

National Vocational and Technical Training Commission (NAVTTTC)

Competency Standards for Building Electrician cum PV Cell Installer

NVQF level 3

July 2014



Implemented by **giz** Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



Islamic Republic of Pakistan
اسلامی جمہوریہ پاکستان
Islāmi Jumhūrī-ye Pākistān



Table of Contents

Competency Standards

| | | |
|---|---|---------|
| A | Apply knowledge of entrepreneurial ideas |03 |
| B | Plan work and calculate cost |05 |
| C | Install three-phase wiring |06 |
| D | Perform distribution of electrical supply |07 |
| E | Perform corrective maintenance as part of electrical operations |08 |
| F | Install and commission off-grid solar PV system |09 |

| | |
|--|---------|
| Documents, policies, guidelines |11 |
|--|---------|

| | |
|----------------------------|---------|
| Tools and Equipment |11 |
|----------------------------|---------|

| | |
|--------------------|---------|
| Consumables |15 |
|--------------------|---------|

Competency Standards: Building Electrician cum PV Cell Installer - Level 3

Competency Standard A: Apply knowledge of entrepreneurial ideas

Overview: This competency standard is intended to assist people in applying knowledge of entrepreneurial ideas and qualities. People holding credit for this competency standard are able to: Demonstrate knowledge of the requirements of entrepreneurs; conduct business start-up activities; develop a financial strategy; develop a marketing strategy; and implement and control business financial strategy

| Competency Unit | Performance Criteria | Knowledge and Understanding |
|---|--|---|
| A1: Demonstrate knowledge of the requirements of entrepreneurs | P1- Identify the importance of entrepreneurs for Pakistan P2- Identify challenges of being an entrepreneur P3- Confirm and implement strategies for improving personal entrepreneurship qualities | K1- Types of verbal and non-verbal messages K2- Requirements and benefits of becoming an entrepreneur K3- Features of personal entrepreneurial assessment tools |
| A2: Conduct business start-up activities | P1- Select and secure business premises P2- Secure business operating clearance P3- Secure business support service | K1- Business premises requirements <ul style="list-style-type: none"> • Size • Location • Cost K2- Municipal guidelines and regulations K3- Application procedures |
| A3: Develop a financial strategy | P1- Estimate total cost of set up P2- Identify sources of funding P3- Estimate business expenses P4- Project profit and loss and cash flow P5- Establish and follow bank requirements | K1- Estimation and calculation K2- Conditions for funding K3- Basic accounting principles K4- Basic accounting principles K5- General bank requirements |

| | | |
|--|--|---|
| <p>A4: Develop a marketing strategy</p> | <p>P1- Identify potential profitable opportunities and target markets P2: Plan service and product delivery P3: Identify competitors operating in the industry P4: Identify methods of promotion</p> | <p>K1- Estimation and calculation K2- Customer expectations and satisfaction K3- Principles of a competitive market K4- Basic promotional and/or marketing concepts</p> |
| <p>A5: Implement and control business financial strategy</p> | <p>P1- Implement financial control system P2- Prepare financial statements and interpret results P3- Prepare and implement periodic plans and budgets P4- Maintain business cash and general liquidity</p> | <p>K1- Basic financial concepts K2- Basic financial concepts K3- Basic financial concepts K4- Basic financial concepts</p> |

Competency Standard B: Plan work and calculate cost

Overview: This competency standard is intended for skilled people in paid employment. People holding credit for this competency standard are able to: Interpret drawings, sketches and specifications; produce drawings and sketches; calculate material and labour cost.

| Competency Unit | Performance Criteria | Knowledge and Understanding |
|--|---|---|
| B1: Interpret drawings, sketches and specifications | P1- Identify and obtain safety and other regulatory requirements as per job requirement P2- Interpret and confirm layout plan P3- Identify distribution points | K1- Safety requirements; Specifications; Hazard identification K2- Drawings and symbols specifications K3- Drawings and symbols specifications |
| B2: Produce drawings and sketches | P1- Produce basic technical drawing and sketch P2- Dimension drawing and sketch correctly P3- Scale drawing and sketch | K1- Drawings and symbols specifications K2- Drawings and symbols specifications K3- Drawings and symbols specifications |
| B3: Calculate material and labour cost | P1- Identify location for installation P2- Estimate material requirements derived from produced drawing or sketch P3- Estimate labour cost for installation P4- Produce estimate of overall cost | K1- Location requirements K2- Estimation and calculation methods K3- Estimation and calculation methods K4- Estimation and calculation methods |

