C2/113
Homologation procedure for HV switchgear according to the technical prescription C2/112

Part 3
Ratings and specific test specifications for HV switchgear, intended for use in an installation connected to the public HV distribution loop of a Belgian DSO
-
Technical file

Edition 2.1 (01.2025)

Version management

1.0	First edition, published 07.2017
2.0	Second edition, published 03.2024

2.1	Second edition - Revision 1, published 02.2025:
	• §3 - Table 1: overview table with ratings and specific test specifications requirements:
	  • §5.2.2 - Item B.3 - Dielectric test on cable testing circuits for FU DKNx (added)
	  • §5.10 – Folder S – VDIS for FU TxGx (added)
	• §4.1 - Table 2: normative references and Synergrid specifications:
	  • Removal of note 1 as Amd.1 of NBN EN 62271-200 Ed.3 has been published
	  • Addition of NBN EN 62271-202 Ed.3 (2022), referenced in §5.9.2.4
	• §4.2 - Minimum required ratings:
	  • Rated current of FU DxGx = 630A instead of 315A + removal of footnote 4
	  • Footnote 2 refers to C2/113-5 instead of C2/112
	  • Rated peak/short-time withstand currents (Ip/Ik-tk): the order of the columns have been swapped for both tables “single rating” and “double rating”
	  • Rating IAC for cables compartment of switchgear of category:
	  - AA1x: I_A, t_A = 20kA,1s instead of I_{Ae}, t_{Ae} = 2kA,1s
	  - AA20 - cables compartment without arc mitigation system: I_A, t_A = 20kA,1s instead of I_{Ae}, t_{Ae} = 2kA,1s
	  - AA20 - cables compartment with arc mitigation system: I_A, t_A = 20kA,x ms instead of I_{Ae}, t_{Ae} = 2kA,x ms
	• §5.9.x - Internal arc tests for switchgear of categories AA1x and AA20, including the revised rating I_A, t_A for the cables compartment:
	  • §5.9.2 - Category AA10
	  • §5.9.3 - Category AA11
	  • §5.9.4 - Category AA13
	  • §5.9.5 - Category AA15
	  • §5.9.6 - Category AA20
	• §5.9.7 - Internal arc tests for switchgear of categories AA30
	• §5.9.8 - Internal arc tests for switchgear of categories AA31
	• §5.9.9 - