



STATE ELECTRIC COMPANY LIMITED



HYBRID SOLAR PV SYSTEM GUIDELINE

RENEWABLE ENERGY DEPARTMENT

2026

VERSION 1.0



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HYBRID SOLAR PV SYSTEM GUIDELINE

This guideline applies to all hybrid solar PV systems, including battery-integrated systems that are connected to consumer premises where electricity service is provided by STELCO, ensuring:

- Safety of personnel and assets
- Grid stability and power quality
- Protection of existing generation and distribution infrastructure
- Safe system integration
- Compliance with URA and STELCO standards
- Controlled export of energy
- Prevention of any unintentional backfeed into the STELCO network

1. GENERAL REQUIREMENTS

- 1.1. Hybrid solar PV systems shall be installed such that the inverter/battery system shall not feed electricity into the STELCO grid except where explicitly approved under STELCO Net Metering provisions and controlled in accordance with approved limits.
- 1.2. All hybrid inverters capable of operating in parallel with the grid shall be equipped with **certified anti-islanding** protection in accordance with IEC 62116, IEEE 1547, or equivalent standards.
- 1.3. The customer shall provide as-built SLDs, equipment specifications, and protection details during inspection.

2. MODES OF OPERATION

2.1. OPERATION OF HYBRID SYSTEM IN PARALLEL WITH THE GRID

- 2.1.1. In this mode, the hybrid inverter operates in synchronization with the STELCO grid at the Point of Common Coupling. The system can supply local loads using solar PV and battery storage while remaining connected to the STELCO network. When the grid supply is available, it shall be considered the primary source, and the hybrid system shall operate in coordination with the STELCO grid. This allows:

- Self-consumption
- Battery usage
- Export (within approved quota)

2.1.2. Operational Requirements

- 2.1.2.1. System shall operate only with certified grid-tied hybrid inverters compliant with applicable IEC/IEEE standards.
- 2.1.2.2. In grid-parallel mode, the inverter shall incorporate certified anti-islanding protection and shall cease to energize the STELCO grid within 2 seconds of loss of grid supply (formation of an unintentional island), unless otherwise specified by an approved interconnection setting.
- 2.1.2.3. Export of energy to the STELCO grid shall be limited to the approved quota in accordance with STELCO Net Metering Guideline.
- 2.1.2.4. Export limitation shall include:
 - Solar PV generation
 - Battery discharge
- 2.1.2.5. Battery discharge to the grid shall not be permitted unless explicitly approved by STELCO.
- 2.1.2.6. Commissioning tests shall verify:
 - Export limitation functionality
 - Anti-islanding operation
 - Protection system performance
 - Proper synchronization with the grid
- 2.1.2.7. The system shall be configured such that no unintentional backfeed to the STELCO grid shall be possible under any operating or fault condition.

2.2. OPERATION OF HYBRID SYSTEM INDEPENDENT OF THE GRID (NON-PARALLEL OPERATION)

- 2.2.1. In this mode, the hybrid system operates in isolation from the STELCO grid and supplies dedicated loads. A break-before-make transfer mechanism ensures that the grid and hybrid system are never connected simultaneously. This allows:
 - Self-consumption
 - Battery usage
 - No export to the STELCO grid

2.2.2. Operational Requirements

- 2.2.2.1. A break-before-make Automatic Transfer Switch (ATS) or manual changeover switch shall be installed.
- 2.2.2.2. No configuration shall allow simultaneous connection to both the STELCO grid and the hybrid system.
- 2.2.2.3. All live and neutral conductors shall be fully isolated during switching:
 - Single-phase: L + N
 - Three-phase: All phases + Neutral
- 2.2.2.4. Additional protection such as undervoltage relays and contactor interlocking shall be implemented where applicable.
- 2.2.2.5. The system shall be configured such that no possibility of backfeed to the STELCO grid shall exist under any operating or fault condition.
- 2.2.2.6. Functional testing of switching and isolation mechanisms shall be conducted during commissioning.
- 2.2.2.7. During off-grid operation, where the hybrid inverter provides the neutral reference, neutral grounding must comply with applicable electrical standards, STELCO requirements, and the inverter manufacturer's specifications.