Competency Standard C: Install three-phase wiring

Overview: This competency standard is intended for those who carry out electrical operations. People holding credit for this competency standard are able to: Plan wiring layout; lay cable; perform wiring test; and complete work.

| Competency Unit | Performance Criteria | Knowledge and Understanding |
|--|---|---|
| C1: Plan wiring layout | P1- Draw wiring layout P2- Measure distance to connection points P3- Estimate material P4- Prepare tools, equipment and materials | K1- Interpretation of drawings, symbols, cable number according to load, and colour coding K2- Measuring of units and conversion K3- Quality of different conductor and insulator types K4- Application of tools, equipment and materials |
| C2: Lay cables | P1- Prepare installation of cable P2- Install conduit, GI pipes, PVC pipes and/or ducts P3- Pull-in cables P4- Connect cables P5- Connect fixtures | K1- Chiselling, ducting, PVC and GI pipe wiring procedures K2- Properties of materials K3- Application of cables and tools K4- Types of joints K5- Types and purpose of fixtures |
| C3: Perform wiring test | P1- Inspect wiring and distribution board P2- Conduct tests P3- Document test results | K1- Importance of continuity and factors of loose fittings K2- Application of equipment and tools used for testing; Importance of earthing K3- Importance of documenting compliance & noncompliance of test results and subsequent steps to be taken |
| C4: Complete work | P1- Complete work related documents and procedures P2- Perform final quality inspection P3- Clean up and store tools, equipment and materials | K1- Importance of documentation; Customer care procedures and techniques K2- Importance of quality; handing over to client K3- Waste disposal procedures; Care of tools and equipment |

Competency Standard D: Perform distribution of electrical supply

Overview: This competency standard is intended for those who carry out electrical operations. People holding credit for this competency standard are able to: review electrical load schedule, set distribution priority, monitor electrical load.

| Competency Unit | Performance Criteria | Knowledge and Understanding |
|--|--|---|
| D1: Review electrical load schedule | P1- Check layout plan P2- Check input & output voltages P3- Check voltage drops | K1- Interpretation of drawings, symbols, cable number, colour coding and electrical load schedule K2- Maintenance of input and output voltages K3- Methods of calculation of voltage drops, overloading and load balance |
| D2: Set distribution priority | P1- Review distribution priority plan P2- Reschedule electrical load as per distribution priority | K1- Interpretation of distribution priority plan K2- Methods of rescheduling of electrical loads |
| D3: Monitor electrical load | P1- Monitor electrical load (current) P2- Monitor power consumption (energy) P3- Monitor voltage drops P4- Perform logout/tag out | K1- Methods of current measurement (Amperes) K2- Methods of energy measurement in (KWH) K3- Methods of voltage drop measurement (Volt) K4- Methods of log out / tag out and labelling |

Competency Standard E: Perform corrective maintenance as part of electrical operations

Overview: This competency standard is intended for those who carry out electrical operations. People holding credit for this competency standard are able to: Plan and prepare for corrective maintenance; perform troubleshooting; carry out corrective maintenance procedures; and complete work.

| Competency Unit | Performance Criteria | Knowledge and Understanding |
|--|--|--|
| E1: Plan and prepare for corrective maintenance | P1- Identify and obtain safety and other regulatory requirements for maintenance P2- Interpret circuit diagrams P3- Identify and select tools and equipment | K1- Safety requirements; Specifications; Hazard identification K2- Drawings and symbols specifications K3- Tools and equipment and calibration thereof |
| E2: Perform troubleshooting | P1- Check for safety hazards P2- Carry out diagnostic procedures P3- Identify faulty parts and/or equipment P4- Analyse system fault | K1- Troubleshooting requirements K2- Identification of electrical faults by checking shape, size and colour of components and parts; Measurement of electrical parameters; Safety precautions K3- Methods of fault identification in electrical components K4- System operations in an electrical environment |
| E3: Carry out corrective maintenance procedures | P1- Dismantle faulty parts or components P2- Replace or repair faulty parts or components P3- Perform commissioning | K1- Dismantling procedures K2- Replacing and repairing procedures K3- Electrical load management; commissioning procedures |
| E4: Complete work | P1- Complete work related documents and procedures P2- Perform final quality inspection P3- Clean up and store tools, equipment and materials | K1- Importance of documentation; Customer care procedures and techniques K2- Importance of quality; handing over to client K3- Waste disposal procedures; Care of tools and equipment |

