Control Panel Technical Guide

How to choose the circuit breaker and transfer switch for a generator set

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Life Is On Schneider Electric

Standby power supply by generator set

Everything has been planned so that this will not happen…

If it is not controlled, the disappearance of the 'mains' power supply of a facility is an event with potentially serious consequences, endangering the occupants, disrupting critical activities and causing economic loss.
A standby generator set is the commonly adopted solution to temporarily supply power when the main source fails. An immediate and reliable service is expected, whatever happens to the electrical installation.

In this guide, important IEC design options that cannot be ignored

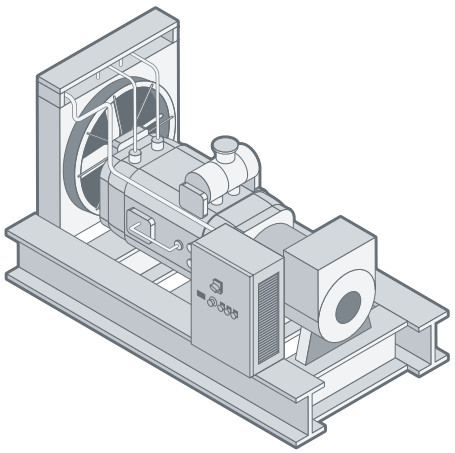
Apart from sizing the set's power, certain **technological options** are important with regard to reliability of service.

They concern, in particular:

> Protecting of the set from electrical faults

> Mains/Generator switchover.

Summary



Design

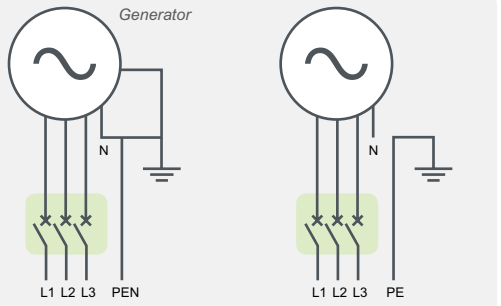
Typical applications

Recommendations

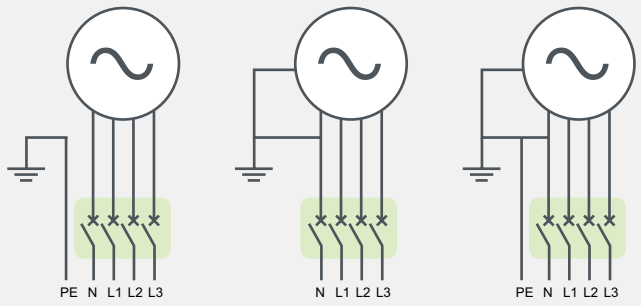
Generator set protection by circuit breaker

What you should know

Number of circuit breaker poles: 4-pole device recommended



Three-pole circuit breaker



** Neutral cutoff: preserves the operation of earth leakage protection devices*

Four-pole circuit breaker

When the earthing system is not known, the choice of a **four-pole circuit breaker** allows ex-post adaptation to all constraints (even if it means using it as a three-pole device in the case of a non-distributed neutral). The same reasoning will apply in choosing the transfer switching equipment.

Overload protection: choice of circuit breaker rating

Adjustable tripping threshold

The IEC 60364 installation rules require overload protection for cable between generator and installation.
However, the protection system is often determined according to the generator characteristics, when its resistance to overload is lower than that of the cable. Consequently, prefer a circuit breaker whose tripping threshold "Ir" is adjustable, to optimize protection.

ESP, PRP, LTP, COP rating categories

ISO-8528-1:2005 defines four generator set basic rating categories:

> Emergency Standby Power (ESP),
> Prime Power (PRP),
> Limited-Time Running Prime (LTP),
> Continuous Power (COP).

For each category, the generator set rating is determined by maximum allowable power output in relation to running time and load profile.

Allowance for max. power: PRP or LTP

The set's PRP (Prime Running Power) is the power available for a variable load, during an unlimited period. A 10% overload is permissible.

or

The set's LTP (Limited Time Running Power) is the power that it can supply for at most 500 hours per year at a constant load. No overload is permissible.

Rating (Ir)*: that corresponding to the current (In) for selected power or that immediately higher

**Ir for 40°C ambient temperature. 50°C: Ir + 5%; 60°C: Ir + 10%*

Example:

PRP = 70 kVA / 400 V ⟶ In: 100 A - possible overload 110 A
LTP = 77 kVA / 400 V ⟶ In: 110 A - overload prohibited

Schneider Electric circuit breaker Ir = 100 A:
- Non-tripping current limit 1.05 x Ir: 105 A
- Tripping < 2h 1.3 x Ir: 130 A

Protection: must be adapted to the generator operating characteristics

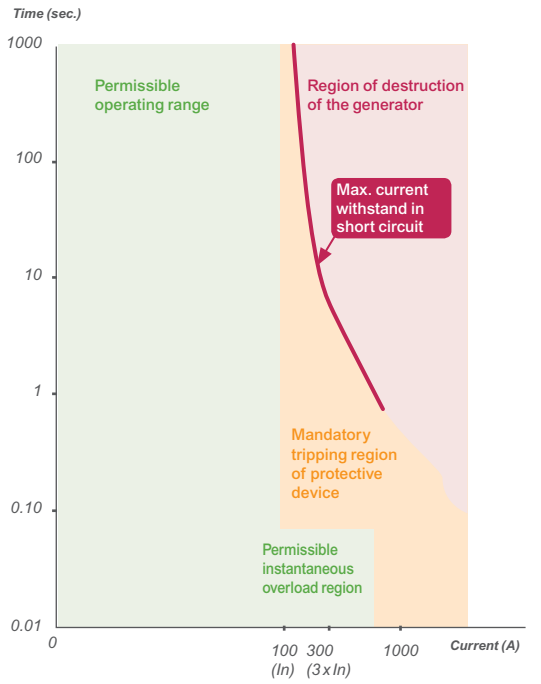
The characteristics define 3 types of situations depending on the current delivered by the generator:

> Normal situation: the max. current can be maintained for a long time

> Risk: the current may reach or exceed its overload value; the circuit breaker must open

> Destruction: the short-circuit current is destructive when it occurs for more than a few seconds.

The circuit breaker must be able to prevent damage to the generator by tripping on a low short-circuit current.



Example of chart of short-circuit resistance time – Generator with In = 100 A

Circuit breaker: with thermomagnetic or electronic tripping device?

Its tripping curve must be located in the mandatory tripping region.

Thermomagnetic tripping device

A circuit breaker with a low magnetic threshold (tripping at 3 x In) will protect better than a circuit breaker with a standard magnetic threshold (tripping between 5 and 10 x In).

Electronic tripping device

The electronic tripping device allows precision adjustment of its tripping curve according to the desired profile.