2.2.3. Break-Before-Make Transfer Requirements

- 2.2.3.1. Where a hybrid system is intended to supply the same Distribution Board as the utility service, a break-before-make transfer device shall be installed at the point of supply, using either an ATS or a manual changeover switch.
- 2.2.3.2. The ATS shall switch all live conductors:
- 2.2.3.3. Single-phase systems: Line and Neutral (L + N)
- 2.2.3.4. Three-phase systems: All phases and Neutral
- 2.2.3.5. Under no circumstance shall the ATS permit the utility supply and inverter supply to be paralleled.
- 2.2.3.6. Manual changeover switches, where used, shall be double-throw, mechanically interlocked, and provided with a center-OFF position to ensure break-before-make operation.

3. PROTECTION REQUIREMENTS

System shall include the following:

3.1. Overcurrent protection (MCB/MCCB) shall be installed on:

- 3.1.1. the grid supply side,
- 3.1.2. the inverter AC output side
- 3.1.3. the PV DC input side.

3.2. Residual current protection (RCD/RCCB) shall be provided:

- 3.2.1. At the Distribution Board (DB) (30mA Leakage Current)
- 3.2.2. At the hybrid inverter AC input (30mA – 100mA where applicable)

3.3. Earthing and bonding shall comply with the URA Standards and STELCO requirements

3.4. Surge Protection Devices (SPD) is recommended to be installed:

- 3.4.1. On DC side
- 3.4.2. On AC side

4. SYSTEM CONTROL PHILOSOPHY

4.1. A typical hybrid system shall operate based on the following priority:

- 4.1.1. Solar PV → supply local loads
- 4.1.2. Battery → support loads
- 4.1.3. STELCO grid → supply deficit

4.2. Operating Conditions

- 4.2.1. During grid failure, the system shall:
 - 4.2.1.1. Automatically isolate from the STELCO grid
 - 4.2.1.2. Continue supplying local loads in island mode
- 4.2.2. When battery level is low, the system shall revert to STELCO grid supply (if necessary)
- 4.2.3. Where export is permitted, the inverter shall limit output to the approved export quota

5. KEY UTILITY REQUIREMENTS

5.1. No hybrid system shall:

- 5.1.1. Allow backfeed into the STELCO grid
- 5.1.2. Operate in parallel with the STELCO grid without approval

5.2. STELCO reserves the right to require:

- 5.2.1. Monitoring systems
- 5.2.2. Export control devices

- 5.3. Any system found to be non-compliant or posing a risk to the STELCO network shall be subject to disconnection from the STELCO grid

6. UNDERVOLTAGE RELAY AND CONTACTOR

- 6.1. An undervoltage relay (UVR) with contactor **is recommended as an additional protective measure** to ensure physical disconnection of the STELCO supply when grid voltage is lost or falls below the pre-set threshold.
- 6.2. The UVR and contactor shall:
- 6.2.1. Operate independently of the hybrid inverter
 - 6.2.2. Ensure disconnection of all poles (L + N / 3P + N)
 - 6.2.3. Be configured to **fail-safe open** upon loss of grid voltage
- 6.3. The UV relay sensing and contactor coil supply shall be taken only from the STELCO supply to prevent the hybrid system from energizing the contactor during grid failure.
- 6.4. The UVR and contactor arrangement shall be regarded as an **additional protective interlock**, and shall not replace:
- 6.4.1. Anti-islanding protection
 - 6.4.2. Transfer switch requirements
 - 6.4.3. Overcurrent and earth leakage protection
 - 6.4.4. Mandatory AC and DC isolators

7. ISOLATION AND LABELLING

- 7.1. A lockable and clearly visible AC isolator shall be installed for the solar PV / hybrid inverter system and shall be accessible to STELCO personnel.
- 7.2. The following labels shall be installed at appropriate locations:
- 7.2.1. Transfer switch positions (Hybrid/Grid)
 - 7.2.2. “DC isolators”
 - 7.2.3. “AC isolators”
 - 7.2.4. “Hybrid Inverter” (on ATS, isolators, and inverter)
- 7.3. All isolators shall comply with applicable electrical safety standards and wiring regulations.