Competency Standard F: Install and commission off-grid solar PV system

Overview: This competency standard is intended for those who carry out electrical operations, including installation and commissioning of off-grid solar PV systems. People holding credit for this competency standard are able to: Plan and prepare for installation; mount a photovoltaic array on a roof; install and commission solar photovoltaic array; carry out maintenance on off-grid solar PV system; and complete work.

| Competency Unit | Performance Criteria | Knowledge and Understanding |
|--|---|--|
| <p>F1: Plan and prepare for installation</p> | <p>P1- Identify and obtain safety and other regulatory requirements for installation</p> <p>P2- Choose suitable location for the PV array and other components</p> <p>P3- Obtain tools, equipment and testing devices</p> <p>P4- Specify installation requirements for all system components to ensure correct operation, long life, safety and ease of maintenance</p> | <p>K1- Safety requirements; Specifications; Hazard identification</p> <p>K2- Factors influencing the efficiency of solar panels; Physical structure</p> <p>K3- Summer and winter requirements</p> <p>K4- Aesthetical aspects</p> |
| <p>F2: Mount a photovoltaic array on a roof</p> | <p>P1- Interpret and confirm installation in terms of roof construction and suitable mounting methods</p> <p>P2- Choose appropriate array frame for the roof type and determine and set correct tilt angle adjustments</p> <p>P3- Use correct fixing methods appropriate for the roof type</p> <p>P4- Place flashing and other waterproofing measures</p> | <p>K1- Roof constructions</p> <p>K2- Azimuth inclination</p> <p>K3- Relation of sun rays to a tilted surface</p> <p>K4- Fixing methods and waterproofing measures</p> |
| <p>F3: Install and commission solar photovoltaic array</p> | <p>P1- Install system components in suitable location</p> <p>P2- Connect PV panels and electrical components and minimise cable route length to minimise power loss</p> <p>P3- Arrange for earthing</p> <p>P4- Commission off-grid solar PV system</p> <p>P5- Confirm installation</p> | <p>K1- Installation requirements</p> <p>K2- Series and parallel circuit setup; Cable sizing; Forward and reverse diodes</p> <p>K3- Requirements for properly bonded earthing</p> <p>K4- Supervisor and/or client communication</p> |

| | | |
|---|---|---|
| <p>F4: Carry out operational checks</p> | <p>P1- Test and adjust component and/or parts P2- Confirm operation of PV system</p> | <p>K1- Functional tests and adjustments; Basic knowledge and calculation of open circuit voltage, on load voltage, short circuit current, maximum current load; Basic function of relay change over K2- Basic operation of PV system and settings to adjust performance</p> |
| <p>F5: Complete work</p> | <p>P1- Complete work related documents and procedures P2- Perform final quality inspection P3- Clean up and store tools, equipment and materials P4- Carry out customer induction on installed off-grid solar PV system</p> | <p>K1- Importance of documentation; Customer care procedures and techniques K2- Importance of quality; handing over to client K3- Waste disposal procedures; Care of tools and equipment K4- Communication skills</p> |

Documents, policies, guidelines:

- International Labour Organisation (ILO) Standards on Occupational Health and Safety
- Pakistan Electricity Act, 1910 and subsequent amendments
- Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA)
- Industry code of practice

