

**Technical Design Notes for Grid Connection of Small Renewable Energy Systems
(for FiT Scheme)**

The following table provides technical information for inverter-based RE Systems with generation capacity of up to 1MW and non-inverter-based RE Systems with generation capacity of up to 200kW. Further technical guidelines and information can be found in the latest edition of EMSD’s “Technical Guidelines on Grid Connection of Renewable Energy Power Systems” (“Technical Guidelines”).

For the requirements of RE Systems with larger generation capacity, the information can be found in our “Grid Connection Requirements for Renewable Energy Systems (RES)”.

| Design Requirements and Considerations | Inverter-based Systems (up to 1MW) | Non-Inverter-based Systems (up to 200kW) |
|---|---------------------------------------|---|
| The Network nominal voltage is 220/380V, nominal frequency is 50Hz. | ✓ | ✓ |
| The RE System should be operating normally in the frequency range from 48.5Hz to 51Hz. | ✓ | ✓ |
| Network auto-switching/reclosing time is from 0.2 to 10 seconds. The RE System should have an anti-islanding function to cater for the auto-switching/reclosing operation. | ✓ | ✓ |
| After disconnection of the RE System due to disturbances in the Network, the RE System should remain disconnected until the Network returns to normal condition continuously for at least 5 minutes. | ✓ | ✓ |
| Total harmonic current distortion of the RE System should not exceed 5% as measured at the point of the RE System output. | ✓ | ✓ |
| The RE System should prevent DC current flowing into the Network, which the DC current into the AC interface shall not exceed 0.5% of rated inverter output under normal or abnormal operating conditions. (Isolation transformer on the output side of the inverter is recommended by Technical Guidelines, which eliminate the possibility of injecting DC current into the Network.) | ✓ | |
| The RE System should have a control function such that its power factor is controllable between 0.9 leading and lagging. | | ✓ |
| The RE System should not affect the power factor of our electricity supply to you as recorded at the supply point resulting in deviating from the requirements stipulated in the Supply Rules. | ✓ | ✓ |

| Design Requirements and Considerations | Inverter-based Systems (up to 1MW) | Non-Inverter-based Systems (up to 200kW) |
|---|---------------------------------------|---|
| Export power from RE System to the Network should not less than 0.85 power factor lagging. If power factor correction equipment is used to improve the power factor, the correction equipment shall not cause any excessive voltage disturbance, inrush current, over-voltage, or resonance with other system components. | ✓ | ✓ |
| The overall fault current contributed from both the RE System and the Network must not exceed the fault current withstanding or breaking capability of any equipment in or connected to the Network under all possible operating conditions. The fault current from the RE System should not affect the protection system of the Network. | ✓ | ✓ |
| Voltage fluctuation during synchronization operation of the RE System should be limited to below 3% at the supply point. | ✓ | ✓ |
| After the connection of the RE System to the Network, the voltage fluctuation at the supply point due to the variation of RE System's input power shall not exceed 1%. | ✓ | ✓ |
| The level of negative phase sequence voltage at supply point on a three-phase system shall not exceed 1.3% of the positive phase sequence voltage, assuming an initially symmetrical of the Network at this point. | ✓ | ✓ |
| The RE System should have an adequate earthing system to ensure the safety of personnel and equipment, and the reliable operation of the protection equipment. The RE System should be properly earthed even when operating in isolation from the Network. | ✓ | ✓ |
| Whenever the generation capacity of the RE Systems is greater than 200kW, telemetry system should be installed at the terminals of the RE Systems to record measurements (including active power and reactive power). | ✓ | Please refer to "Grid Connection Requirements for Renewable Energy Systems (RES)" |
| If the RE System with generation capacity greater than 200kW is planned for exporting power to the Network, additional telemetry should be installed at the supply points for monitoring of the active power, reactive power, voltage, current and circuit breakers' status. | ✓ | |

Legend:

✓ Applicable

| RE System Voltage Protection Requirements (Reference to IEEE1547) | | |
|--|---|---|
| Over-voltage Protection | Disconnect RE system when over-voltage (i.e. $V > 110\%$) occurs | Max. trip time of 1 sec for $V > 110\%$ and Max. trip time of 0.16 sec for $V > 120\%$ |
| Under-voltage Protection | Disconnect RE system when under-voltage (i.e. $V < 70\%$) occurs | Max. trip time of 2 sec for $V < 70\%$ and Max. trip time of 0.16 sec for $V < 45\%$ |

| RE System Voltage Ride Through Capability (Reference to IEEE1547) | | |
|--|--|---------------------------------------|
| Abnormal Voltage Range (% of nominal voltage) | Minimum Holding Time (second) | Maximum Trip Time (second) |
| $V > 120$ | -- | 0.16 |
| $117.5 < V \leq 120$ | 0.2 | -- |
| $115 < V \leq 117.5$ | 0.5 | -- |
| $110 < V \leq 115$ | 1.0 | -- |
| $88 \leq V \leq 110$ | Infinite | -- |
| $65 \leq V < 88$ | 2.0 | -- |
| $45 \leq V < 65$ | 0.32 | -- |
| $30 \leq V < 45$ | 0.16 | -- |
| $V < 30$ | -- | 0.16 |

Remarks:

Starting from 1st March 2021, all RES/FiT applications must incorporate over-voltage protection, under-voltage protection and voltage ride through capability.