8. PROHIBITION OF BACKFEED

- 8.1. Hybrid systems shall be designed and installed such that no **unintentional backfeed to the STELCO grid shall occur under any operating or fault condition.**

8.2. Any configuration that allows inverter or battery power to energise:

8.2.1. The STELCO grid, or

8.2.2. The grid side of the transfer system (ATS/changeover switch) outside approved operating conditions is strictly prohibited.

8.3. During grid outage, the hybrid system shall:

8.3.1. Automatically disconnect from the STELCO grid

8.3.2. Operate only in isolated (island) mode

9. COMMISSIONING AND COMPLIANCE

The following requirements shall apply to **all hybrid systems, including both grid-parallel and non-parallel configurations.**

9.1. Pre-Commissioning Requirements

Before energising the system, the installer must demonstrate proper operation of the transfer system:

9.1.1. No parallel position between STELCO grid and hybrid system

9.1.2. Correct operation of anti-islanding protection (for grid-parallel systems)

9.1.3. Correct operation of undervoltage relay (UVR) and contactor, where installed

9.1.4. No possible backfeed path to the STELCO grid under any operating condition

9.2. Functional Testing

The following tests shall be carried out:

9.2.1. Export limitation verification (where applicable)

9.2.2. Anti-islanding test (for grid-parallel systems)

9.2.3. Protection system testing

9.2.4. Voltage and frequency verification

9.2.5. Verification of correct synchronization with the STELCO grid (for grid-parallel systems)

9.2.6. Verification of switching and isolation mechanisms (for non-parallel systems)

9.3. Non-compliance

Installations found to allow backfeed, or pose a risk of backfeed to the STELCO grid shall be subject to **immediate disconnection from the STELCO network.**

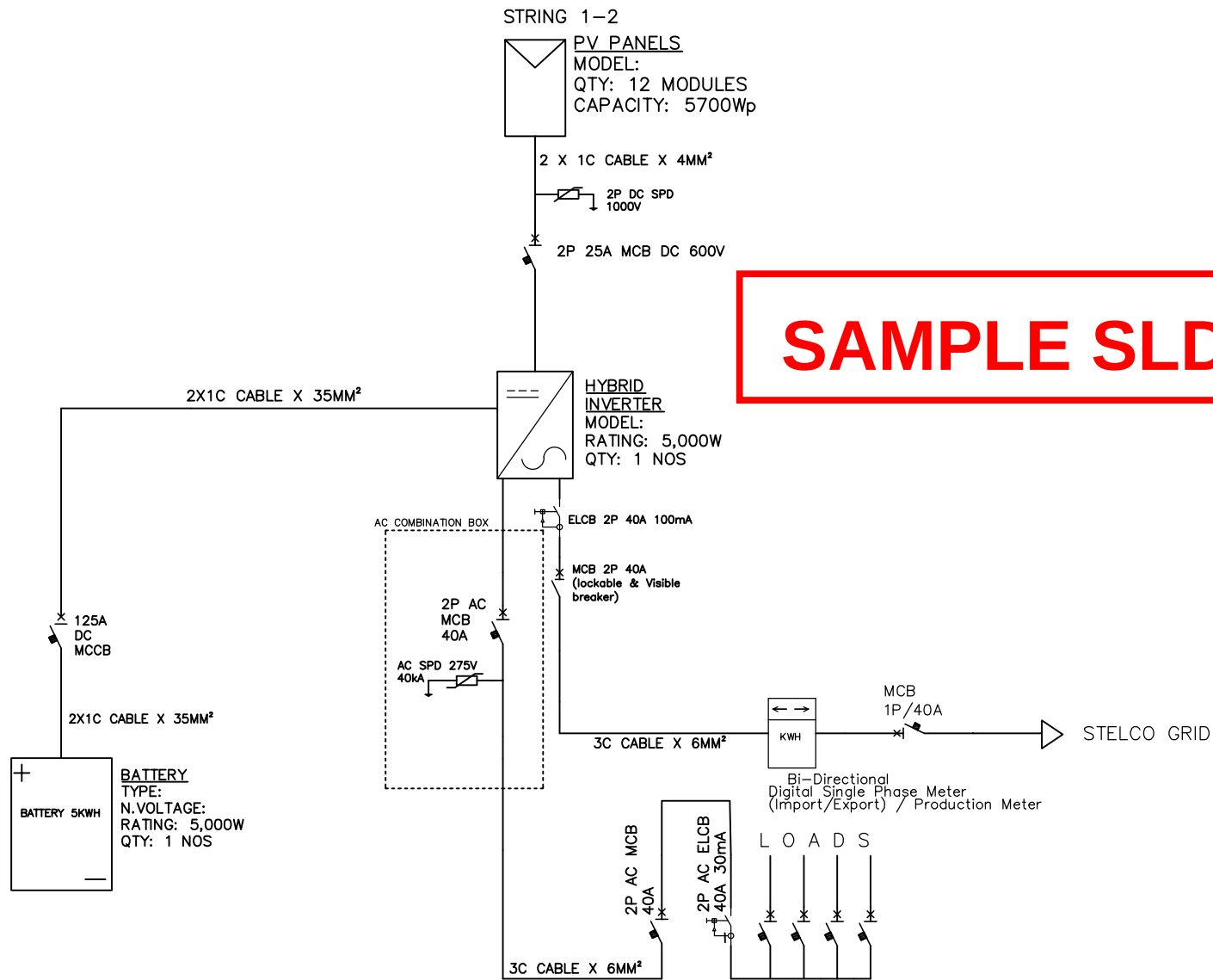
9.4. Authority

STELCO reserves the right to:

9.4.1. Require monitoring systems, or additional export control equipment where necessary to ensure compliance with this guideline and applicable regulations

- 9.4.2. Inspect installations
- 9.4.3. Verify compliance prior to commissioning
- 9.4.4. Require corrective action where necessary

ANNEX A: SINGLE PHASE HYBRID PV SAMPLE SLD



SAMPLE SLD

SINGLE LINE DIAGRAM

COMPONENT SPECIFICATIONS:

SOLAR PV PANEL:

Brand:

Model:

CELL TYPE:

Dimensions:

Weight:

SPECIFICATIONS: (STC)

Pmax:

Vmp:

Imp:

Voc:

Isc:

TOTAL CAPACITY: 5.7kWp

PANEL RATING: 475Wp
NO. OF PANELS: 12 NOS
NO. OF STRINGS: 02 NOS

HYBRID INVERTER DETAILS:

INVERTER 1 RATING: 5kW X 01

STRING DETAILS:

NO. OF PANELS IN STRING 1: 6 - A1
NO. OF PANELS IN STRING 2: 6 - B1

BATTERY DETAILS:

NOMINAL VOLTAGE:
NOMINAL CAPACITY:
MAX CHARGING CURRENT:
MAX DISCHARGE CURRENT:
BMS COMMUNICATION PROTOCOL:

NOTE:

A SUITABLE SMART METER CAN BE
INSTALLED AT POINT OF COMMON
COUPLING WITH CT TO ENABLE EXPORT
LIMITATION FUNCTION.



