MICRO HYDRO POWER PLANT TECHNOLOGY

CBT Curriculum

National Vocational Certificate Level 2

Version 1 - July 2015

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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.

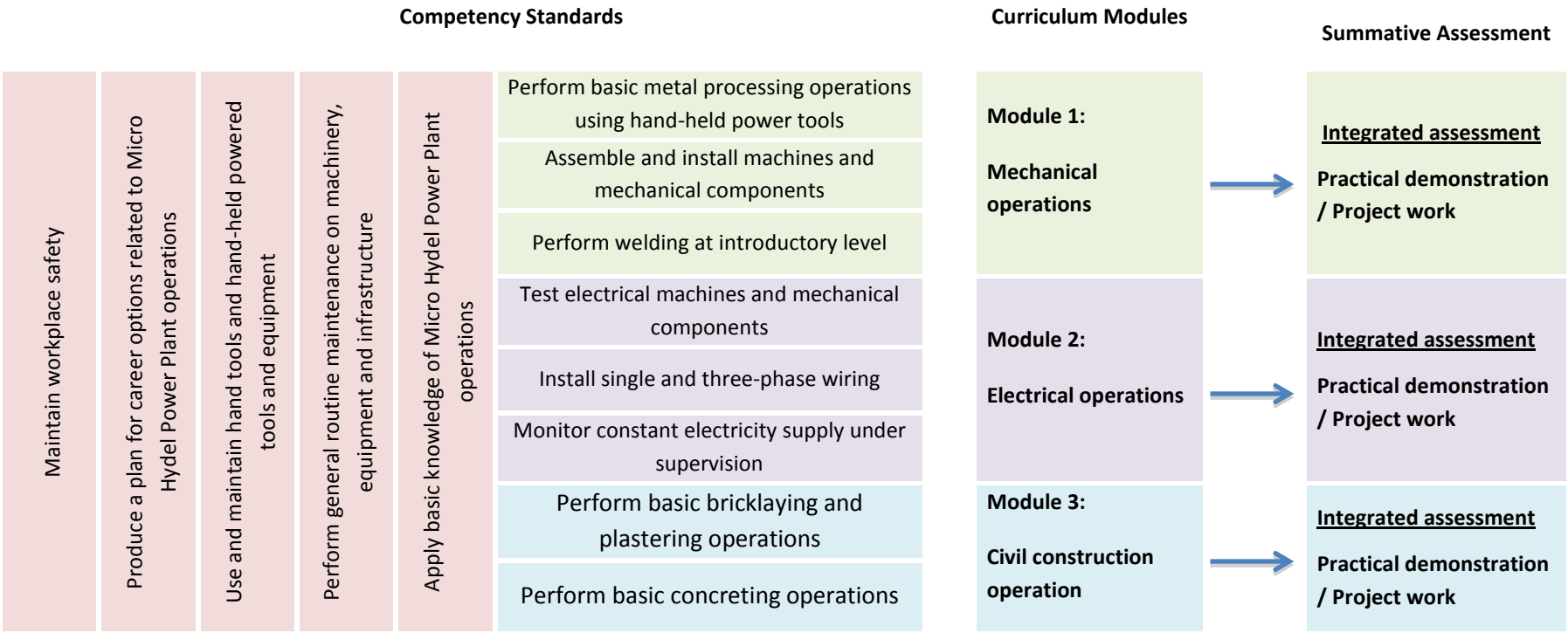
The curriculum for ***Micro Hydel Power Plant operations (Assistant) – Level 2*** aims to respond to this demand. It has been developed as an outcome-based course designed to transfer a range of skills needed to succeed in a high-performance work environment, as defined by labour market requirements. Although the course design is aimed for further progression to the Micro Hydel Power Plant operations (Operator) - NVQF level 3 programme, it seamlessly articulates horizontally and vertically with other training programmes at NVQF level 2 in a number of Electrical 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 basic knowledge and skills in mechanical, electrical and civil construction areas, required to accomplish a career in MHP operations.

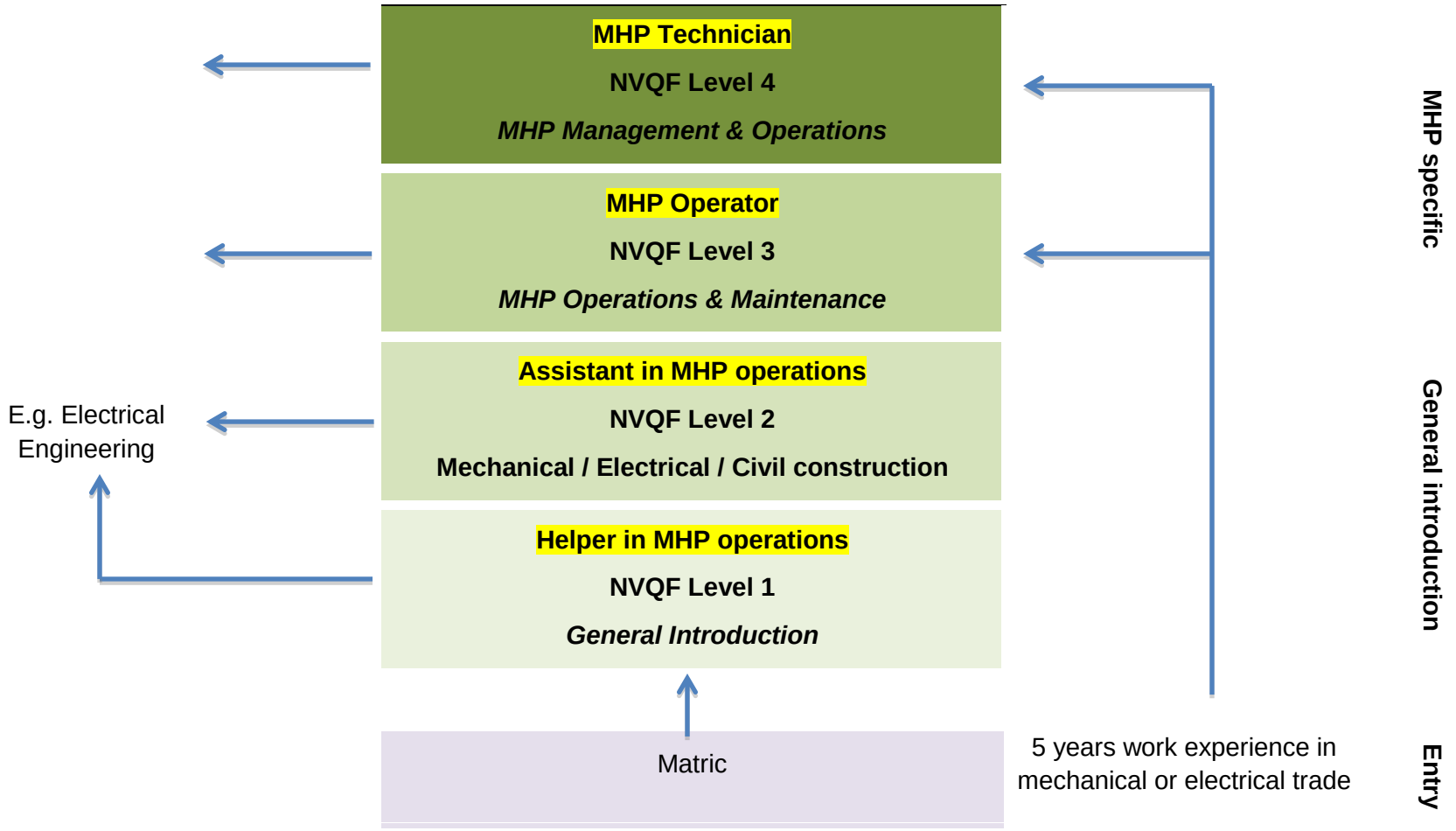
1.2 Course competencies

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 2 training course related to ***MHP operations (Assistant)*** transfers employment skills and articulates with a number of other level 2 training programmes. Based on the design and flexible approach qualified trainees will find opportunities to continue their studies in MHP operations (Level 3) or persuade a career in e.g. Electrical 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 1 qualification in MHP operations, or equivalent;
- Comfort level of English language and mathematics;
- 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 5 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 betailored to suit individual needs.