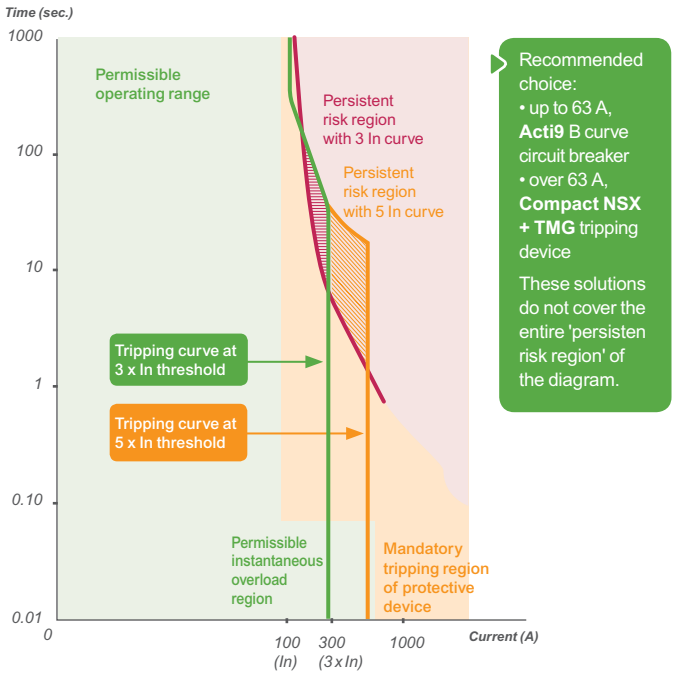


Illustration of persistent risk: with circuit breaker at 3 x In threshold, with 5 x In circuit breaker

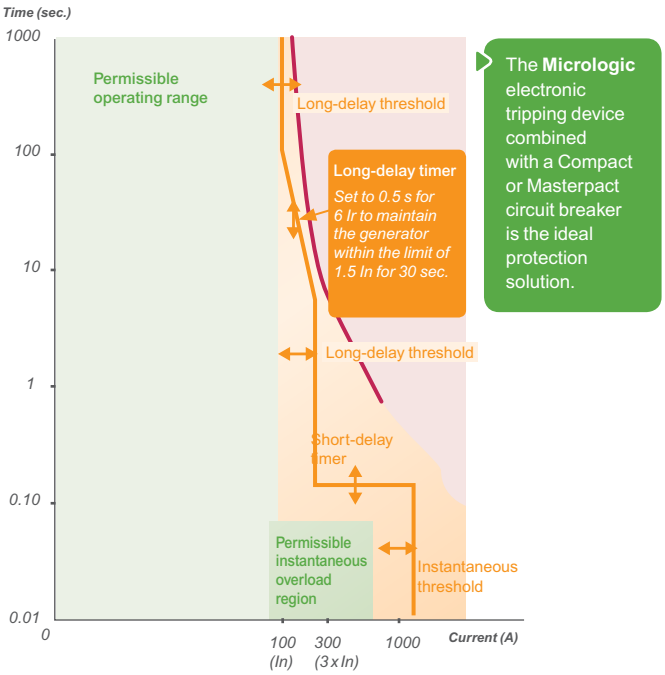


Illustration of the adjustable tripping curve: no risk region persists

Insulation fault protection system

What you should know

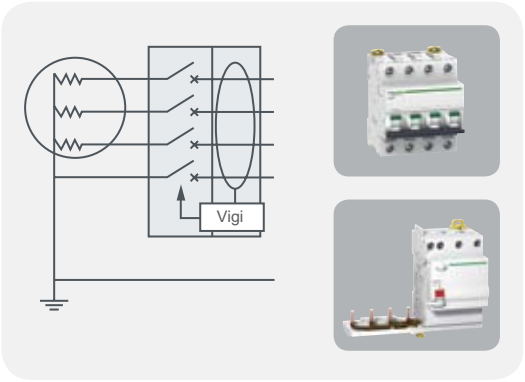
Protection by a Residual Current Device (RCD)

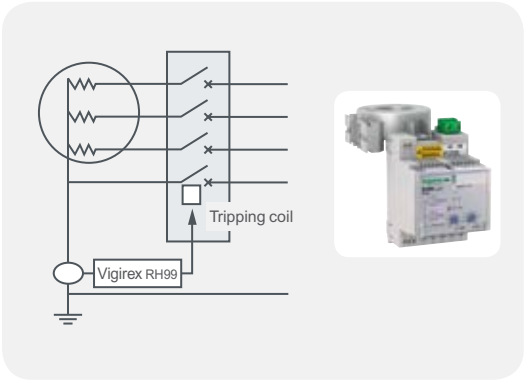
This is mandatory:
> in a TN system when the main circuit breaker does not trip fast enough in the event of a phase-to-earth fault (in particular with C curves or TM-D tripping devices: see previous chapter)
> in a TT system
> on mobile units

When the generator set is provided with power sockets, they must be protected by RCDs of 30 mA sensitivity.

Principle of RCDs

RCDs monitor any earth current leak. They are activated upon a fault exceeding a current threshold after a time lag. The threshold and the time lag can be adjustable.





'Vigi module' type RCD:

To be associated electrically and mechanically with a circuit breaker.

Advantage: no auxiliary power supply.

Disadvantages: size, less installation flexibility, commercial reference depending on the rating of the main circuit breaker.

'Residual current relay' type RCD:

This RCD, independent of the circuit breaker, measures the earth fault current by means of a current transformer placed on the neutral earthing of the generator. Its 'fault' output contact controls the tripping coil (MX or MN) of the main circuit breaker.

Advantage: one product reference and one size irrespective of the set's power.

Disadvantages: requires a tripping coil in the main circuit breaker and an auxiliary power supply.

RCDs are by definition very sensitive. Due to their position at the incoming end of the installation in the generator set, it is recommended to choose selective versions, of the 'S' type, with an adjustable time lag (when there is no information concerning the downstream installation).

Combination of RCD + circuit breaker

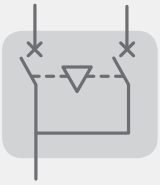
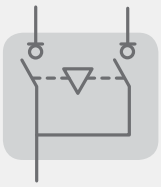
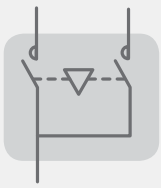
Installation rules such as IEC 60364 require checking the conformity of the time for automatic disconnection of the power supply in the event of a phase-to-earth fault.

In practice, setting the 'magnetic' threshold of a TMG tripping device to 3 x In or choosing a B-curve circuit breaker combined with an RCD offers satisfactory protection of the electrical installation.

Combining an RCD with either aTMD tripping device or a C-curve circuit breaker contributes to human life protection but dramatically reduces the generator protection because of their response time in case of short-circuit.

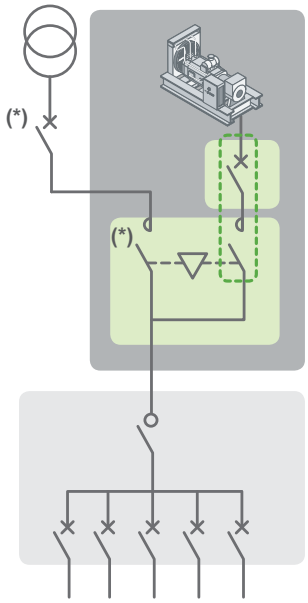
Transfer switching equipment

What you should know

Transfer switching equipt. classes as per IEC 60947-6-1	CB	PC	CC
Technology	Circuit breakers 	Switches 	Contactors 
Short-circuit withstand	☑	⊟	☒
Breaking capacity in the event of a short circuit	Yes Without risk of contact welding	No Without risk of contact welding	No Risk of contact welding
Necessary coordination	-	With the circuit breaker upstream	
Selection criteria	Icu = ultimate breaking capacity Must be greater than the prospective short-circuit current of the installation	Iq = conditional short-circuit current of the combination circuit breaker + switch or contactor. Must be greater than the prospective short-circuit current of the installation	

Transfer switching equipment

Recommended solution up to 410 kVA



(*) Coordination of contactor (transfer-switch) and main source (Utility) protection device must be validated by electrical installation designer.

Contactors with electrical and mechanical interlocking

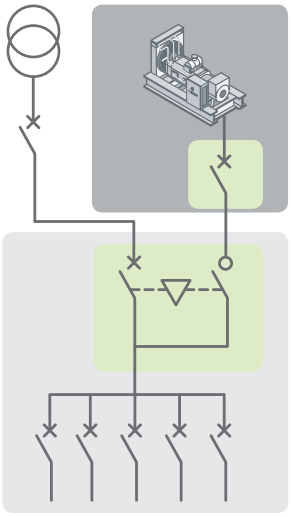
This CC class solution is economical.
The installation's safety is ensured by choosing a coordinated contactor + circuit breaker combination, but with no guarantee of absence of contact welding.

Selection of contactors according to the coordination table
The table on pages 4 and 5 shows coordinated contactor + circuit breaker combinations according to type 1, in accordance with the IEC 60947-4-1 standard, up to the breaking capacity of the upstream circuit breaker.

Type 1 coordination specifies that the effect of the short circuit on all coordinated products is safe for the operators.

Repair or replacement is needed to resume operation.

Recommended solution above 410 kVA



Circuit breaker + switch with electrical and mechanical interlocking integrated into the main LV switchboard

Since the transformer is generally near the main LV switchboard, this solution is optimized, and ensures good reliability:

> A single circuit breaker performs the functions of switchboard incoming end protection and 'Mains' source switching

> One switch is sufficient to ensure switching to the generator set

> The circuit breaker and switch have been designed to interface directly with an interlocking mechanism.

Savings can be achieved by using different ratings for Mains and Generator, when the generator set is sized for partial backup of the electrical installation.

Feasible combinations: Mains circuit breaker + Generator circuit breaker or switch

	Generator				
Mains	NSX100 NSX160 NSX250	NSX400 NSX630	NS630b NS1600	MTZ1	MTZ2 MTZ3
NSX100/160/250	✓				
NSX400 - 630	✓	✓			
NS630b… NS1600			✓		
MTZ1				✓	
MTZ2, MTZ3				✓	✓

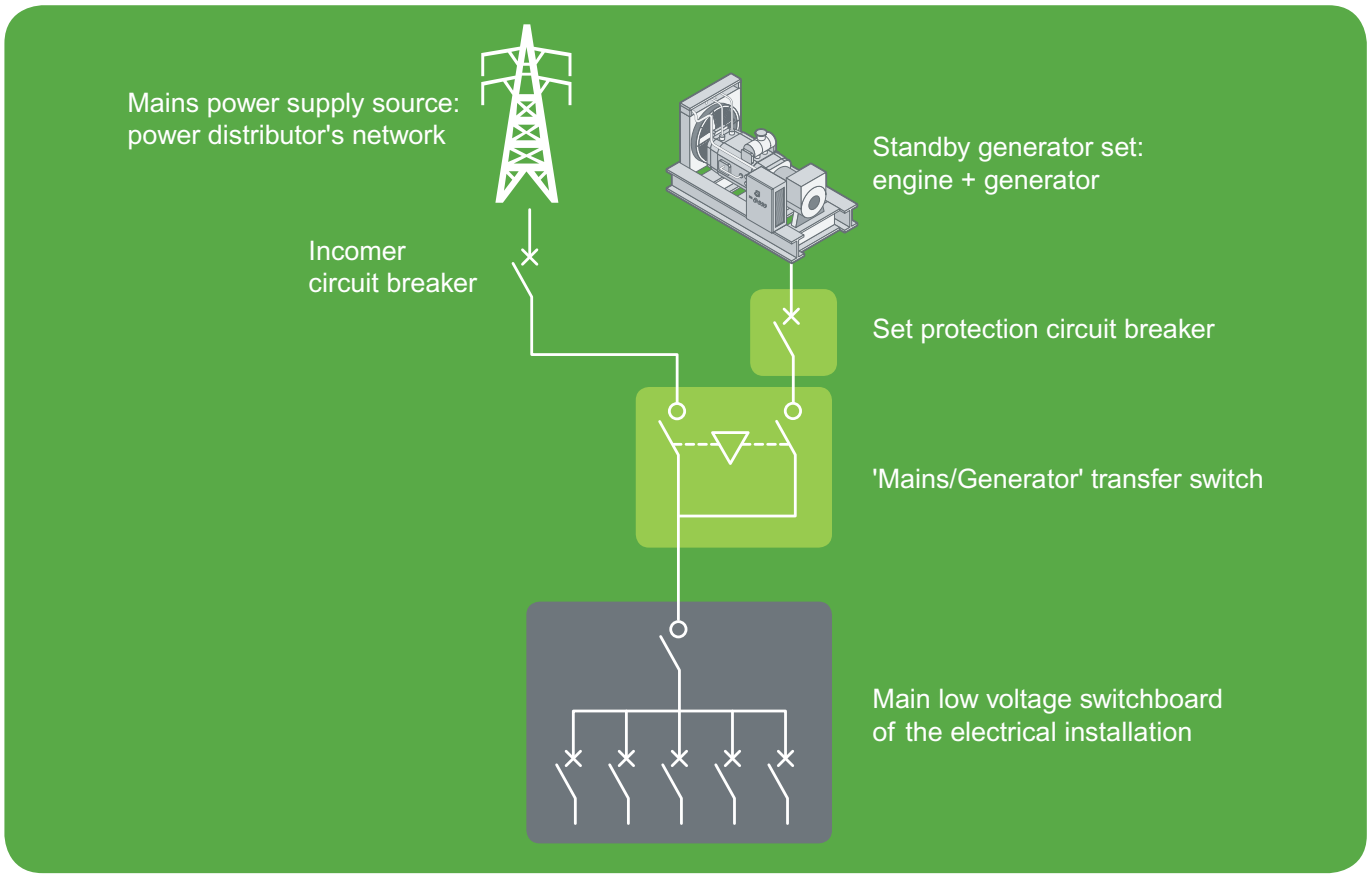
These combinations allow the use of an interlocking mechanism, irrespective of the size or rating of the devices.

Standby power supply for standard installations

Backup power supply is appreciated in case of power outage from the main supply (e.g. the Utility).

In this case, the generator supplies a selection of essential equipment.

Standby power supply for standard applications



What is expected

Typical concern for normal service application:

> Loads supply for a limited period of time

> Technically/economically optimized solution.

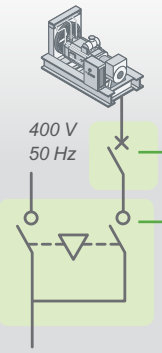
The Genset is used as a backup source in case of power outage (usually the Grid).

