehman (Assistant Professor KP-TEVTA Peshawar) , Mr. Engr. Abdul Rasheed (Associate Professor KP-TEVTA Peshawar)

Layout and Design by:
Ms. Maria Arif (Freelance Consultant)

Date of approval by NCRC:
11th -12th June 2015

Date of Notification:
10th December 2014, vide notification no F.2-1/2013-DD(VT)

This curriculum has been produced by the National Vocational & Technical Training Commission (NAVTCC) with the technical assistance of TVET Reform Support Programme, which is funded by the European Union, the Embassay of the Kingdom of the Netherland, Federal Republic of Germany and the Royal Norwegian Embassy. The Programme has been commissioned by the German Federal Ministry for Economic Cooperation and Development and is being implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Contents

1. Introduction

Today's 'World of Work' has undergone radical changes. The emergence of new technologies, global markets for products and services, and international competition require economies to upgrade and enhance the skill level of their human resources. Technical and Vocational Education and Training (TVET) systems all over the world are constantly challenged by this question of how to respond to the demand of a knowledge-based economy. As TVET systems and their training programmes directly relate to the world of work in terms of quantity and quality output, the approach of TVET programmes need to focus on the acquisition of technical and non-technical skills, also referred to employability skills.

With the release of the National Skills Strategy 2009-2013 the Pakistan government has made skills development a political priority. The framework for skills development aims to:

- Change TVET education from time-bound, curriculum-based training to flexible, competency-based training;
- Bring about a shift from supply-led training to demand-driven (outcome-based) skills development by promoting the role of industry in designing and delivering TVET.

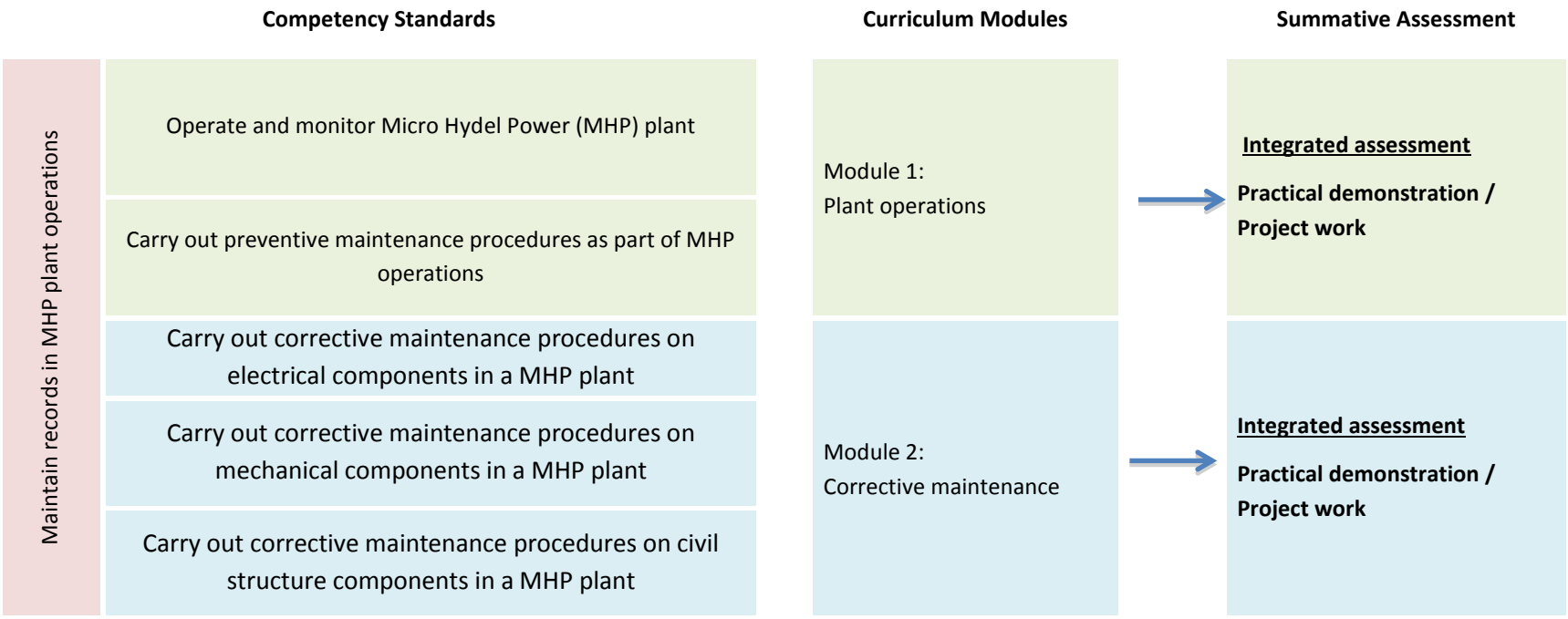
The curriculum for ***Micro Hydel Power Plant operations (Operator) – Level 3*** aims to respond to this demand. It has been developed as an outcome-based course designed to transfer a range of skills needed to succeed in a high-performance work environment, as defined by labour market requirements. Although the course design is aimed for further progression to the Micro Hydel Power Plant operations (Technician) - NVQF level 4 programme, it may also articulates horizontally and vertically with other training programmes at NVQF level 3 in a number of Electrical, Mechanical and/or Civil construction trade areas. People who wish to go this route are advised to seek Recognition of Prior Learning for their achievements.