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

- **Direct Instruction Method:** This might be effective 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 (Assistant) – NVQF level 2***, consists of three (3) modules and should be delivered in the following sequence:

Module 1: Mechanical operations

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

Module 2: Electrical operations

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

Module 3: Civil construction operations

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 (Assistant) – NVQF level 2*** work environment.

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

Module Title and Aim	Learning Units	Theory[1] hours	Workplace[2] hours	Timeframe of modules
Module 1: Mechanical operations ***Aim:*** To provide trainees with the knowledge and skills to safely carry out basic mechanical operations required in an MHP work environment	**LU-1:** Inspect and maintain turbines **LU-2:** Inspect and maintain drive systems **LU-3:** Inspect and maintain mechanical speed governors **LU-4:** Inspect and maintain valves and gauges **LU-5:** Perform welding and metal processing	**100**	**400**	**500**

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

Module 2: Electrical operations ***Aim:*** To provide trainees with the knowledge and skills to safely carry out basic electrical operations required in an MHP work environment	**LU-1:** Inspect and maintain generators/alternators **LU-2:** Inspect and maintain electronic load controllers **LU-3:** Inspect and maintain power transformers **LU-4:** Inspect and maintain transmission and distribution lines **LU-5:** Perform wiring	**120**	**300**	**420**
Module 3: Civil construction operations ***Aim:*** To provide trainees with the knowledge and skills to safely carry out basic civil construction operations required in an MHP work environment	**LU-1:** Perform maintenance on infrastructure **LU-2:** Perform brick and concrete work **LU-3:** Produce plan for career	**80**	**200**	**280**

3. Curriculum Contents: *Micro Hydel Power Plant operations (Assistant) – NVQF level 2*

Module 1:	**Mechanical 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: Maintain workplace safety • C: Perform general routine maintenance on machinery, equipment and infrastructure • D: Perform welding at introductory level • E: Perform basic metal processing operations using hand-held powered tools • F: Assemble and install machines and mechanical components • G: Use and maintain hand tools and hand-held powered tools and equipment • I: Apply basic knowledge of Micro Hydel Power Plant operations				
Duration:	Total: 500 hours	Theory: 100 hours		Practice: 400 hours	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Inspect and maintain turbines** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – C1/2/3/4** *F – F1/2/3/4** *G – G2/4** *I – I2** ** In absence of a national coding system, internal training provider codes are being used*	1.1 Perform safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • PPE • operate turbine manually • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 155 **Theory** 25 **Practical** 130	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring tools and equipment	• Classroom • Workplace

	1.2 Describe different types of turbines	Impulse turbines • Pelton Wheel • Turgo • Cross-flow • Multi-jet Pelton Reaction turbines • Francis • Propeller • Kaplan		• Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	
	1.3 Conduct routine inspection and maintenance procedure	Safety and regulatory requirements • Hazard identification Drawings and symbol specifications • Sketches • Engineering drawings - line types - projection techniques - dimensions - sections - symbols Use and adjustment of tools and equipment • hand tools • hand-held powered			

		Common turbine faults Measurement and adjustment procedures Maintenance procedure for turbines Documentation • Maintenance report			
	1.4 Perform turbine assembling and installing procedures	Assembling and installation requirements • Hazards • Tools and equipment Procedures for assembling and installing Pre-commission procedure • Reporting			
	1.5 Adopt testing procedures	Functional test and adjustments • Hazards Permit closing Methods of turbine testing Documentation (Final) Final quality inspection procedure Housekeeping • Waste disposal • Care of tools and equipment			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-2: **Inspect and maintain drive systems** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – C1/2/3/4** *F – F1/2/3/4** *G – G2/4** *I – I2** ** In absence of a national coding system, internal training provider codes are being used*	2.1 Apply safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • PPE • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 155 **Theory** 25 **Practical** 130	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring tools and equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace
	2.2 Describe drive systems and auxiliary components	Drive system and auxiliary components, e.g.: • Belts • Levers • Bearings • Shafts • Chains and sprockets • gearbox • Pulleys • Fasteners • Keys			

	2.3 Carry out routine inspection and maintenance procedure	Safety and regulatory requirements • Hazard identification Drawings and symbol specifications • Sketches • Engineering drawings - line types - projection techniques - dimensions - sections - symbols Use and adjustment of tools and equipment • hand tools • hand-held powered Common drive system faults Measurement and adjustment methods Maintenance procedure for drive systems Documentation • Maintenance report			
	2.4 Adopt drive system assembling and installing procedures	Assembling and installation requirements • Hazards			

		• Tools and equipment Procedures for assembling and installing Pre-commission procedure Reporting			
	2.5 Apply testing procedures	Functional test and adjustments • Hazards Permit closing Methods of drive system testing Documentation (Final) Final quality inspection procedure Housekeeping • Waste disposal • Care of tools and equipment			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-3: **Inspect and maintain mechanical speed governors** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – C1/2/3/4** *F – F1/2/3/4** *G – G2/4** *I – I2** ** In absence of a national coding system, internal training provider codes are being used*	3.1 Perform safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • PPE • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 70 **Theory** 20 **Practical** 50	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring tools and equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace
	3.2 Describe purpose of mechanical speed governors	Mechanical speed governors • stabilise voltage output • stabilise frequency			
	3.3 Carryout routine inspection and maintenance procedure	Safety and regulatory requirements • Hazard identification Drawings and symbol specifications • Sketches • Engineering drawings			

		Use and adjustment of tools and equipment • hand tools • hand-held powered Common speed governor faults Measurement and adjustment procedures Maintenance procedure for speed governor Documentation • Maintenance report			
	3.4 Apply drive system assembling and installing procedures	Assembling and installation requirements • Hazards • Tools and equipment Procedures for assembling and installing Pre-commission procedure • Reporting			

	3.5 Apply testing procedures	Functional test /adjustments • Hazards Permit closing Procedures for speed governor testing Documentation (Final) Final quality inspection procedure Housekeeping • Waste disposal Care of tools and equipment			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-4: **Inspect and maintain valves and gauges** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – C1/2/3/4** *F – F1/2/3/4** *G – G2/4** *I – I2** ** In absence of a national coding system, internal training provider codes are being used*	4.1 Apply safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • PPE • First aid procedures • Evacuation procedures • Storage and stacking of tools and equipment	**Total** 65 **Theory** 15 **Practical** 50	• Fire extinguisher • Fire blanket • Fire bucket • Safety signage • Personal protective equipment and clothing • Hand tools • Hand-held powered tools • Measuring tools and equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace
	4.2 Identify types of valves and gauges	Types of valves may include but are not limited to: • Industrial valve • Ball valve • Gate valve • Flow control valve Types of gauges may include but are not limited to: • Commercial pressure gauge • Industrial pressure gauge • Low pressure gauges			

	4.3 Perform routine inspection and maintenance procedure	Safety and regulatory requirements • Hazard identification Drawings and symbol specifications • Sketches Engineering drawings Use and adjustment of tools and equipment • hand tools • hand-held powered Common valve/gauge faults Measurement and adjustment procedures Maintenance procedure for valves/gauges Documentation • Maintenance report			
	4.4 Perform valve assembling and installing procedures	Assembling and installation requirements • Hazards • Tools and equipment Procedures for assembling and installing Pre-commission procedure Reporting			
	4.5 Demonstrate testing procedures of valves and gauges	Functional test /adjustments • Hazards Permit closing Procedures for valve testing			