A transfer switch is needed (open transition).

Quick component selection table

Standby
Standard

> Generator sets up to 45 kVA



Generator			Circuit breaker (1)			Transfer switching equipment (2)
Power		**Current**	**Curve**	**Rating**	**Type**	**CC class**
PRP (40°C) (kVA)	LTP (27°C) (kVA)	@ 400 V / 50 Hz (A)		(A)		Reference (3)
10	10	**14.4**	B	16	iC60N 16 A – B + Vigi or RH	TeSys **LC1DT20••**
15	15	**21.7**	B	20	iC60N 20 A – B + Vigi or RH	TeSys **LC1DT20••**
20	20	**28.9**	B	32	iC60N 32 A – B + Vigi or RH	TeSys **LC1DT32••**
25	25	**36.1**	B	40	iC60N 40 A – B + Vigi or RH	TeSys **LC1DT40••**
27	27	**39**	B	40	iC60N 40 A – B + Vigi or RH	TeSys **LC1DT40••**
32	32	**46.2**	B	50	iC60N 50 A – B + Vigi or RH	TeSys **LC1DT60A••**
35	35	**50.5**	B	50	iC60N 50 A – B + Vigi or RH	TeSys **LC1DT60A••**
40	40	**57.7**	B	63	iC60N 63 A – B + Vigi or RH	TeSys **LC1DT60A••**

Interlocking devices for transfer switching assemblies

Interlocking kits for	Mechanical + electrical with set of connections	Mechanical with set of connections	Mechanical
LC1DT20 to DT40	LADT9R1V	LADT9R1	LAD9V2
LC1DT60A	-	-	LAD4CM

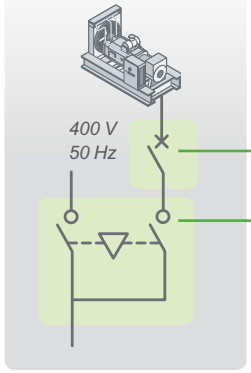
*(1) Circuit breakers in accordance with the IEC 60947-2 standard – **for a 40°C environment (for 60°C, derate by 10%)***
Vigi = Residual Current Device; RH = Residual Current protection relay
(2) Transfer switching equipment in accordance with the IEC 60947-6-1 standard - Two devices of this type are needed, with mechanical and electrical interlocking
(3) Each reference must be completed by a coil voltage code > see details on page 15

The addition of a residual current protection relay to the circuit breaker is recommended: Associated RCD: Acti9 Vigi iC60 – 100 mA earth leakage module.

⚠ *CC type transfer switching equipt: selectivity not guaranteed for tripping of a downstream CB; contactor welding possible upon short circuit.*

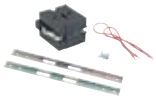
Standby
Standard

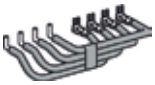
> Generator sets up to 450 kVA



Generator			Circuit breaker (1)			Transfer switching equipment (2)
Puissance		Current	Curve	Rating	Type	CC class
PRP (40°C) (kVA)	LTP (27°C) (kVA)	@ 400 V / 50 Hz (A)		(A)	Reference	Reference (3)
45	45	**65**	TM-G	63	Compact NSX100B + TM-G 80	TeSys **LC1DT60A••**(3)
50	50	**72.2**	TM-G	80	Compact NSX100B + TM-G 80	TeSys **LC1DT80A••**(3)
60	60	**86.6**	TM-G	80	Compact NSX100B + TM-G 80	TeSys **LC1D80004••**(3)
70	70	**101**	TM-G	100	Compact NSX100B + TM-G 100	TeSys **LC1D80004••**(3)
80	80	**115.5**	TM-G	125	Compact NSX160B + TM-G 125	TeSys **LC1D80004••**(3)
90	90	**129.9**	TM-G	125	Compact NSX160B + TM-G 125	TeSys **LC1D115004••**(3)
105	105	**151.6**	TM-G	160	Compact NSX160B + TM-G 160	TeSys **LC1D115004••**(3)
125	125	**180.4**	TM-G	200	Compact NSX250B + TM-G 200	TeSys **LC1D115004••**(3)
135	135	**194.9**	TM-G	200	Compact NSX250B + TM-G 200	TeSys **LC1D115004••**(3)
150	150	**216.5**	TM-G	200	Compact NSX250B + TM-G 200	TeSys **LC1F1504••**(3)
165	165	**238.2**	TM-G	250	Compact NSX250B + TM-G 250	TeSys **LC1F1504••**(3)
180	180	**259.8**	TM-G	250	Compact NSX250B + TM-G 250	TeSys **LC1F1854••**(3)
200	200	**288.7**	Adj.	400	Compact NSX400F + Micrologic 2.3 400 A	TeSys **LC1F2254••**(3)
250	250	**360.8**	Adj.	400	Compact NSX400F + Micrologic 2.3 400 A	TeSys **LC1F3304••**(3)
280	280	**404.1**	Adj.	400	Compact NSX400F + Micrologic 2.3 400 A	TeSys **LC1F4004••**(3)
315	315	**454.7**	Adj.	630	Compact NSX630F + Micrologic 2.3 630 A	TeSys **LC1F4004••**(3)
365	365	**526.8**	Adj.	630	Compact NSX630F + Micrologic 2.3 630 A	TeSys **LC1F5004••**(3)
410	410	**591.8**	Adj.	630	Compact NSX630F + Micrologic 2.3 630 A	TeSys **LC1F5004••**(3)

Interlocking devices for transfer switching assemblies





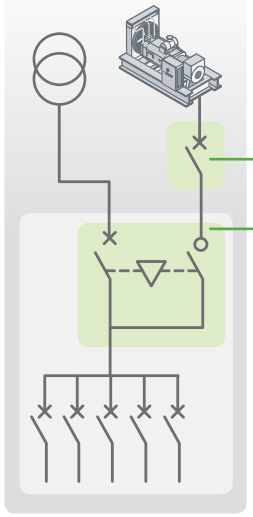
For pair of contactors	Mechanical interlocks with electrical interlocking	Mechanical interlocks without elec. interlocking	Set of connections	Power connection	Mechanical interlock
LC1D80004	LA9D4002	LA9D50978	LA9D8070	-	-
LC1D115004	LA9D11502	-	LA9D11570	-	-
LC1F1504	-	-	-	LA9F15077	LA9FF970
LC1F1854	-	-	-	LA9FG977	LA9FG970
LC1F2254	-	-	-	LA9F22577	LA9FG970
LC1F2654	-	-	-	LA9FH977	LA9FJ970
LC1F3304	-	-	-	LA9FJ977	LA9FJ970
LC1F4004	-	-	-	LA9FJ977	LA9FJ970
LC1F5004	-	-	-	LA9FK977	LA9FJ970

*(1) Circuit breakers in accordance with the IEC 60947-2 standard – **for a 40°C environment (for 60°C, derate by 10%)***
The addition of a residual current protection relay to the circuit breaker is recommended:
> Integrated RCD: MH vigi module for Compact NSX100 and NSX160 (LV429211), MH Vigi module for NSX250 (LV431536) and MB vigi module for NSX400 and NSX630 (LV432456).
> Separate RCD: Vigirex RH21.
(2) Transfer switching equipment in accordance with the IEC 60947-6-1 standard - Two devices of this type are needed, with mechanical and electrical interlocking
(3) Each reference must be completed by a coil voltage code > see details on page 15