1.1 Course objective

The overall objective of this course is to facilitate transferable skills to the trainees necessary to succeed in an ever-changing work environment. The modules delivered through this programme will provide knowledge and skills in mechanical, electrical and civil construction areas, required to accomplish a career in MHP operations.

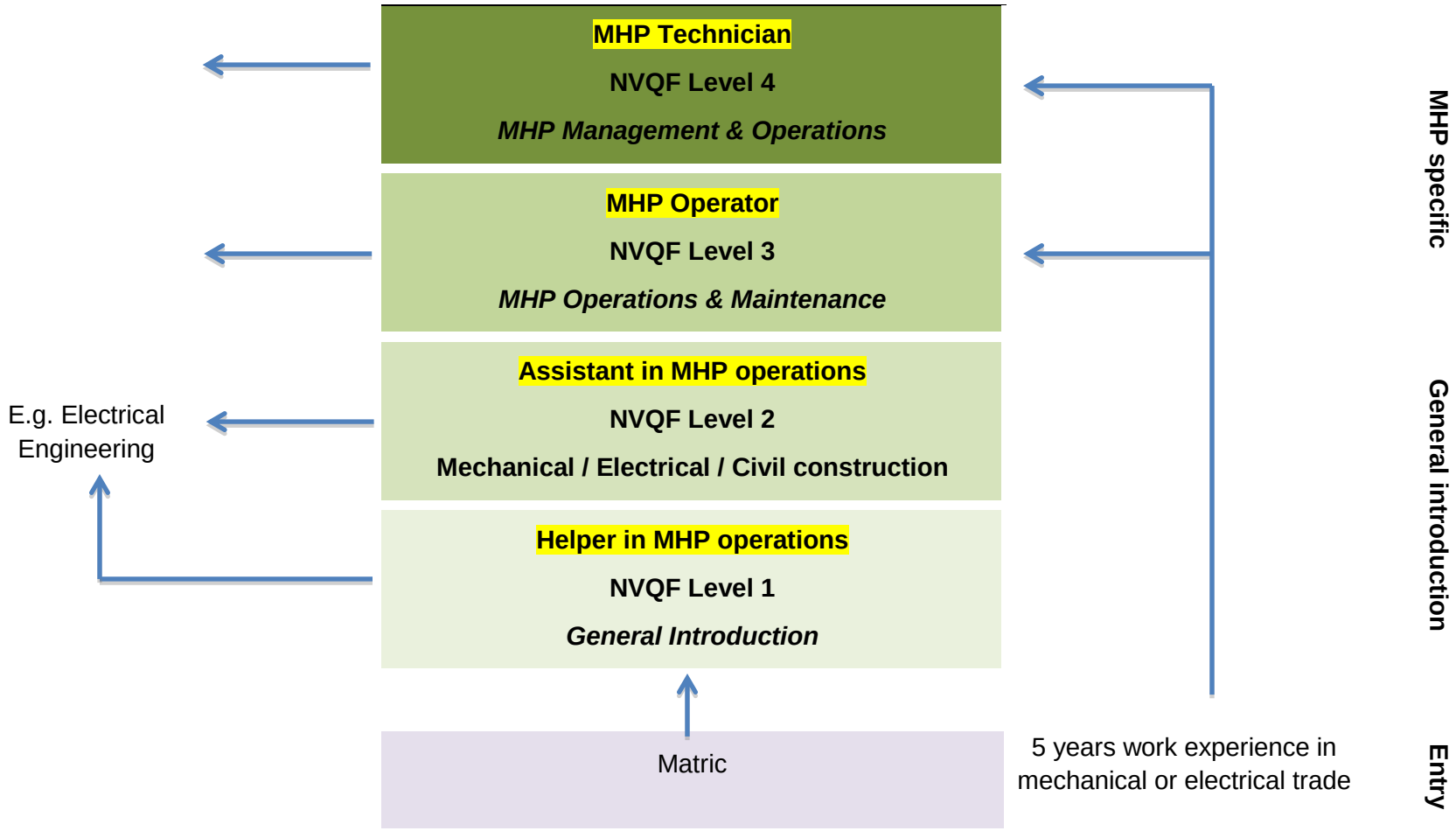
1.2 Course competencies

Curriculum modules (training input) are clusters of competencies expressed in learning units, learning outcomes, and learning elements. After successful completion of this course, the trainee has gained a range of competencies required to progress to the next NVQF level. The framework below reflects industry requirements expressed in competency standards (training output).



1.3 Job opportunities

The level 3 training course related to ***MHP operations (Operator)*** transfers employment skills and articulates with a number of other level 3 training programmes. Based on the design and flexible approach qualified trainees will find opportunities to continue their studies in MHP operations (Level 4) or persuade a career in e.g. Electrical, Mechanical or Civil Engineering as shown in the diagram below:



1.4 Trainee entry level

Individuals who wish to enter this course of study have to comply against the following criteria:

- NVQF level 2 qualification in MHP operations, or equivalent;
- Comfort level of English language and mathematics; (Read, write and speak English)
- Satisfactory completion of appropriate admission assessment test/interview.

1.5 Trainer requirements

Trainers who wish to offer this programme should meet one of the following requirements:

- B.Sc. Eng. and 2 years of relevant work experience; or
- B-Tech and 4 years of relevant work experience; or
- Diploma Associate Engineer (DAE) and 5 years relevant work experience; or
- Certificate issued by authentic authority/body as Electrician with a minimum of 8 years relevant work experience

Trainers offering this programme must be computer literate and be conversant with the delivery of competency-based education and training (CBET). All legislative requirements applicable to carry out training and assessment, if any, must be complied with.

1.6 Teaching strategies in a competency-based environment

Training in a competency-based environment differs from the traditional method of training delivery.It is based on defined competency standards, which are industry oriented.

