What's Really Important When You're Designing The Low Voltage Switchgear?

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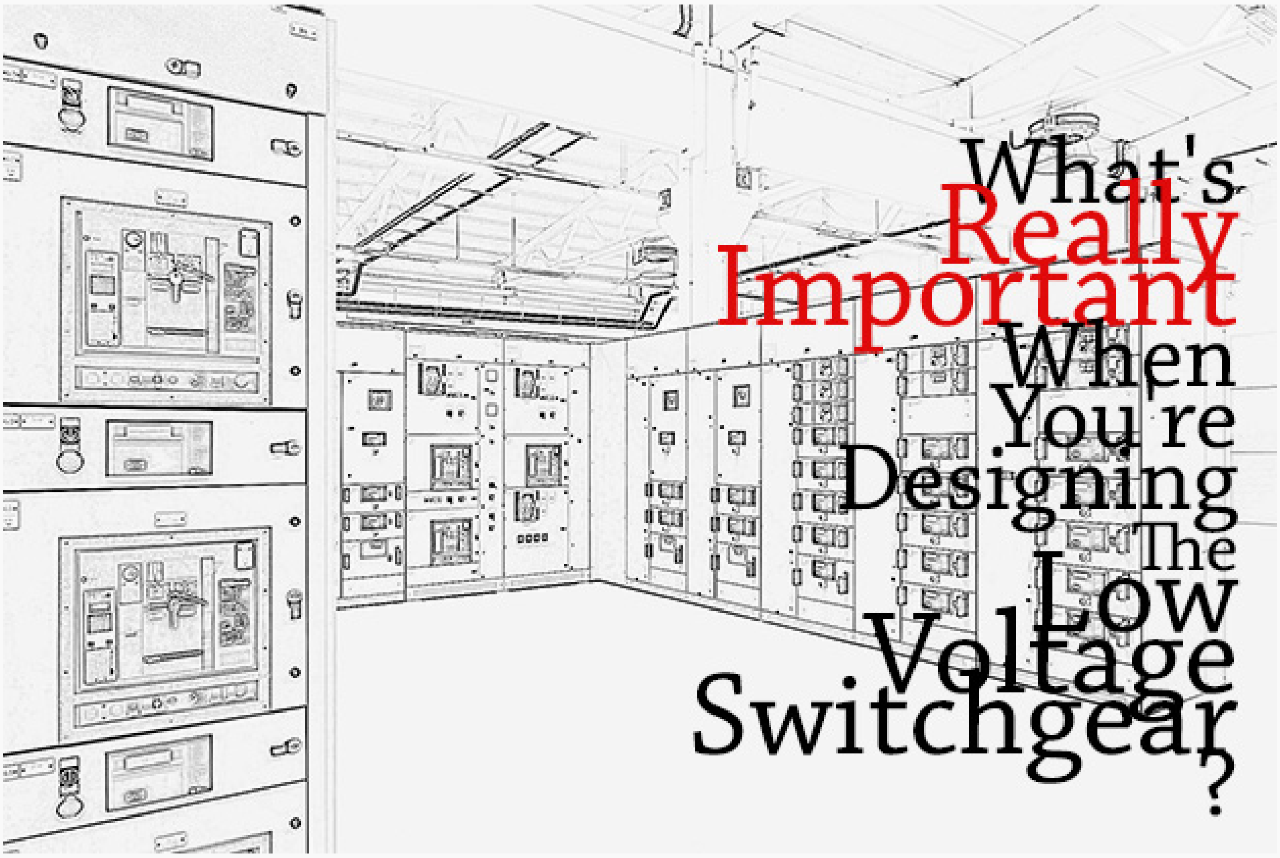

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Requirements on the Switchgear

Here what's important when you're designing the low voltage switchgear:

1. Device Application in the Supply Circuit

The system infeed is the ***most "sensitive" circuit*** in the entire power distribution. A failure here would result in the entire network and therefore the building or production being without power. This worst-case scenario must be considered during the planning.

Redundant system supplies and selective protection setting are important preconditions for a safe network configuration. The selection of the correct protective devices is therefore of elementary importance in order to create these preconditions.