Tools and Equipment:

| No. | Description | Quantity |
|-----|-------------------------------|----------|
| 1 | Personal protective equipment | |
| 2 | Fire extinguishers | |
| 3 | First aid box | |
| 4 | Adjustable wrench | |
| 5 | Amp meter | |
| 6 | AVO meter | |
| 7 | Batteries | |
| 8 | Battery charger | |
| 9 | Bench vice | |
| 10 | Ceiling hole cutter | |

| | | |
|-----------|--------------------|--|
| 11 | Charge controller | |
| 12 | Chisel | |
| 13 | Clamp on meter | |
| 14 | Compass | |
| 15 | Cutter | |
| 16 | Drill machine | |
| 17 | Earth tester meter | |
| 18 | Extension board | |
| 19 | File set | |
| 20 | First Aid box | |
| 21 | Gloves | |
| 22 | Goggles | |
| 23 | Grinder | |
| 24 | Hammer | |
| 25 | Hand drill machine | |
| 26 | Helmet | |
| 27 | Hertz meter | |
| 28 | Hexsaw | |
| 29 | Knife (cable) | |
| 30 | Level | |

| | | |
|-----------|---------------------------------------|--|
| 31 | L-key set | |
| 32 | Lock plier | |
| 33 | Measuring tape | |
| 34 | Megger meter (Analog & Digital) | |
| 35 | Micrometer | |
| 36 | Multimeter | |
| 37 | Number punch | |
| 38 | Phase sequence meter | |
| 39 | Pipe cutter | |
| 40 | Pipe vice | |
| 41 | Pipe wrench | |
| 42 | Plier set | |
| 43 | Punching tool (Networking /Telephone) | |
| 44 | Ratchet set | |
| 45 | Safety boots | |
| 46 | Scissor | |
| 47 | Screw driver set | |
| 48 | Soldering iron | |
| 49 | Spanner set | |
| 50 | Steel scale | |

| | | |
|-----------|------------------------------------|--|
| 51 | Steel wire | |
| 52 | synchronizing meter | |
| 53 | Tachometer | |
| 54 | Tester | |
| 55 | Thimble press | |
| 56 | Tong tester (clamp-on meter) AC/DC | |
| 57 | Torch | |
| 58 | Vernier caliper | |
| 59 | Volt meter | |
| 60 | Wire gauge | |
| 61 | Wood saw | |

Consumables:

| No. | Description | Quantity |
|-----|-------------------------|-------------|
| 1 | Cable 3 / .029" | As Required |
| 2 | Cable 7 / .029" | As Required |
| 3 | Cable 1 / .036" | As Required |
| 4 | Cable 23 / .0076" | As Required |
| 5 | Cable 40 / .0076" | As Required |
| 6 | Switch Single Way | As Required |
| 7 | Switch Two Way | As Required |
| 8 | Push Button | As Required |
| 9 | Bulb Holder Piano Type | As Required |
| 10 | Bulb Holder Button Type | As Required |
| 11 | Ceiling Rose | As Required |
| 12 | Fan Dimmer | As Required |
| 13 | Socket Two Pin | As Required |
| 14 | Socket Three Pin | As Required |
| 15 | Light Plug | As Required |
| 16 | Power Plug | As Required |
| 17 | PVC Pipe | As Required |
| 18 | PVC Elbow | As Required |
| 19 | PVC Band | As Required |

| | | |
|-----------|---------------------|-------------|
| 20 | Junction Box | As Required |
| 21 | Fan Box | As Required |
| 22 | Raval Plug | As Required |
| 23 | Pipe Shaddle | As Required |
| 24 | Cable Shaddle | As Required |
| 25 | Board 4 x 4 | As Required |
| 26 | Board 7 x 4 | As Required |
| 27 | Board 8 x 10 | As Required |
| 28 | TV Pin | As Required |
| 29 | Telephone Pin | As Required |
| 30 | Insolation Tape | As Required |
| 31 | PVC Duct Plain 3/4" | As Required |
| 32 | PVC Duct Slotted 1" | As Required |
| 33 | PVC Duct Plain 3/4" | As Required |
| 34 | PVC Duct Slotted 1" | As Required |
| 35 | Fuse Piano Type | As Required |
| 36 | Main Switch | As Required |
| 37 | Breaker Single Poll | As Required |
| 38 | Breaker Double Poll | As Required |
| 39 | Volt meter Panel | As Required |
| 40 | Ampere Meter Panel | As Required |