The traditional role of a trainer changes and shifts towards the facilitation of training. A facilitator in CBET encourages and assists trainees to learn for themselves. Trainees are likely to work in groups (pairs) and all doing something different. Some are doing practical tasks in the workshop, some writing, some not even in the classroom or workshop but in another part of the building using specialist equipment, working on computers doing research on the Internet or the library. As trainees learn at different pace they might well be at different stages in their learning, thus learning must be tailored to suit individual needs.

The following facilitation methods (teaching strategies) are generally employed in CBET programs:

- **Direct Instruction Method:** This might beeffective when introducing a new topic to a larger group of trainees in a relative short amount of time. In most cases this method relies on one-way communication, hence there are limited opportunities to get feedback on the trainee's understanding.

- **Discussion Method:** This allows trainees to actively participate in sharing knowledge and ideas. It will help the trainer to determine whether trainees understand the content of the topic. On the other hand, there is a possibility ofstraying offtopic under discussion and some trainees dominating otherson their views.

- **Small Group Method:** Pairing trainees to help and learn from each other often results in faster knowledge/skill transfer than with the whole class. The physical arrangement of the classroom/workshop and individual assessment may be challenging.

- **Problem Solving Method:** This is avery popular teaching strategy for CBET. Trainees are challenged and are usually highly motivated when they gain new knowledge and skills by solvingproblems (Contingency skills). Trainees develop critical thinking skills and the ability to adapt to new learning situations (Transfer skills). It might be time consuming and because trainees sometimes work individually, they may not learn all the things that they are expected to learn.

- **Research Method:** This is used for workshops and laboratory tasks, field experiments, and case studies. It encourages trainees to investigate and find answers for themselves and to critically evaluate information. It however requires a lot of time and careful planning of research projects for the trainee.

