**Solar Electric Technician (Level 2)**

**Module 5: Installation and assembly**

**E16: Assignment – System integration, testing, troubleshooting, verification, commissioning and handover**

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| **E16: ASSIGNMENT MEMO** | |
| **Date** | …. |
| **To** | Participants |
| **From** | Trainers |
| **Subject** | System integration, testing, troubleshooting, verification, commissioning and handover. |
| **What** | Integrate, test, troubleshoot, verify and commission a system. |
| **Why** | To enable participants in learning to integrate, test, troubleshoot, verify and commission a system. |
| **How** | 1. Group of 2 or 4. 2. As per the given instruction, perform the integration, testing, troubleshooting, verification and commissioning a system. 3. Answer the questions and discuss the results. |
| **Time** | 340’ |

**As per the given site conditions, perform the integration, testing, troubleshooting, verification and commissioning a system.**

**Required tools/equipment**

* Solar PV system components (modules, inverters, battery bank, etc.)
* Inverter (grid-tied or off-grid)
* Charge controller
* Battery bank (if applicable)
* Mounting structure
* Wiring and cables
* Protection devices (MCB, MCCB, fuses, surge protection)
* Multimeter, clamp meter
* Earth resistance tester
* Solar irradiance meter
* Tools: screwdrivers, crimpers, cable strippers, testers
* Installation manual and wiring diagrams
* Safety gear (helmets, gloves, goggles)
* Ladder or scaffolding for access to the mounting structure

**Instruction**

Follow each step to conclude the practice session.

**Step 1: Properly mount and connect solar PV modules in series and/or parallel, following the wiring schematic.**

* Mount the solar panels on the ground or roof structure as per the site design.
* Use appropriate clamps and hardware for mounting.
* Connect the modules in series and/or parallel as per the system design, ensuring the correct voltage and current output.
* Use MC4 connectors to make safe and secure connections between the panels.

**Testing**

* Use a multimeter to verify the voltage and current output of the solar array after connection.

**Step 2: Install the solar inverter and batteries, ensuring all connections are secure and compliant with the system schematic.**

**Inverter installation**

* Mount the solar inverter at the designated location (near the load or battery bank).
* Ensure proper ventilation and space for heat dissipation.
* Follow the inverter manual to connect the DC input from the solar panels and the AC output to the load.

**Battery bank installation**

* Install the battery bank (4 x 200Ah/12V) following the system design.
* Connect the batteries in series or parallel to achieve the desired voltage (48Vdc in this case).
* Ensure battery cables are properly sized and connected using suitable lugs and crimping tools.
* Follow safety protocols while handling batteries (insulation, fuses).

**Testing**

* Test the voltage across the battery terminals to ensure correct wiring.
* Use a multimeter to check that all battery connections are secure and producing the correct output.

**Step 3: Integrate protection devices (MCBs, MCCBs, SPD) and wire the system following the protection scheme.**

**Protection device installation**

* Install the MCBs, MCCBs, and surge protection devices (SPDs) at appropriate locations between the solar array, inverter, and load.
* Ensure the earthing system is properly connected to all metallic components.

**Wiring**

* Run the DC and AC cables between the solar panels, inverter, battery, and load using proper conduits.
* Use cable ties, cable trays, or conduits for clean and safe cable management.
* Ensure all wire connections are securely terminated with lugs and properly labeled.

**Testing**

* Perform continuity and insulation resistance tests on all wiring to ensure safe operation.
* Check each protection device for proper functioning.

**System testing and troubleshooting**

**Step 4: Perform the first round of testing on the integrated system.**

**Test the solar array**

* Measure the voltage and current at the solar array under different irradiance conditions to ensure proper functioning.

**Battery and inverter testing**

* Verify that the battery bank charges from the solar array.
* Test the inverter's performance, checking both DC input from the batteries and AC output to the load.

**Protection testing**

* Check the operation of MCBs, MCCBs, and SPDs under normal load and fault conditions.

**Troubleshooting**

* If any part of the system is not working correctly, troubleshoot using testing equipment (multimeter, power analyzer).
* Identify and correct any loose connections, miswiring, or defective components.

**Step 5: Identify and fix any issues discovered during system testing.**

**Common faults to check**

* Incorrect wiring of solar panels (wrong series/parallel connections).
* Loose or poor connections in the DC and AC wiring.
* Inverter malfunctions or improper configuration.
* Batteries not charging due to faulty wiring or bad connections.
* Protection devices (MCBs, MCCBs) not tripping or providing incorrect protection.

**Fault rectification**

* Use a multimeter and continuity tester to locate wiring faults.
* Replace any damaged components or wires.
* Recheck all connections after rectification and ensure they are secure.

**Final System Commissioning**

**Step 6: Verify that the system operates as expected and prepare it for handover.**

**Full load test**

* Connect the system to its intended load and run it at full capacity.
* Monitor the inverter, batteries, and solar array performance under real operating conditions.

**Energy flow test**

* Verify that energy is flowing correctly from the solar panels to the inverter and batteries.
* Check that the inverter outputs clean AC power to the load.

**Protection system check**

* Perform a final check on all protection devices, ensuring that they trip correctly during fault conditions.

**Documentation review**

* Review all system documentation, including wiring diagrams, protection layouts, and inverter settings.
* Ensure that all installation and safety guidelines are followed.

**Step 7: Prepare for system handover to the owner and provide a detailed report.**

**System commissioning report**

* Fill out a system commissioning checklist to confirm all components are installed correctly, tested, and functioning.
* Include notes on any issues encountered and rectified during the installation process.

**Owner handover**

* Present the system to the system owner, explaining how it operates, key safety points, and maintenance requirements.
* Provide the owner with all relevant manuals and documentation.
* Participate in a final discussion about lessons learned during the installation, testing, and commissioning phases.

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| **Answers** |
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