		Procedures for gauge testing Documentation (Final) Final quality inspection procedure Housekeeping • Waste disposal Care of tools and equipment			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-5: **Perform welding and metal processing** *This learning unit addresses competency standard(s):* *A – A1/2/3** *D – D1/2/3** *E – E1/2/3/4** *G – G2/4** ** In absence of a national coding system, internal training provider codes are being used*	5.1 Perform safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • PPE • Material handling • First aid procedures • Safty Precautions • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**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 • Welding equipment • Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace
	5.2 Describe different welding processes	Welding processes • Gas welding • Manual Metal Arc Welding • TIG welding • MIG/MAG welding Tools and equipment • Connections • Hose • Regulator • Torch • Cables • Gas cylinder • Cable insulation			

		• Filler metals • Welding rods • Welding wire • Welding PPE			
	5.3 Demonstrate welding procedures	Welding safety • Electric shock • Burns • Fumes • Noise • Hard/hot particles • Dust Interpret drawings and symbol specifications • Sketches Engineering drawings Welding procedures • Factors affecting quality weld Defective weld identification			

	5.4 Perform grinding and drilling operations	Safety procedures • Hazards • Tools and equipment Types of grinding/cutting disks • Application • Metal types and properties • Grinding procedures Drilling • Types of drills • Accessories • Lubricants • Accessories • Drill speed and feed • Drilling procedures Housekeeping • Waste disposal • Care and storage of tools and equipment			

Module 2:	Electrical operations				
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: • A: Maintain workplace safety • C: Perform general maintenance on machinery, equipment and infrastructure • G: Use and maintain hand tools and hand-held powered tools and equipment • H: Test electrical machines and mechanical components • I: Apply basic knowledge of Micro Hydel Power Plant operations • L: Install single and three-phase wiring • M: Monitor constant electricity supply under supervision				
Duration:	Total: 420 hours	Theory: 120 hours		Practice: 300 hours	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Inspect and maintain generator/alternator** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – 1/2/3/4** *G – G1/4** *H – H1/2/3** *I – I1** ** In absence of a national coding system, internal training provider codes are being used*	1.1 Apply safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • Earthing methods • PPE • Manual handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 170 **Theory** 30 **Practical** 140	• 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 Describe different types of generator/alternator	Types of generator/alternator • Synchronous • Induction		• Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	
	1.3 Perform routine inspection and maintenance procedure	Safety and regulatory requirements • Hazard identification Drawings and symbol specifications • Sketches • Engineering drawings - line types - projection techniques - dimensions - sections - symbols Use and calibration of tools and equipment • hand tools • hand-held powered tools • Common generator/alternator faults • Measurement and adjustment procedures • Maintenance procedure for generator/alternator • Documentation • Maintenance report			

	1.4 Demonstrate generator/alternator testing and diagnostic procedures	Visual inspection • Cracks • Noise • Disorder in shape and structure • Broken parts Testing and diagnostic procedures • Electrical and mechanical parameters • Locating and identifying faults			•
	1.5 Demonstrate procedure for repairing/replacing	Procedures for repair/replacement Procedures for operational testing Documentation (Final) Final quality inspection Housekeeping • Waste disposal • Care of tools and equipment			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-2: **Inspect and maintain electronic load controller** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – C1/2/3/4** *G – G2/4** *H – H1/2/3** *I – I2** *M – M1/2/3** ** In absence of a national coding system, internal training provider codes are being used*	2.1 Apply safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • Earthing methods • PPE • Manual handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 50 **Theory** 20 **Practical** 30	• 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 Describe purpose and basic function of electronic load controller	Electronic load controller • Output power control • Load and frequency stabilisation			