1.7 Medium of instruction

Instructions will be provided in Urdu, local languages and/or English.

1.8 Sequence and delivery of the modules

The curriculum for ***Micro Hydel Power Plant operations (Operator) – NVQF level 3***, consists of three (2) modules and should be delivered in the following sequence:

Module 1: Plant operations

Learning units within this module can be delivered interchangeably as stand-alone module or in a holistic approach

Module 2: Corrective maintenance

Learning units within this module can be delivered interchangeably as stand-alone module or in a holistic approach

All theoretical content related to the modules should be delivered, where possible, in an applied setting related to the ***Micro Hydel Power Plant operations (Operator) – NVQF level 3*** work environment.

2. Overview about the programme: Curriculum for MHP operations (Operator) – NVQF Level 3

Module Title and Aim	Learning Units	Theory[1] hours	Workplace[2] hours	Timeframe of modules
Module 1: Plant operations ***Aim:*** To provide trainees with the knowledge and skills to safely operate and monitor an MHP plant, and perform routine maintenance.	**LU-1:** Conduct pre-start checks **LU-2:** Control and monitor plant operation **LU-3:** Perform preventive maintenance operations	**100**	**200**	**300**
Module 2: Corrective maintenance ***Aim:*** To provide trainees with the knowledge and skills to safely carry out corrective maintenance work required in MHP operations.	**LU-1:** Plan for corrective maintenance **LU-2:** Identification of fault and cause **LU-3:** Perform corrective maintenance	**60**	**140**	**200**

[1]Learning hours in training provider premises
[2]Training workshop, laboratory and on-the-job workplace

3. Curriculum Contents: *Micro Hydel Power Plant operations (Operator) – NVQF level 3*

Module 1:	**Plant operations**		
Objective of the Module:	On completion of this module the trainee will be able to demonstrate knowledge and skills according to the following competencies standards: • A: Operate and monitor Micro Hydel Power (MHP) plant • E: Maintain records in MHP operations • F: Carry out preventive maintenance procedures as part of MHP operations		
Duration:	Total: 300 hours	Theory: 100 hours	Practice: 200 hours

Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Conduct pre-start checks** *This learning unit addresses competency standard(s):* *A – A1/2** *E – E1/2** *F – F2** ** In absence of a national coding system, internal training provider codes are being used*	1.1 Demonstrate safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation, lockout and Tag-out • Earthing methods • PPE • Material handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 60 **Theory** 20 **Practical** 40	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring and calibration tools and equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with*	• Classroom • Workplace
	1.2 Demonstrate daily plant and auxiliary equipment checks	Transmission and distribution lines • Line and pole damage • Nearby tree branches			

		• Water reservoir level • Other obstacles Waterway facilities • Structural damage • Sand sedimentation in front of intake • Suspended trash at the screens • Sand sedimentation in the setting basin and fore bay • Water leakage or overflow Turbine, generator/alternator, and controller • Visual inspection • Wear of brush • Deformation or cracks • Mechanical malfunction - sound - Alignment - vibration - temperature - oil leakage Insulation resistance of the circuit		*internet access)*	

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-2: **Control and monitor plant operation** *This learning unit addresses competency standard(s):* *A – A2/3** *E – E1/2** ** In absence of a national coding system, internal training provider codes are being used*	2.1 Demonstrate power plant operation	Safety and regulatory requirements • Hazard identification Knowledge of plant components and auxiliary equipment • Turbine (including RPM Max & Min for safe operation) • Generator/Alternator • Control system • Water conveyance system • Spillway gates • Valves Instruments and gauges Water intake • Adjustment procedure • Monitoring procedure • Common mechanical faults Water conveyance system • Operation procedure • Monitoring procedure • Common mechanical faults Turbine, generator/ alternator, control system • Operation procedure	**Total** 130 **Theory** 50 **Practical** 80	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring and calibration tools and equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace

		• Monitoring procedure • Common electrical faults Auxiliary equipment • Operation procedure • Monitoring procedure Procedures for detecting deviations • Corrective measures			
	2.2 Complete documentation	Maintain log book and forms • Site recording, status of plant • Malfunctions, irregularities • Material requirements Storing and communicating information • Storing and caring procedures • Incident reporting • Daily, Weekly and Monthly reporting			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-3: **Perform preventive maintenance operation** *This learning unit addresses competency standard(s):* *F – F3** *E – E1/2** ** In absence of a national coding system, internal training provider codes are being used*	3.1 Demonstrate safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation, lockout and Tag-out • Earthing methods • PPE • Manual handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 110 **Theory** 30 **Practical** 80	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring and calibration tools and equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace
	3.2 Demonstrate procedures for preventive maintenance	Maintenance procedures • Preventive maintenance schedule - chart - check list • Hazard identification • Consequences of **NOT** performing preventive			

		maintenance • Remove debris • Flush out sand sedimentation • Remove sand and rocks • Reduce water intake • Remove/Replace worn or faulty components Documentation Final quality inspection procedure Housekeeping • Waste disposal • Care of tools and equipment • Work order			

Module 2:	Corrective maintenance				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • B: Carry out corrective maintenance procedures on electrical components in a MHP plant • C: Carry out corrective maintenance procedures on mechanical components in a MHP plant • D: Carry out corrective maintenance procedures on civil structure components in a MHP plant • E: Maintain records in MHP operations				
Duration:	Total: 200 hours	Theory: 60 hours		Practice: 140 hours	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Plan for corrective maintenance** *This learning unit addresses competency standard(s):* *B – B1** *C – C1** *D – D1** ** In absence of a national coding system, internal training provider codes are being used*	1.1 Demonstrate safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation, lockout, Tag-out • Earthing methods • PPE • Material handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 35 **Theory** 15 **Practical** 20	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring and calibration tools and equipment • Testing equipment	• Classroom • Workplace
	1.2 Interpret electrical/mechanical/ civil structure component specifications	Drawings and symbol specifications • Sketches • Engineering drawings		• Teaching aids • Flip charts • Technical drawing equipment	

		- line types - projection techniques - dimensions - sections - symbols Use and calibration of tools and equipment • hand tools • hand-held powered		• Computer *(preferably with internet access)*	

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-2: **Identification of fault and cause** *This learning unit addresses competency standard(s):* *B – B2** *C – C2** *D – D2** ** In absence of a national coding system, internal training provider codes are being used*	2.1 Demonstrate safe assessment/ diagnostic procedures 2.2 Identification of Civil issues	Hazard identification Visual inspection, testing Mechanical components • Turbine • Drive system • Gearbox • Belt, pulley • Chain and sprocket • Mechanical load controller Electrical components • Generator/Alternator • Control panel • Electronic load controller • Power transformer • Transmission and distribution lines Civil structure components • Weir and intake • Channel • Settling basin • Spillways • Fore bay tank • Penstock • Other components	**Total** 55 **Theory** 15 **Practical** 40	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring and calibration tools and equipment • Testing equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace

	2.2 Assess deviations and/or faulty components 2.3 Implement fault identification procedure	Condition assessment / fault identification procedure • Mechanical components • Electrical components • Civil structure components			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-3: **Perform corrective maintenance** *This learning unit addresses competency standard(s):* *B – B3/4** *C – C3/4** *D – D3/4** *E – E1/2** ** In absence of a national coding system, internal training provider codes are being used*	3.1 Demonstrate safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • Earthing methods • PPE • Material handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting • Storage and stacking of tools and equipment	**Total** 110 **Theory** 30 **Practical** 80	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring and calibration tools and equipment • Testing equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace
	3.2 Dismantle/Remove/ Repair / Fix/ Amend/ Build component	Dismantle/Remove/ Repair / Fix/Amend/Build procedures • Mechanical components • Electrical components • Civil structure components			
	3.3 Carry out post-repair testing	Procedures for post-repair testing			
	3.4 Complete work	Documentation (Final) Final quality inspection Housekeeping • Waste disposal • Tet Run ***** • Care of tools & equipment			

4. Assessment guidance

Competency-based assessment is the process of gathering evidence to confirm the candidate's ability to perform according to specified outcomes articulated in the competency standard(s).

4.1 Types of assessment

a) Sessional assessment

The goal ofsessional assessment is to monitor student progress in order to provide constant feedback. This feedback can be used by the trainers to improve their teaching and by learners to improve their learning.

