# 3 Installed power loads - Characteristics



| Type of lamp | Lamp power (W) | Current at 230 V (A) |
|---|---|---|
| Separated ballast lamp | 10 | 0.080 |
| | 18 | 0.110 |
| | 26 | 0.150 |
| Integrated ballast lamp | 8 | 0.075 |
| | 11 | 0.095 |
| | 16 | 0.125 |
| | 21 | 0.170 |

**Fig. A7** Current demands and power consumption of compact fluorescent lamps (at 230 V-50 Hz)

The power in watts indicated on the tube of a discharge lamp does not include the power dissipated in the ballast.

## 3.4 Discharge lamps

See also chapter N §4 "Lighting circuits".

**Fig. A8** gives the current taken by a complete unit, including all associated ancillary equipment.

These lamps depend on the luminous electrical discharge through a gas or vapour of a metallic compound, which is contained in a hermetically-sealed transparent envelope at a pre-determined pressure. These lamps have a long start-up time, during which the current Ia is greater than the nominal current In. Power and current demands are given for different types of lamp (typical average values which may differ slightly from one manufacturer to another).

| Type of lamp (W) | Power demand (W) | | Current In(A) | | | | Starting | | Luminous efficiency (lumens per watt) | Average timelife of lamp (h) | Utilization |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | at 230 V | 400 V | PF not corrected 230 V | 400 V | PF corrected 230 V | 400 V | x In | Period (mins) | | | |
| **High-pressure sodium vapour lamps** | | | | | | | | | | | |
| 50 | 60 | | 0.76 | | 0.3 | | 1.4 to 1.6 | 4 to 6 | 80 to 120 | 9000 | ■ Lighting of large halls<br>■ Outdoor spaces<br>■ Public lighting |
| 70 | 80 | | 1 | | 0.45 | | | | | | |
| 100 | 115 | | 1.2 | | 0.65 | | | | | | |
| 150 | 168 | | 1.8 | | 0.85 | | | | | | |
| 250 | 274 | | 3 | | 1.4 | | | | | | |
| 400 | 431 | | 4.4 | | 2.2 | | | | | | |
| 1000 | 1055 | | 10.45 | | 4.9 | | | | | | |
| **Low-pressure sodium vapour lamps** | | | | | | | | | | | |
| 26 | 34.5 | | 0.45 | | 0.17 | | 1.1 to 1.3 | 7 to 15 | 100 to 200 | 8000 to 12000 | ■ Lighting of motorways<br>■ Security lighting, railway platforms<br>■ Platform, storage areas |
| 36 | 46.5 | | | | 0.22 | | | | | | |
| 66 | 80.5 | | | | 0.39 | | | | | | |
| 91 | 105.5 | | | | 0.49 | | | | | | |
| 131 | 154 | | | | 0.69 | | | | | | |
| **Mercury vapour + metal halide (also called metal-iodide)** | | | | | | | | | | | |
| 70 | 80.5 | | 1 | | 0.40 | | 1.7 | 3 to 5 | 70 to 90 | 6000 | ■ Lighting of very large areas by projectors (for example: sport stadiums, etc.) |
| 150 | 172 | | 1.80 | | 0.88 | | | | | 6000 | |
| 250 | 276 | | 2.10 | | 1.35 | | | | | 6000 | |
| 400 | 425 | | 3.40 | | 2.15 | | | | | 6000 | |
| 1000 | 1046 | | 8.25 | | 5.30 | | | | | 6000 | |
| 2000 | 2092 | 2052 | 16.5 | 8.60 | 10.50 | 6 | | | | 2000 | |
| **Mercury vapour + fluorescent substance (fluorescent bulb)** | | | | | | | | | | | |
| 50 | 57 | | 0.6 | | 0.30 | | 1.7 to 2 | 3 to 6 | 40 to 60 | 8000 to 12000 | ■ Workshops with very high ceilings (halls,hangars)<br>■ Outdoor lighting<br>■ Low light output [a] |
| 80 | 90 | | 0.8 | | 0.45 | | | | | | |
| 125 | 141 | | 1.15 | | 0.70 | | | | | | |
| 250 | 268 | | 2.15 | | 1.35 | | | | | | |
| 400 | 421 | | 3.25 | | 2.15 | | | | | | |
| 700 | 731 | | 5.4 | | 3.85 | | | | | | |
| 1000 | 1046 | | 8.25 | | 5.30 | | | | | | |
| 2000 | 2140 | 2080 | 15 | | 11 | 6.1 | | | | | |

[a] Replaced by sodium vapour lamps.