Some of the key dimensioning data is addressed in the following:

1.1 Rated current

The feeder circuit-breaker in the ***Low-voltage main distribution (LVMD)*** must be dimensioned for the maximum [load of the transformer/generator](). When using ventilated transformers, the higher operating current of ***up to 1.5 x*** $\boldsymbol{I_N}$ of the transformer must be taken into account.

3WL11 air circuit breaker optimized for use in power distribution boards and wind turbines

2. Short-circuit strength

The short-circuit strength of the feeder circuit-breaker is determined by ***(n–1) x*** $\boldsymbol{I_{k\ max}}$ of the transformer or transformers (*n = number of transformers*).

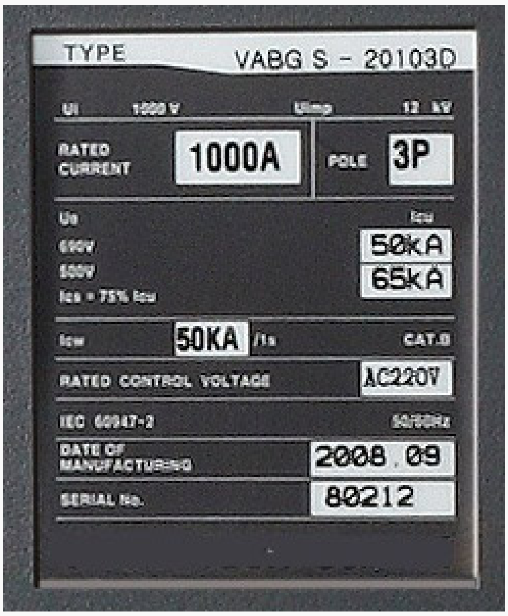
This means that the maximum shortcircuit current that occurs at the installation position must be known in order to specify the appropriate ***short-circuit strength of the protective device*** ($\boldsymbol{I_{cu}}$).

2.1 Utilization category

When ***dimensioning a selective network***, time grading of the protective devices is essential. When using time grading up to 500 ms, the selected circuit-breaker must be able to carry the short-circuit current that occurs for the set time. Close to the transformer, the currents are very high.

This current carrying capacity is specified by the $\boldsymbol{I_{cw}}$ value (*rated short-time withstand current*) of the circuit-breaker. This means the contact system must be able to carry the maximum short-circuit current, i.e. the energy contained therein, until the circuit-breaker is tripped.

This requirement is satisfied by circuit-breakers of ***utilization category B*** (*e.g. air circuit-breakers, ACB*). Current-limiting circuit breakers (molded-case circuit breakers, MCCB) trip during the current rise. They can therefore be constructed more compactly.



Circuit breaker nameplate

3. The Release (Trip Unit)

For a selective network design, ***the release (trip unit)*** of the feeder circuit-breaker must have an ***LSI (electronic trip unit) characteristic***.

It must be possible to deactivate the ***instantaneous release (I)***.

Depending on the curve characteristic of the ***upstream and downstream protective devices***, the characteristics of the feeder circuit breaker in the ***overload range (L)*** and also in the ***time-lag short circuit range (S)*** should be optionally switchable (*I^4t or I^2t characteristic curve*).

This facilitates the adaptation of upstream and downstream devices.

LSI (electronic protection unit)

3.1 Internal accessories

Depending on the respective control, ***not only shunt releases*** (previously: f releases), but also ***undervoltage releases*** are required.

3.2 Communication

Information about the current operating states, maintenance, error messages and analyses, etc. is being increasingly required, especially from the very sensitive supply circuits. Flexibility may be required with regard to a later upgrade or retrofit to the desired type of data transmission.

4. Device Application in Supply Circuits (Coupling)

If the coupling (*connection of Network 1 to Network 2*) is operated open, the circuit-breaker (*tie breaker*) ***only has the function of an isolator or main switch***. A protective function (*release*) is not absolutely necessary.

The following considerations apply to closed operation:

4.1 Rated current

Must be dimensioned for the maximum possible operating current (load compensation). The simultaneity factor can be assumed to be ***0.9***.

4.2 Short-circuit strength

The short-circuit strength of the feeder circuit-breaker is determined by the sum of the short-circuit components that flow through the coupling. This depends on the configuration of the component busbars and their supply.

4.3 Utilization category

As for the system supply, ***utilization category B*** is also required for the c***urrent carrying capacity (I_{cw} value)***.