More specifically, sessional assessments Help learners to identify their strengths and weaknesses and Help trainers to recognize where learners are struggling and address problems immediately

Examples of sessional assessments include:

- Observations
- Presentations
- Activity sheets
- Project work
- Oral questions

b) Summative (final) assessment

The goal of summative (final) assessment is to evaluate learning progress at the end of a training programme by comparing it against, e.g. set of competency standards.

Examples of summative assessments include:

- Direct observation of work activities
- Final project
- Written questions

4.2 Principles of assessment

When conducting assessment or developing assessment tools, trainers/assessors need to ensure that the following principles of assessment are met:

Validity

- Indicates if the assessment outcome is supported by evidence. The assessment outcome is valid if the assessment methods and materials reflect the critical aspects of evidence required by the competency standards (Competency units, performance criteria, knowledge and understanding).

Reliability

- Indicates the level of consistency and accuracy of the assessment outcomes. The assessment is reliable if the assessment outcome will produce the same result for learners with equal competence at different times or places, regardless of the trainer or assessor conducting the assessment.

Flexibility

- Indicates the opportunity for learners to discuss certain aspects of their assessment with their trainer or assessor, such as scheduling the assessment. All learners should be made aware of the purpose of assessment, the assessment criteria, the methods and tools used, and the context and proposed timing of the assessment well in advance. This can be achieved by drawing up a plan for assessment.

Fair assessment

- Fair assessment does not advantage or disadvantage particular learners because of status, race, beliefs, culture and/or gender. This also means that assessment methods may need to be adjusted for learners with disabilities or cultural differences. An assessment should not place unnecessary demands on learners that may prevent them from demonstrating competence.

4.3 Assessment template – Sessional and Summative assessment

Module 1: Plant operations

Learning Units	Recommended form of assessment	
	Sessional	**Summative**
LU-1: Conduct pre-start checks *This learning unit addresses competency standard(s):* *A – A1/2*; E – E1/2*; F – F2** ** In absence of a national coding system, internal training provider codes are being used*	• Observation • Activity sheets • Simulation • Oral and written questions • Demonstration	<u>Integrated assessment:</u> Practical demonstration/ Project work on plant operation to include: a) Pre-start checks b) Controlling and monitoring operation c) Preventive maintenance The assessment tasks have to include aspects of health and safety, use of tools, knowledge of MHP components, and documentation
LU-2: Control and monitor plant operation *This learning unit addresses competency standard(s):* *A – A2/3*; E – E1/2** ** In absence of a national coding system, internal training provider codes are being used*		
LU-3: Perform preventive maintenance operation *This learning unit addresses competency standard(s):* *F – F3*; E – E1/2** ** In absence of a national coding system, internal training provider codes are being used*		

Module 2: Corrective maintenance

Learning Units	Recommended form of assessment	
	Sessional	**Summative**
LU-1: Plan for corrective maintenance *This learning unit addresses competency standard(s):* *B – B1*; C – C1*; D – D1** ** In absence of a national coding system, internal training provider codes are being used*	• Observation • Activity sheets • Role play Oral and written questions	Integrated assessment: Practical demonstration/ Project work on plant operation to include: a) Pre-start checks b) Troubleshooting c) Preventive maintenance The assessment tasks have to include aspects of health and safety, use of tools, knowledge of MHP components, and documentation
LU-2: Perform troubleshooting *This learning unit addresses competency standard(s):* *B – B2*; C – C2*; D – D2** ** In absence of a national coding system, internal training provider codes are being used*		
LU-3: Perform corrective maintenance *This learning unit addresses competency standard(s):* *B – B3/4*; C – C3/4*; D – D3/4*; E – E1/2** ** In absence of a national coding system, internal training provider codes are being used*		

5. List of Tools, Machinery & Equipment

Occupational title	Micro Hydel Power Plant operations (Operator) – Level 3	
Duration	**6 months**	
Sr. No.	**Name of Item/ Equipment / Tools**	**Quantity**
	Mechanical	
1.	7 pieces screwdriver set	
2.	Adjustable wrench set	
3.	Allen Keys Set	
4.	Aluminum Spirit Level (leveling instrument)	
5.	Bastard File with wood handle (Flat)	
6.	Bastard File with wood handle (Round)	
7.	Bench Vice	
8.	Bench Workstation	
9.	Chisel	
10.	Clamp Meter	
11.	Claw hammer with wood handle	
12.	Combination Pliers	
13.	Crimping Tool	
14.	Hack Saw with Blades	
15.	Hand Drill [1/8" – 1/8"]	
16.	Hand Grease Gun	