⚠ *CC type transfer switching equipt: selectivity not guaranteed for tripping of a downstream CB; contactor welding possible upon short circuit.*

Quick component selection table

Standby
Standard



> Generator sets over 450 kVA

Compact Masterpact

Generator			Circuit breaker (1)			Transfer switching equipment (2)
Power		**Current**	**Curve**	**Rating**	**Type**	**CB class**
PRP (40°C) (kVA)	LTP (27°C) (kVA)	@ 400 V / 50 Hz (A)		(A)		
455	455	**656.7**	Adj.	800	Compact NS800N - Micrologic 2.0 + RH	**CB class transfer switching equipment recommended in main LV switchboard**
500	500	**721.7**	Adj.	800	Compact NS800N - Micrologic 2.0 + RH	
550	550	**793.9**	Adj.	800	Compact NS800N - Micrologic 2.0 + RH	
600	600	**866**	Adj.	1000	Compact NS1000N - Micrologic 2.0 + RH	
660	660	**952.6**	Adj.	1000	Compact NS1000N - Micrologic 2.0 + RH	
725	725	**1046.4**	Adj.	1250	Compact NS1250N - Micrologic 2.0 + RH	
800	800	**1154.7**	Adj.	1250	Compact NS1250N - Micrologic 2.0 + RH	
880	880	**1270.2**	Adj.	1600	Compact NS1600N - Micrologic 2.0 + RH	
910	910	**1313.5**	Adj.	1600	Compact NS1600N - Micrologic 2.0 + RH	
1000	1000	**1443.4**	Adj.	1600	Compact NS1600N - Micrologic 2.0 + RH	
1250	1250	**1804.2**	Adj.	2000	Masterpact MTZ2 20 H1 - Micro 5.0X + RH	
1350	1350	**1948.6**	Adj.	2000	Masterpact MTZ2 20 H1 - Micro 5.0X + RH	
1500	1500	**2165.1**	Adj.	2500	Masterpact MTZ2 25 H1 - Micro 5.0X + RH	

(1) Circuit breakers in accordance with the IEC 60947-2 standard
(2) Transfer switching equipment in accordance with the IEC 60947-6-1 standard - Two devices of this type are needed, with mechanical and electrical interlocking

The addition of a residual current protection relay to the circuit breaker is recommended:
> Vigirex RH21.

TeSys D, TeSys F contactor reference coding

LC1DT

4-pole contactors

Frequency	Code
50 Hz	5
60 Hz	6
50/60 Hz	7

Coil voltage	Code
24 V	B
48 V	E
110 V	F
220 V	M
240 V	U
380 V	Q
415 V	N
440 V	R

Terminals	Code
Screw clamp power terminals	- - (no character printed)
Everlink BTR screw power terminals	A -
Spring power terminals	- 3
Everlink BTR screw terminals spring control terminal	A 3

AC-1 operational current rating Ue ≤ 440 V	Code
20… 80 A	20… 80

LC1F

3 and 4-pole contactors

Frequency	Code
50 Hz	5
60 Hz	6
50/60 Hz	7

Coil voltage	Code
24 V	B
48 V	E
110 V	F
220 V	M
240 V	U
380 V	Q
415 V	N
440 V	R

Poles	Code
3-pole	- (no character printed)
4-pole	4

AC-1 rated operational current Ue ≤ 440 V	Code
115… 800 A	115… 800

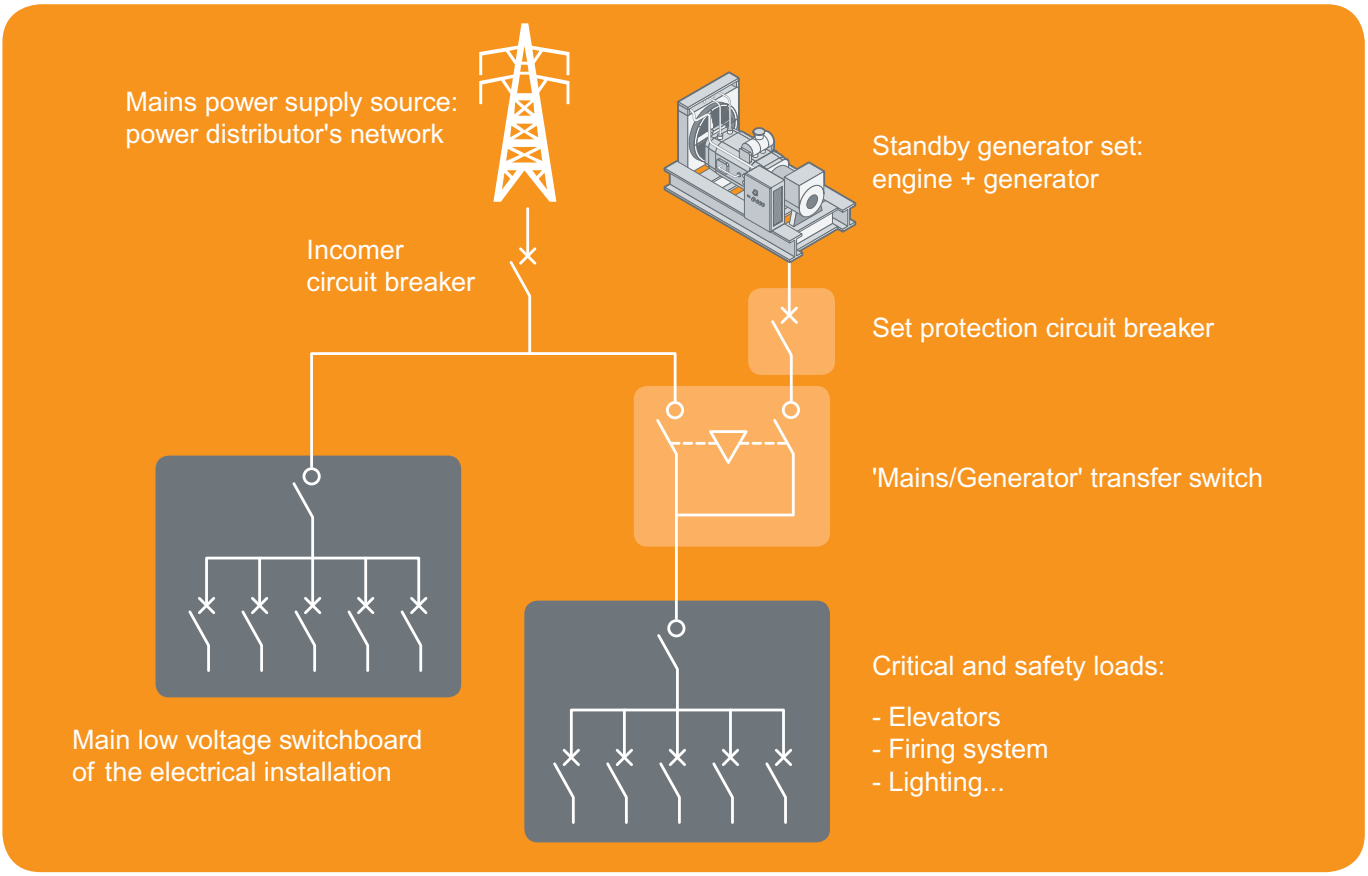
Standby power supply for safety installations

Permanence of the power supply can be important to maintain the safety of building users in the event of a mains failure.