**Note:** these lamps are sensitive to voltage dips. They extinguish if the voltage falls to less than 50 % of their nominal voltage, and will not re-ignite before cooling for approximately 4 minutes.

**Note:** Sodium vapour low-pressure lamps have a light-output efficiency which is superior to that of all other sources. However, use of these lamps is restricted by the fact that the yellow-orange colour emitted makes colour recognition practically impossible.

**Fig. A8** Current demands of discharge lamps

# 1 Power supply at medium voltage



Considering the previous requirements and basic usages, four typical architectures can be defined for an electrical installation connected to a MV utility distribution network:

Fig. B1: single MV/LV power transformer with metering at LV level

Fig. B2: single MV/LV power transformer with metering at MV level

Fig. B3: several MV/LV transformers, all located in the main substation

Fig. B4: several secondary substations supplied by an internal MV distribution. Most of MV/LV transformers are located in secondary substations. Some of them when required are installed in the main substation

The functional and safety requirements defined above are detailed in this chapter, in the following sub-clauses:

- **1.2 to 1.4:** Voltages and currents according to IEC Standards, different types of MV power supply, practical issues concerning MV distribution networks
- **2.1 to 2.2:** Procedure for the establishment of a new substation
- **3.1 to 3.4:** Protection against electrical hazards, faults and mis-operations
- **4.1 to 4.2:** Consumer substation with LV metering
- **5.1 to 5.2:** Consumer substation with MV metering
- **6.1 to 6.4:** Choose and use MV equipment and MV/LV transformers
- **7.1 to 7.3:** Substation including generators and parallel operation of transformers
- **8.1 to 8.3:** Types and constitution of MV/LV distribution substations.

The methodology of selection of an architecture for a MV/LV electrical installation is detailed in **chapter D**.

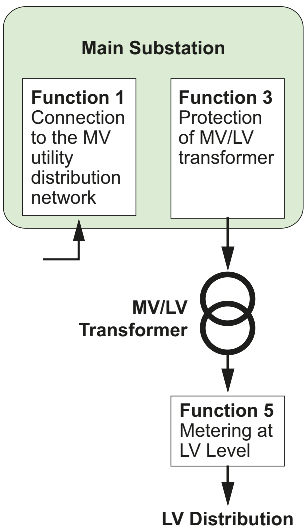


Fig. B1 Installation including a single MV/LV power transformer with metering at LV level

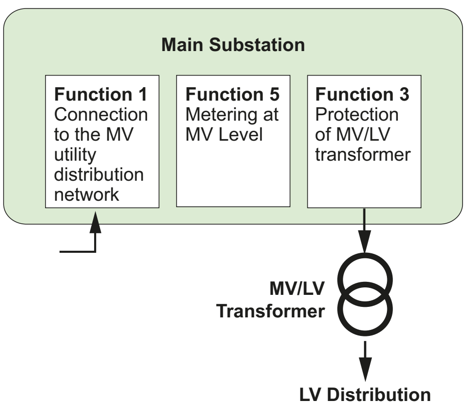


Fig. B2 Installation including a single MV/LV power transformer with metering at MV level

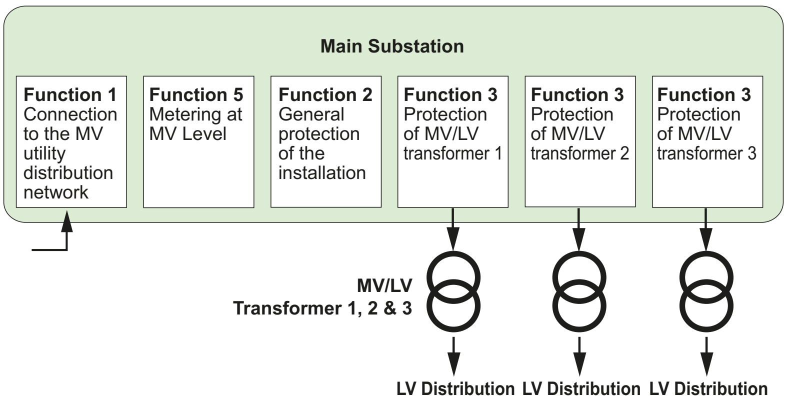


Fig. B3 Installation including several MV/LV transformers, all located in the main substation

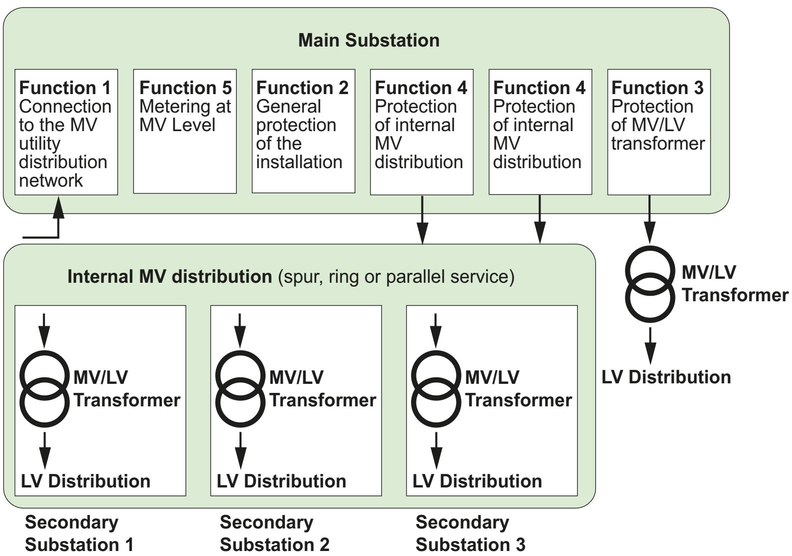


Fig. B4 Installation including several secondary substations supplied by an internal MV distribution