17.	Hand Grinding Machine	
18.	Hot Air Blower	
19.	Measuring tape	
20.	Micro Meter [Screw Gauge]	
21.	Nose Plier	
22.	Oil Can	
23.	Pedestal Drill	
24.	Pen Grinder	
25.	Pipe Wrench [18" & 24"]	
26.	Portable Welding Plant [100 – 300 Amperes]	
27.	Puller	
28.	Punch Set	
29.	Retched Block with Grip	
30.	Screw Driver Set (-)[6"-18"]	
31.	Screw Driver Set (+) [6"-18"]	
32.	Side Cutting Plier	
33.	Spanner Set (Open)	
34.	Spanner Set (Ring)	
35.	Stainless Steel Slogging Ring Spanner	
36.	Thread Gauge	
37.	Tong/Monkey Plier	
38.	Vernier Calliper	

39.	Wheel Grinder	
40.	Wire Gauge	
41.	Welding Plant	
Electrical		
1.	Clamp Meter	
2.	Combination Plier	
3.	Earth Tester	
4.	Line Tester	
5.	Megger	
6.	Multi Meter	
7.	Nose Plier	
8.	Pin Plier	
9.	Screw Driver Set	
10.	Side Cutter	
Safety Tools		
1.	Fire Extinguisher	
2.	First Aid Box	
3.	Hand Gloves	
4.	Hard top Hat	
5.	Mask	
6.	Overall combination [Dress]	
7.	Safety Belt	

8.	Safety Goggles	
9.	Steel Toe Shoes	
EQUIPMENT		
Civil		
1.	Air Vent Pipe	
2.	Bell Mouth	
3.	Control Gates	
4.	Control Valves	
5.	Expansion Joint	
6.	Flanges	
7.	Flushing Gates	
8.	Flushing Pipe	
9.	Penstock	
10.	Reducer	
11.	Rubber Seal	
12.	Trash Rack	
Electrical		
1.	Ballast Tank with Heaters	
2.	Binding wire	
3.	Cable Shoe	
4.	Channel Iron	
5.	Conductors	

6.	D-Iron Set	
7.	Disc Insulator [With Tension Set]	
8.	Earth Wire	
9.	Earthing Plate	
10.	Electrical Panels	
11.	Electronic Load Controller	
12.	Energy Meter	
13.	Generator[Brushed and Brush-less]	
14.	Metal Clad Main Switch	
15.	Pin Insulator	
16.	Pole	
17.	Power Cable	
18.	Pressure Transducer	
19.	Shackle Insulator	
20.	Stay Insulator	
21.	Stay Plate	
22.	Stay Rod	
23.	Stay Wire	
24.	Thimble	
25.	Transformer	
26.	Turn Buckle	
27.	Ultra Sonic Flow Meter	

Mechanical		
1.	Angle Iron [Cross Arm]	
2.	Butterfly Valve	
3.	Coupling [Flexible/Rigid]	
4.	Crossflow Turbine	
5.	Flat Belt	
6.	Flat Pulleys	
7.	Fly Wheel	
8.	Francis Turbine	
9.	Gate Valve	
10.	Gear Box	
11.	Governor	
12.	Hydraulic Jack	
13.	Operating Rod	
14.	Pelton Turbine	
15.	Propeller/Kaplan Turbine	
16.	Single Phase Variac [Auto Transformer]	
17.	Tachometer	
18.	V Belt	
19.	V-Pulleys	

6. List of Consumable Supplies

Occupational title	Micro Hydel Power Plant operations (Operator) – Level 3	
Duration	6 months	
Sr. No.	**Name of Consumable Supplies**	**Quantity**
1.	Notepad	
2.	Ball pens	
3.	Pencils	
4.	Erasers	
5.	Sharpeners	
6.	White board markers in different colours	
7.	Stapler	
8.	Paper punch	
9.	Ruler	
10.	Compass	

National Vocational & Technical Training Commission (NAVTTC)
5th Floor Evacuee Trust Complex Sector F-5/1,
Islamabad.
T +92 51 904404
F +92 51 904404
E info@navttc.org
I http://www.navttc.org/