In that case the generator source powers the lighting of areas used for evacuation, smoke extractors, elevators reserved for emergency responders, etc.

Additional requirements apply to generator sets in this case (appended: IEC 60364-5-56)

Standby power supply for safety applications



What is expected

The Genset shall provide power supply to the critical equipments and life safety systems in case of power outage (safety lighting, smoke extractors, elevators...).

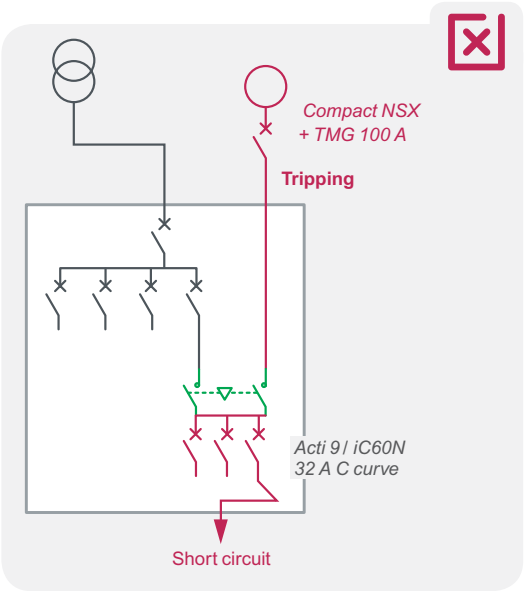
Typical concerns for safety services application:

> Local regulation requirements
> Selective electrical protection
> High reliability and periodic tests requested
> Need for a transfer switch (open transition)

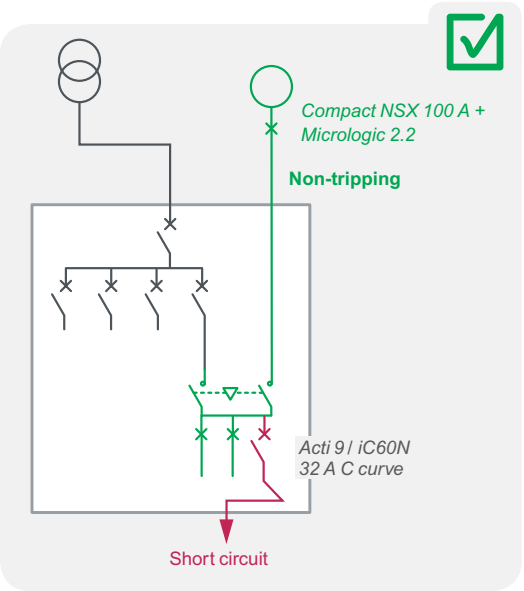
Standby power supply for safety installations

> Selectivity requirement: only the circuit breaker closest to the electrical fault should trip

Transfer switching equipment's impact on selectivity



The Compact NSX circuit breaker with TMG 100 A thermomagnetic tripping device does not allow selectivity with the Acti9 iC60N C-curve circuit breaker.



The Compact NSX circuit breaker with Micrologic 2.2 electronic tripping device allows selectivity with the Acti9 iC60N C-curve circuit breaker

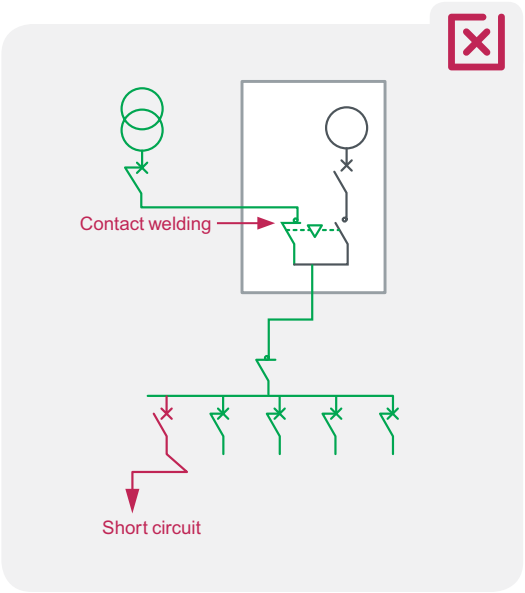
Selectivity is also required:

> between the circuit breakers and the Mains power circuit breaker;

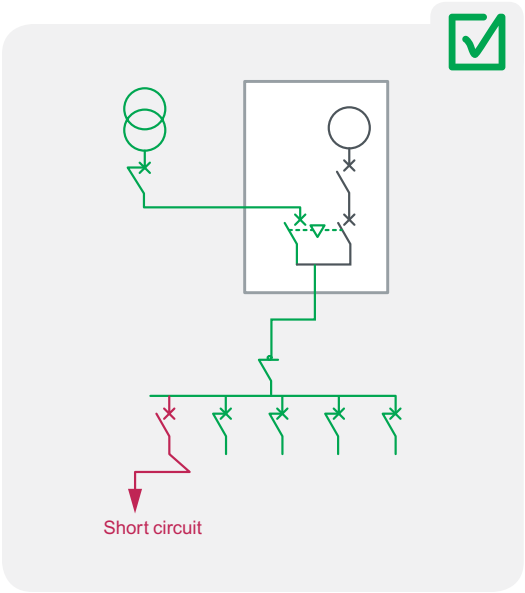
> between RCDs.

Safety requirement: the transfer switching equipment must withstand short-circuit currents without any damage

Transfer switching equipment's impact on safety



Transfer switching equipment with contactors:
A short circuit in the installation is likely to cause welding of the Mains contactor contacts.
Switchover to the generator set will becomes impossible.



Transfer switching equipment with circuit breakers (= class CB) or switches (= class PC)

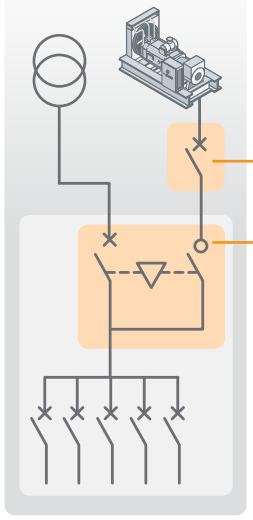
Safe switchover to the generator set, without risk of contact welding.

The coordination study of the various protection and switching devices must be performed for the complete installation in accordance with the IEC 60364-5-56 standard.

Integration of the transfer switching equipment in the main LV switchboard facilitates consistent electrical studies.

Standby power supply for safety installations

Standby
Safety



> Generator sets up to 410 kVA

Integration of the transfer switching equipment in the Main Low Voltage Switchboard is the preferred solution.