RENEWABLE ENERGY DEPARTMENT
STATE ELECTRIC COMPANY LIMITED
MALE', MALDIVES

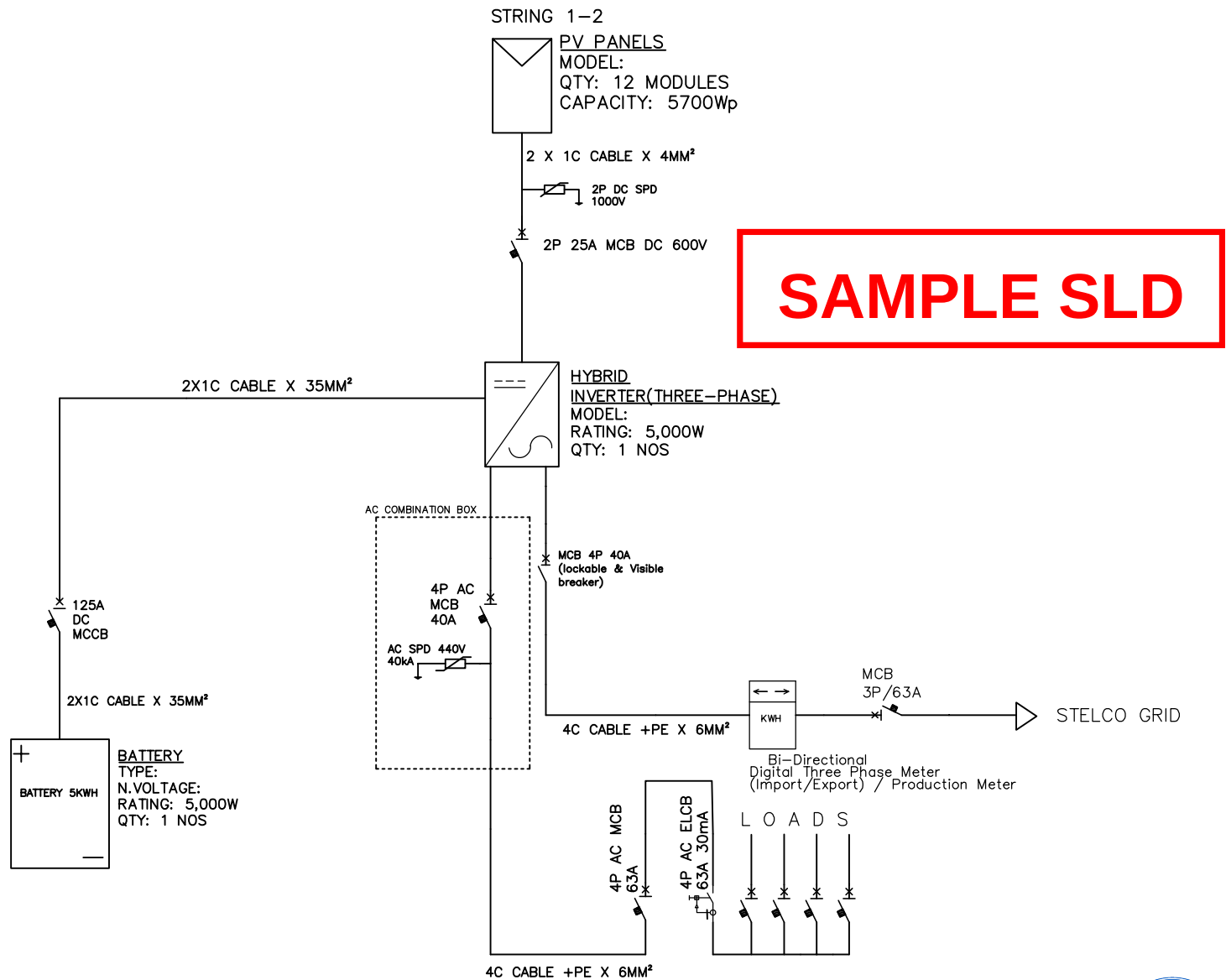
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ANNEX B: THREE PHASE HYBRID PV SYSTEM SLD



SINGLE LINE DIAGRAM

COMPONENT SPECIFICATIONS:

SOLAR PV PANEL:

Brand:

Model:

CELL TYPE:

Dimensions:

Weight:

SPECIFICATIONS: (STC)

Pmax:

Vmp:

Imp:

Voc:

Isc:

TOTAL CAPACITY: 5.7kWp

PANEL RATING: 475Wp
NO. OF PANELS: 12 NOS
NO. OF STRINGS: 02 NOS

HYBRID INVERTER DETAILS:

INVERTER 1 RATING: 5kW X 01

STRING DETAILS:

NO. OF PANELS IN STRING 1: 6 - A1
NO. OF PANELS IN STRING 2: 6 - B1

BATTERY DETAILS:

NOMINAL VOLTAGE:
NOMINAL CAPACITY:
MAX CHARGING CURRENT:
MAX DISCHARGE CURRENT:
BMS COMMUNICATION PROTOCOL:

NOTE:

A SUITABLE SMART METER CAN BE
INSTALLED AT POINT OF COMMON
COUPLING WITH CT TO ENABLE EXPORT
LIMITATION FUNCTION.



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