	2.3 Perform routine inspection and maintenance procedure	Safety and regulatory requirements • Hazard identification • Drawings, symbol and specifications • Sketches • Engineering drawings - line types - projection techniques - dimensions - sections - symbols Use and calibration of tools and equipment • hand tools • hand-held powered Common electronic load controller faults Measurement and adjustment procedures Maintenance procedure for electronic load controller Documentation • Maintenance report			
	2.4 Demonstrate electronic load controller testing and diagnostic procedures	Visual inspection • Cracks • Noise • Disorder in shape and structure			

		• Broken parts Testing and diagnostic procedures • Electrical and mechanical parameters Locating and identifying faults			
	2.5 Demonstrate procedure for repairing/replacing	• Procedures for repair/replacement • Procedures for operational testing • Documentation (Final) • Final quality inspection Housekeeping • Waste disposal • Care of tools and equipment			
	2.6 Monitor load supply	Load schedule review • Check layout plan • Check input and output voltages • Check voltage drops • Calculate voltage drops, overloading and load balance Set distribution priority • Priority plan • Reschedule load Monitor main and ballast			

		load • Electrical load • Power consumption • Voltage drops • Logout/tag out			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-3: **Inspect and maintain power transformer** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – C1/2/3/4** *G – G2/4** *H – H1/2/3** *I – I2** ** In absence of a national coding system, internal training provider codes are being used*	3.1 Apply safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • Earthing methods • PPE • Manual handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 100 **Theory** 30 **Practical** 70	• 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 Describe purpose and basic function of power transformer	Power transformer • Step-down transformer • Step-up transformer			

	3.3 Demonstrate routine inspection and maintenance procedure	• Common power transformer faults • Measurement and adjustment procedures • Maintenance procedure for power transformer • Maintenance report			
	3.4 Demonstrate power transformer testing and diagnostic procedures	Visual inspection • Cracks • Noise • Broken parts Testing and diagnostic procedures • Electrical and mechanical parameters Locating and identifying faults			
	3.5 Discribe procedure for repairing/replacing	Procedures for repair/replacement Procedures for operational testing Documentation Final quality inspection Housekeeping • Waste disposal • Care of tools and equipment			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-4: **Inspect and maintain transmission and distribution lines** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – C1/2/3/4** *G – G2/4** *H – H1/2/3** *I – I2** ** In absence of a national coding system, internal training provider codes are being used*	4.1 Apply safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • Earthing methods • PPE • Manual handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 50 **Theory** 20 **Practical** 30	• 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
	4.2 Describe purpose of transmission and distribution lines	• Purpose and characteristics of transmission and distribution lines • Pole setting			
	4.3 Demonstrate routine inspection and maintenance procedure	Common transmission and distribution line faults Measurement and adjustment procedures Maintenance procedure for transmission and distribution lines Documentation • Maintenance report			

	4.4 Demonstrate transmission and distribution line testing and diagnostics	Visual inspection • Cracks • Broken parts Testing and diagnostic procedures • Electrical and mechanical parameters Locating and identifying faults • Documentation (Final) • Final quality inspection Housekeeping • Waste disposal Care of tools and equipment			
	4.5 Demonstrate knowledge of network design	Design • Number and route of low voltage (LV) distributors • Cross section of LV wire • Transformer at the end of LV distributor • Location of mid voltage (MV) and low voltage poles and their distance			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials,Tools and Equipments Reqired	Learning Place
LU-5: **Perform wiring** *This learning unit addresses competency standard(s):* *A – A1/2/3** *G – G2/4** *L – L1/2/3** ** In absence of a national coding system, internal training provider codes are being used*	5.1 Apply safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • Earthing methods • PPE • Manual handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 50 **Theory** 20 **Practical** 30	• 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
	5.2 Lay cables	Plan wiring layout • Distance to connection points • Estimation of materials Drawings and symbol specifications • Sketches • Engineering drawings - line types - projection techniques - dimensions - sections - symbols			