# 1 Power supply at medium voltage



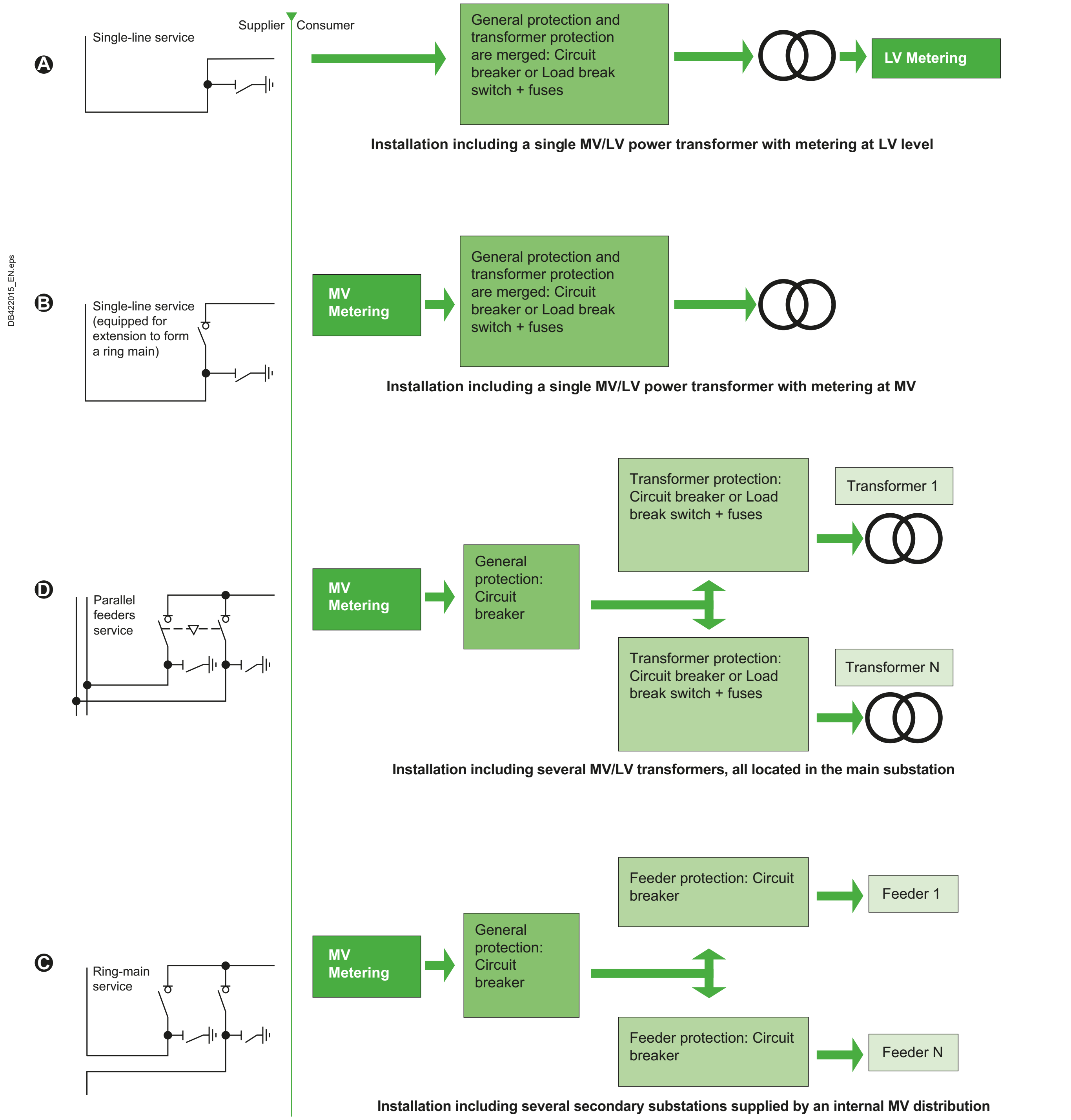


**Fig. B6** A: Single line service. B: Single line service with provision for extension to ring main or parallel feeder service.
C: Ring main service. D: parallel feeder service

## 1.4 Some practical issues concerning MV distribution networks

### 1.4.1 Overhead networks

Weather conditions such as wind may bring overhead wires into contact and cause phase to phase short-circuits.

Over voltages due to lightning strokes may generate flash-over across ceramic or glass insulators and cause phase to earth faults

Temporary contacts of vegetation such as trees with live overhead conductors may also generate phase to earth faults.

Most of these faults are temporary. They disappear naturally with the interruption of the voltage. This means that the supply can be restored after a short delay following the tripping. This delay is usually named "dead time".

Hence the sequence of fault clearing and voltage restoration in an overhead network is as follows:

- Fault detection by phase to phase or phase to earth protection
- Circuit breaker opening, the faulty over-head line is de-energized
- Dead time
- Circuit breaker reclosing. Following the reclosing two situations are possible:
  - The fault has been cleared by the interruption of the voltage, the reclosing is successful
  - The line is still faulty, a new tripping is initiated followed again by a reclosing sequence.
- Several sequences of tripping-reclosing may be activated depending on the rules of operation of the network adopted by the utility
- If after the execution of the preselected number of reclosing sequences the fault is still present, the circuit breaker is automatically locked and consequently the faulty part of the network remains out of service until the fault is localized and eliminated.

As such, it is possible to improve significantly the service continuity of overhead networks by using automatic reclosing facilities. Generally a reclosing circuit breaker is associated to each overhead line.

The use of centralised remote control and monitoring based on SCADA (Supervisory Control And Data Acquisition) systems and recent developments in digital communication technology is increasingly common in countries where the complexity associated with highly interconnected networks justifies the investment required.

### 1.4.2 Underground networks

Cable Faults on underground MV cables may have several causes such as:

- Poor quality of cable laying, absence of mechanical protection
- Bad quality of cable terminations confection
- Damages caused by excavators or tools such as pneumatic drills
- Over voltages generated by lightning strokes occurring on overhead line connected to underground cables. The over voltages can be amplified at the levels of the junctions between overhead lines and underground cables causing the destruction of the cable terminations. Lightning arresters, are often installed at these locations to limit the risks of damages.

The experience shows that the rate of fault occurring on underground cables is lower than the one registered for overhead lines. But faults on underground cables are invariably permanent and take longer time to locate and repair.

A loop architecture (see **Fig. B10**) correctly instrumented with fault detectors and motorized load break switches allow within a short period of time to identify a faulty cable, to disconnect it and to restore the supply to the whole substations included in the loop.

These procedures of faults detection, cables disconnection and supply restoration can be automatically performed in less than one minute by dedicated functions commonly integrated in remote control and monitoring systems of MV networks.

### 1.4.3 Remote control and monitoring for MV networks (see Fig. B7)

Remote control and monitoring of MV feeders make it possible to reduce loss of supply resulting from cable faults by supporting fast and effective loop reconfiguration.

This facility relies on motorized switches associated with fault detectors on a number of substations in the loop and controlled by remote control units.

All stations containing this equipment can have their supply restored remotely, whereas other stations will require additional manual operations.

Scada.eps

**Fig. B7** Supervisory Control And Data Acquisition System SCADA