4.4 Release

Partial shutdown with the couplings must be taken into consideration for the supply reliability. As the coupling and the feeder circuit-breakers have the same current components when a fault occurs, similar to the parallel operation of two transformers, the LSI characteristic is required.

The special ***"Zone Selective Interlocking (ZSI)" function*** should be used for larger networks and/or protection settings that are difficult to determine.

5. Device Application in the Distribution Circuit

The distribution circuit receives power from the ***higher level*** (*supply circuit*) and feeds it to the ***next distribution level*** (*final circuit*).

Depending on the country, local practices, etc., circuit-breakers and fuses can be used for system protection.

The specifications for the circuit dimensioning must be fulfilled. The ACB has advantages if full selectivity is required. However for cost reasons, the ACB is only frequently used in the distribution circuit as of a rated current of ***630 A*** or ***800 A***. As the ***ACB is not a current-limiting device***, it differs greatly from other protective devices such as ***MCCB, MCB and fuses***.

As no clear recommendations can otherwise be given, ***Table 1*** shows the major differences and limits of the respective protective devices.

6. Device Application in the Final Circuit

The final circuit receives power from the distribution circuit and supplies it to the consumer (*e.g. motor, lamp, non-stationary load (power outlet), etc.*). The protective device must satisfy the requirements of the consumer to be protected by it.

Note: All protection settings, comparison of characteristic curves, etc. ***always start with the load***. This means that no protective devices are required with adjustable time grading in the final circuit.

Table 1 – Overview of the protective devices

		ACB air circuit-breaker	MCCB molded-case circuit-breaker	Fuse switch disconnector	Switch disconnector with fuses	MCB miniature circuit-breaker	Reference values, specifications
Standards	IEC	Yes	Yes	Yes	Yes	Yes	Region
Application	System protection	Yes	Yes	Yes	Yes	Yes	Power supply system
Installation	Fixed mounting	Yes	Yes	Yes	Yes	Yes	Availability
	Plug-in	–	up to 800 A	–	Partly	–	
	Withdrawable unit	Yes	Yes	–	–	–	
Rated current	I_n	6,300 A	1,600 A	630 A	630 A	125 A	Operating current I_B
Short-circuit breaking capacity	I_{cu}	up to 150 kA	up to 100 kA	up to 120 kA	up to 120 kA	up to 25 kA	Maximum short-circuit current $I_{k\,max}$
Current carrying capacity	I_{cw}	up to 80 kA	up to 5 kA	–	–	–	Circuit
Number of poles	3-pole	Yes	Yes	Yes	Yes	Yes	Power supply system
	4-pole	Yes	Yes	–	Partly	–	
Tripping characteristic	ETU	Yes	Yes	–	–	–	Power supply system
	TM	–	up to 630 A	Yes	Yes	Yes	
Tripping function	LI	Yes	Yes	Yes*	Yes*	Yes	Power supply system
	LSI	Yes	Yes	–	–	–	
	N	Yes	Yes	–	–	–	
	G	Yes	Yes	–	–	–	
Characteristics	Fixed	–	Yes	Yes	Yes	Yes	Power supply system
	Adjustable	Yes	Yes	–	–	–	
	Optional	Yes	Yes	–	–	–	
Protection against electric shock, tripping condition	Detection of $I_{k\,min}$	No limitation	No limitation *)	Depends on cable length	Depends on cable length	Depends on cable length	Minimum short-circuit current $I_{k\,min}$
Communication (data transmission)	High	Yes	–	–	–	–	Customer specification
	Medium	Yes	Yes	–	–	–	
	Low	Yes	Yes	Yes	Yes	Yes	
Activation	Local	Yes	Yes	Yes	Yes	Yes	Customer specifications
	Remote (motor)	Yes	Yes	–	Partly	–	
Derating	Full rated current up to	60 °C	50 °C	30 °C	30 °C	30 °C	Switchgear
System synchronization	Yes		up to 800 A	–	–	–	Power supply system

Table 1 - Overview of the protective devices

***)** with ETU: No limitation / with TMTU: depends on cable length

Reference: *Siemens Energy Sector – Power Engineering Guide Edition 7.0*

Source:
http://electrical-engineering-portal.com/whats-really-important-when-youre-designing-the-low-voltage-switchgear