		Chiselling, ducting PVC and GI pipe wiring procedures Properties of cables • Application • Types of joints • Types and purpose of fixtures			
	5.3 Demonstrate procedures for wiring testing	Continuity Earthing Procedures for wiring testing Documentation			

Module 3:	Civil construction operations				
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: • A: Maintain workplace safety • B: Produce a plan for career options related to MHP operations • C: Perform general maintenance on machinery, equipment and infrastructure • G: Use and maintain hand tools and hand-held powered tools and equipment • I: Apply basic knowledge of Micro Hydel Power Plant operations • J: Perform basic concreting operations • K: Perform basic bricklaying and plastering operations				
Duration:	Total: 280 hours	Theory: 80 hours		Practice: 200 hours	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Perform maintenance on infrastructure** *This learning unit addresses competency standard(s):* *A – A1/2/3** *C – C1/2/3/4** *G – G2/4** *I – I3** ** 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 and lockout • PPE • Material handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 100 **Theory** 30 **Practical** 70	• 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	• Classroom • Workplace

	1.2 Demonstrate knowledge of civil structures in MHP operations	Purpose, design and features: • Weirs and intake • Channels • Settling basin • Spillway • Fore bay tank • Penstock		• Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	
	1.3 Demonstrate routine inspection and maintenance procedure of civil structures	Safety and regulatory requirements • Hazard identification Drawings, symbol and specifications • Sketches • Engineering drawings - line types - projection techniques - dimensions - sections - symbols Use of tools and equipment • hand tools hand-held powered Common faults on civil structures in MHP set up Maintenance procedure for turbines Documentation • Maintenance report			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-2: **Perform brick and concrete work** *This learning unit addresses competency standard(s):* *A – A1/2/3** *G – G3/4** *J – J1/2/3/4/5** *K – K1/2/3/4** ** In absence of a national coding system, internal training provider codes are being used*	2.1 Demonstrate safe workplace practices	• Hazard identification • Safety signs, barricades and symbols • Isolation and lockout • PPE • Manual handling • First aid procedures • Evacuation procedures • Fire safety, fire fighting procedures • Storage and stacking of tools and equipment	**Total** 155 **Theory** 35 **Practical** 120	• 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
	2.2 Demonstrate procedures for laying bricks	Safety and regulatory requirements • Hazard identification Drawing symbols & specs • Sketches Use of tools and equipment • hand tools • hand-held powered Mortar materials • Mixing ratio • Properties of cement and mortar • Masonry reinforcement Procedures for laying bricks			

	2.3 Demonstrate plastering procedures	Types of coat Tools and equipment Procedures for plastering masonry Documentation (Final) Final quality inspection procedure Housekeeping • Waste disposal • Care of tools and equipment			
	2.4 Demonstrate basic concreting procedures	Safety and regulatory requirements • Hazard identification Drawings symbol and specifications • Sketches Use of tools and equipment • hand tools • hand-held powered Procedures for digging excavation • Use of site pegs and safety signs • Trench and excavation support Procedures for casting concrete • Concrete mixing ratio • Concrete properties • Concrete reinforcement			

		Procedures for levelling concrete • Curing process that may include hosing, sprinklers, ponding, plastic sheeting Documentation (Final) Final quality inspection procedure Housekeeping • Waste disposal • Care of tools and equipment			

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place
LU-3: **Produce plan for career** *This learning unit addresses competency standard(s):* *B – B1/2** ** In absence of a national coding system, internal training provider codes are being used*	3.1 Gather information for a personal profile	• Analysis of own knowledge, skills and abilities • Description of personal profile and compatible options • Methods of research • Methods of prioritising best available options	**Total** 25 **Theory** 15 **Practical** 10	• Teaching aids • Flip charts • Technical drawing equipment • Computer *(preferably with internet access)*	• Classroom • Workplace
	3.2 Produce a plan for achieving future directions	• Career guidance plan			