| | | |
|-----------|-----------------------------|-------------|
| 41 | DB Box | As Required |
| 42 | DB Switch | As Required |
| 43 | PG Connector | As Required |
| 44 | Neutral Terminal | As Required |
| 45 | Screw Different Size | As Required |
| 46 | Steel Nail Different Size | As Required |
| 47 | Bulb 100 Watt | As Required |
| 48 | Bulb 200 Watt | As Required |
| 49 | Nut Bolt Different Size | As Required |
| 50 | Electric Bell | As Required |
| 51 | Two Pin Shoe | As Required |
| 52 | Three Pin Shoe | As Required |
| 53 | Cable Tube Connection | As Required |
| 54 | Tube Rod | As Required |
| 55 | Choke 20w, 40w | As Required |
| 56 | Tube Starter | As Required |
| 57 | Choke Patti Fitting | As Required |
| 58 | Winding Wire Different Size | As Required |
| 59 | Slat Paper Different Size | As Required |
| 60 | Cotton Tape | As Required |

| | | |
|-----------|---------------------------------|-------------|
| 61 | Sleeve Different Size | As Required |
| 62 | Varnish | As Required |
| 63 | Cable Three Core 40/ .0076 | As Required |
| 64 | Cable Four Core 7/ .036 | As Required |
| 65 | Cable Three Core 7/ .029 | As Required |
| 66 | Connection Plate | As Required |
| 67 | Clutch Plate | As Required |
| 68 | Breaker Fitting Patti (Din Ray) | As Required |
| 69 | Relay 12V, 5A | As Required |
| 70 | Resistor Different Types | As Required |
| 71 | Transistor Different Types | As Required |
| 72 | LED | As Required |
| 73 | Diode | As Required |
| 74 | Rectifier Bridge | As Required |
| 75 | Carbon Brush | As Required |
| 76 | Battery 6v | As Required |
| 77 | Breaker Stripe | As Required |
| 78 | Flout Switch | As Required |
| 79 | Magnetic Connector | As Required |
| 80 | Cut Out | As Required |

| | | |
|------------|---|-------------|
| 81 | Breaker Cartridge Fuse | As Required |
| 82 | ON / OFF Push Button | As Required |
| 83 | Timer | As Required |
| 84 | Relay AC – 220V | As Required |
| 85 | Relay DC- 12V | As Required |
| 86 | Selector Switch Volt Meter | As Required |
| 87 | Selector Switch Ampere Meter | As Required |
| 88 | Emergency Switch | As Required |
| 89 | Soldering Wire | As Required |
| 90 | Paste | As Required |
| 91 | Light Indicator | As Required |
| 92 | Limit Switch (MEM Inter Locking) | As Required |
| 93 | Motor Driven Selector Switch (Water Tank) | As Required |
| 94 | Speaker | As Required |
| 95 | Acid | As Required |
| 96 | Hydro Metter | As Required |
| 97 | Multi Metter (Analogue / Digital) | As Required |
| 98 | Cam Starter (single phase & three phase) | As Required |
| 99 | Generator Switch | As Required |
| 100 | Star Delta Manual | As Required |

| | | |
|------------|--|-------------|
| 101 | Capacitor Different Size | As Required |
| 102 | Intercom Bell | As Required |
| 103 | Over Load Relay | As Required |
| 104 | Forward Reverse Switch | As Required |
| 105 | Tai Different Size | As Required |
| 106 | Magnetic Connector | As Required |
| 107 | Current Transformer | As Required |
| 108 | 8 Pin type & 11 Pin type relay with base | As Required |
| 109 | Timer Circuit | As Required |
| 110 | Relay Circuit | As Required |
| 111 | Boben Transformer | As Required |
| 112 | Core Transformer | As Required |
| 113 | Coal | As Required |
| 114 | Calcium Carbonate | As Required |
| 115 | Petrol | As Required |
| 116 | Heat Sleeve Tube | As Required |
| 117 | Changer Over Switch | As Required |
| 118 | Timer 0-60 second | As Required |
| 119 | Time 1-6 minute | As Required |
| 120 | Babon 1 ¼", 1 ½", 2", 2x3" | As Required |
| 121 | UPS Card | As Required |