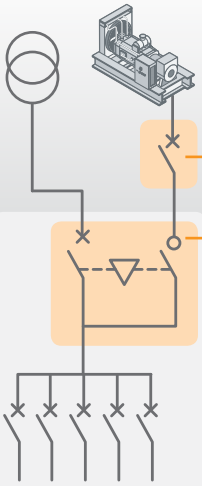
Generator			Circuit breaker (1)		Transfer switching equipment (2)
Power		**Current**	**Rating**	**Type**	**CB class**
PRP (40°C) (kVA)	LTP (27°C) (kVA)	@ 400 V / 50 Hz (A)	(A)		
45	50	**65**	80	Compact NSX 100B + Micrologic 2.2: **LV429785**	
50	55	**72.2**	80	Compact NSX 100B + Micrologic 2.2: **LV429785**	
60	66	**86.6**	100	Compact NSX 100B + Micrologic 2.2: **LV429785**	
70	77	**101**	100	Compact NSX 100B + Micrologic 2.2: **LV429785**	
80	90	**115.5**	125	Compact NSX 160B + Micrologic 2.2: **LV430750**	
90	100	**129.9**	160	Compact NSX 160B + Micrologic 2.2: **LV430750**	
105	116	**151.6**	160	Compact NSX 160B + Micrologic 2.2: **LV430750**	
125	138	**180.4**	200	Compact NSX 250B + Micrologic 2.2: **LV431150**	
135	150	**194.9**	200	Compact NSX 250B + Micrologic 2.2: **LV431150**	**CB class transfer switching equipment recommended in main LV switchboard**
150	165	**216.5**	250	Compact NSX 250B + Micrologic 2.2: **LV431150**	
165	175	**238.2**	250	Compact NSX 250B + Micrologic 2.2: **LV431150**	
180	203	**259.8**	400	Compact NSX 400F + Micrologic 2.3 400 A: **LV432677**	
200	223	**288.7**	400	Compact NSX 400F + Micrologic 2.3 400 A: **LV432677**	
250	275	**360.8**	400	Compact NSX 400F + Micrologic 2.3 400 A: **LV432677**	
280	300	**404.1**	400	Compact NSX 400F + Micrologic 2.3 400 A: **LV432677**	
315	341	**454.7**	630	Compact NSX 630F + Micrologic 2.3 630 A: **LV432877**	
365	420	**526.8**	630	Compact NSX 630F + Micrologic 2.3 630 A: **LV432877**	
410	450	**591.8**	630	Compact NSX 630F + Micrologic 2.3 630 A: **LV432877**	

(1) Circuit breakers in accordance with the IEC 60947-2 standard – the addition of a residual current protection relay is recommended
(2) Transfer switching equipment in accordance with the IEC 60947-6-1 standard - Two devices of this type are needed, with mechanical and electrical interlocking

RCD: if used it should be chosen to ensure selectivity:
> Integrated RCD: MH vigi module for Compact NSX100 and NSX160 (LV429211), MH Vigi module for NSX250 (LV431536) and MB vigi module for NSX400 and NSX630 (LV432456)
> Separate RCD: Vigirex RH99.

Standby
Safety

> Generator sets over 450 kVA



Generator			Circuit breaker (1)			Transfer switching equipment (2)
Power		**Current**	**Curve**	**Rating**	**Type**	**CB class**
PRP (40°C) (kVA)	LTP (27°C) (kVA)	@ 400 V / 50 Hz (A)	(A)	(A)		
455	500	**656.7**	Adj.	800	Compact NS800N + Micrologic 5.0: **33337**	**CB class transfer switching equipment recommended in main LV switchboard**
500	570	**721.7**	Adj.	800	Compact NS800N + Micrologic 5.0: **33337**	
550	600	**793.9**	Adj.	800	Compact NS800N + Micrologic 5.0: **33337**	
600	660	**866**	Adj.	1000	Compact NS1000N + Micrologic 5.0: **33347**	
660	725	**952.6**	Adj.	1000	Compact NS1000N + Micrologic 5.0: **33347**	
725	800	**1046.4**	Adj.	1250	Compact NS1250N + Micrologic 5.0: **33357**	
800	880	**1154.7**	Adj.	1250	Compact NS1250N + Micrologic 5.0: **33357**	
880	960	**1270.2**	Adj.	1600	Compact NS1600N + Micrologic 5.0: **33367**	
910	1000	**1313.5**	Adj.	1600	Compact NS1600N + Micrologic 5.0: **33367**	
1000	1100	**1443.4**	Adj.	1600	Compact NS1600N + Micrologic 5.0: **33367**	
1250	1375	**1804.2**	Adj.	2000	Masterpact MTZ2 20 H1 - Micro 5.0X	
1350	1485	**1948.6**	Adj.	2000	Masterpact MTZ2 20 H1 - Micro 5.0X	
1500	1650	**2165.1**	Adj.	2500	Masterpact MTZ2 25 H1 - Micro 5.0X	

(1) Circuit breakers in accordance with the IEC 60947-2 standard – the addition of a residual current protection relay is recommended
(2) Transfer switching equipment in accordance with the IEC 60947-6-1 standard - Two devices of this type are needed, with mechanical and electrical interlocking

RCD: if used it should be chosen to ensure selectivity:
> Integrated RCD: Micrologic 7.0
> Separate RCD: Vigirex RH99.

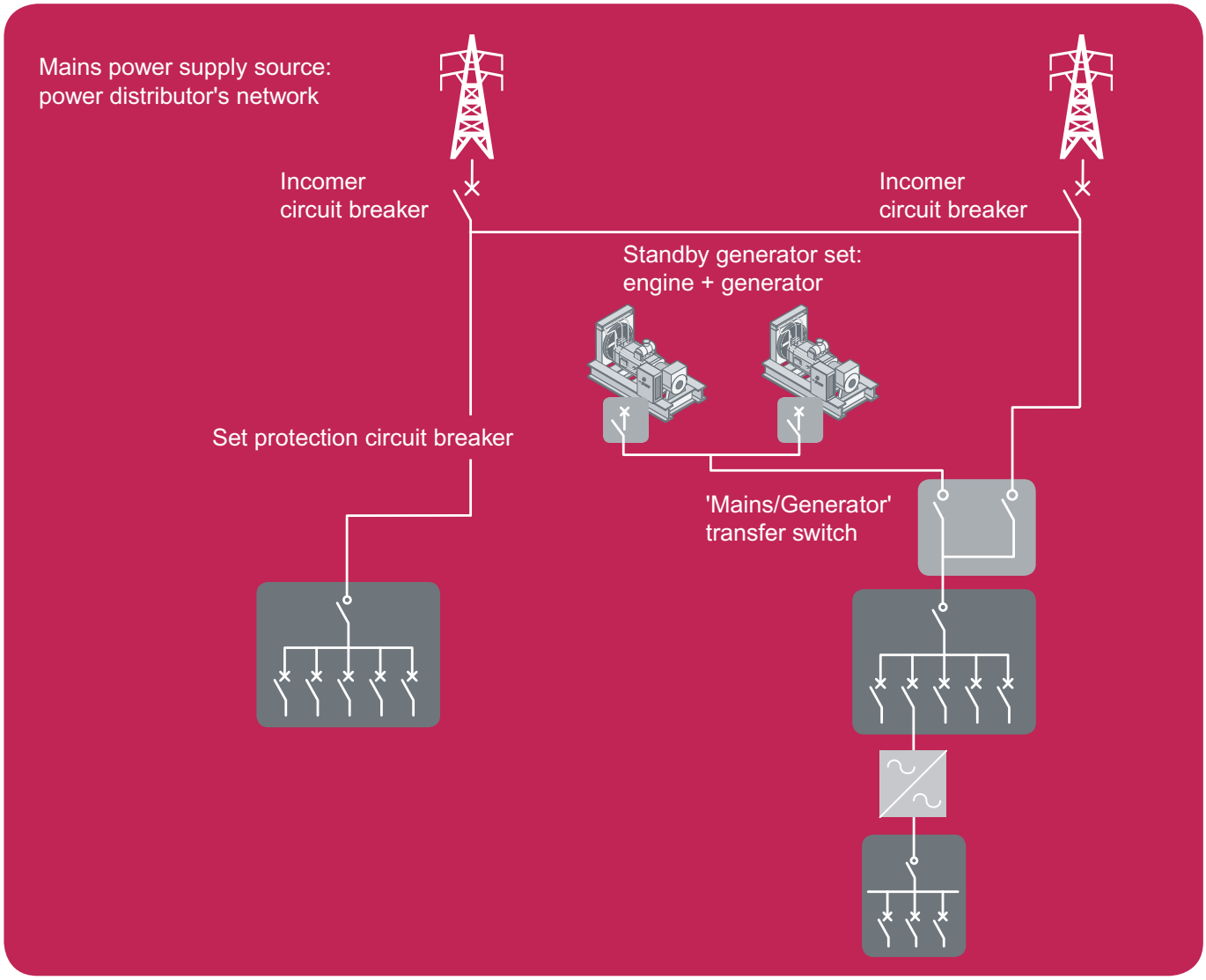
Standby power supply for mission critical installations