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 recognise 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: Mechanical operations

Learning Units	Recommended form of assessment	
	Sessional	**Summative**
LU-1: Inspect and maintain turbines *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – C1/2/3/4*; F – F1/2/3/4*; G – G2/4*; I – I2** ** 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(s)/ Project work(s) on turbine, drive system, speed governors, valves and gauges to include: a) Inspection b) Maintenance c) Welding The assessment tasks have to include aspects of health and safety, use of tools, knowledge of MHP components, and documentation.
LU-2: Inspect and maintain drive systems *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – C1/2/3/4*; F – F1/2/3/4*; G – G2/4*; I – I2** ** In absence of a national coding system, internal training provider codes are being used*		
LU-3: Inspect and maintain mechanical speed governors *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – C1/2/3/4*; F – F1/2/3/4*; G – G2/4*; I – I2** ** In absence of a national coding system, internal training provider codes are being used*		
LU-4: Inspect and maintain valves and gauges *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – C1/2/3/4*; F – F1/2/3/4*; G – G2/4*; I – I2** ** In absence of a national coding system, internal training provider codes are being used*		
LU-5: Perform welding and metal processing *This learning unit addresses competency standard(s):* *A – A1/2/3*; D – D1/2/3*; E – E1/2/3/4*; G – G2/4** ** In absence of a national coding system, internal training provider codes are being used*		

Module 2: Electrical operations

Learning Units	Recommended form of assessment	
	Sessional	**Summative**
LU-1: Inspect and maintain generator/alternator *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – 1/2/3/4*; G – G1/4*; H – H1/2/3*; I – I1** ** In absence of a national coding system, internal training provider codes are being used*	• Observation • Activity sheets • Role play Oral and written questions	<u>Integrated assessment:</u> Practical demonstration(s)/ Project work(s) on generator/alternator, load controller, power transformer, transmission and distribution lines to include: a) Inspection b) Maintenance c) Wiring The assessment tasks have to include aspects of health and safety, use of tools, knowledge of MHP components, and documentation.
LU-2: Inspect and maintain electronic load controller *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – C1/2/3/4*; G – G2/4*; H – H1/2/3*; I – I2*; M – M1/2/3** ** In absence of a national coding system, internal training provider codes are being used*		
LU-3: Inspect and maintain power transformer *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – C1/2/3/4*; G – G2/4*; H – H1/2/3*; I – I2** ** In absence of a national coding system, internal training provider codes are being used*		
LU-4: Inspect and maintain transmission and distribution lines *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – C1/2/3/4*; G – G2/4*; H – H1/2/3*; I – I2** ** In absence of a national coding system, internal training provider codes are being used*		
LU-5: Perform wiring *This learning unit addresses competency standard(s):* *A – A1/2/3*; G – G2/4*; L – L1/2/3** ** In absence of a national coding system, internal training provider codes are being used*		

Module 3: Civil construction operations

Learning Units	Recommended form of assessment	
	Sessional	**Summative**
LU-1: Perform maintenance on infrastructure *This learning unit addresses competency standard(s):* *A – A1/2/3*; C – C1/2/3/4*; G – G2/4*; I – I3** ** 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(s)/ Project work(s) on infrastructure to include: a) Inspection b) Brick and concrete work The assessment tasks have to include aspects of health and safety, use of tools, knowledge of MHP components, career planning and documentation.
LU-2: Perform brick and concrete work *This learning unit addresses competency standard(s):* *A – A1/2/3*; G – G3/4*; J – J1/2/3/4/5*; K – K1/2/3/4** ** In absence of a national coding system, internal training provider codes are being used*		
LU-3: Produce plan for career *This learning unit addresses competency standard(s):* *B – B1/2** ** 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 (Assistant) – Level 2	
Duration	**12 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 (Assistant) – Level 2	
Duration	12 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	

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