A reliable power supply is critical to ensure uninterrupted surgical operations, breathing assistance systems, premature infant care, etc.

Power failure to certain industrial processes has serious consequences.

Like those of safety installations (reliability, selectivity), the characteristics of these installations are also enhanced: redundant standby sources, test modes, parallel connection of sources, etc.

Standby power supply for mission critical installations



What is expected

The Genset shall provide power supply to the critical loads and life safety systems in case of power outage from the main supply (Grid).

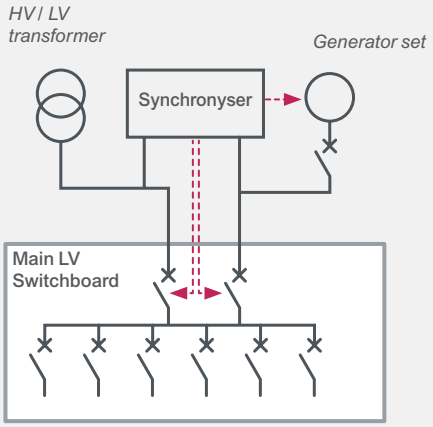
Typical concerns for critical mission application:

> Regulatory requirements related to building activity (e.g. hospital)
> Selective electrical protection
> Continuity of service
> High reliability and periodic tests requested
> Architectures allowing operating redundancy
> Need for a transfer switch (could be open, close or soft transition).

The design of the backup power supply through generator sets is generally managed by the design engineering company in charge of the design for the project.

Indeed each project is different and has its own specificities according to final application (hospital, data center…) and geographical locations, generator sets can be redundant, operates in parallel with the Grid, be centralized in medium voltage… so no selection table is given in this section as all case studies are different.

Source changeover without outage



Specific constraints for choosing the generator circuit breaker and transfer switching equipment:

> They must resist the sum total of short-circuit currents: main source + generator

> They allow total selectivity

> The transfer switching equipment does not prevent simultaneous closing of the two electrical paths (main/backup)

There are solutions that can limit the impact of cutoffs during switching:

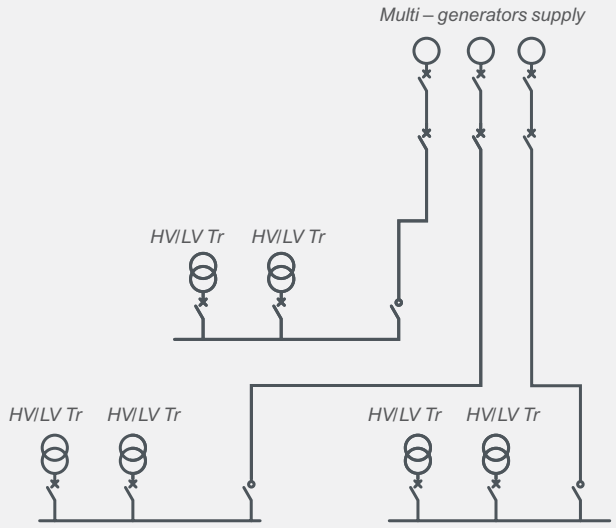
> during scheduled cutoffs of the Mains source

> during generator set tests

> upon return to the Mains source

One of the solutions is coupling of the generator set for a period of time in parallel with the main source (Grid).

High power or very high availability



Source changeover types:

> Open transition: transition where the changeover from one source to the other is done sequentially without overlap. Interlocks are implemented between the 2 sources.

> Close transition: transition where the changeover from one source to the other is done with short overlap (< 100-300 ms) meaning both sources operating in parallel during a short period of time.

> Soft transition: transition where the changeover from one source to the other is done with longer overlap (few seconds to 1 min) meaning both sources operating in parallel to enable Genset load ramp up or down.

Parallel coupling of generator sets is used to increase the standby power or to get redundancy in case of unavailability of a generator (maintenance, malfunction, etc.).

Note: *specific constraints for choosing generator circuit breakers:*

> They must resist the sum total of short-circuit currents of the generator sets + possibly the main source (if main and backup sources are used in parallel)

> They do not prevent parallel operation of the generator sets (no interlocking)

> They allow total selectivity with the downstream protective devices

Recommended products for generator set applications

Circuit breakers, for protection of generators and cables

Acti 9 iC60

Compact NSX

Compact NS

Masterpact

Residual current devices, for protection of human life

Acti 9 DPN Vigi

Vigi iC60 modules

Compact NSX Vigi

Vigirex

Transfer switching equipment

CC type: TeSys D

CC type: TeSys F

CB type: Compact NS

Recommended products for generator set applications

Buttons, indicators, emergency stop switch

Harmony

Measuring equipment

Voltmeters and ammeters

Powerlogic multi-function metering

PowerTag sensors for Acti9 circuit breakers

Auxiliary circuit monitoring and control

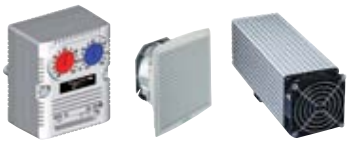
Zelio control relays

TeSys motor starters pre-assembled with TeSys GV motor circuit breakers and TeSys K or D contactors

TeSys GV4 motor circuit breaker

Enclosures and thermal management

Spacial



ClimaSys

Industrial power sockets

Pratika

MV transformers, switchgears

Trihal

Minera

Premset

SM6

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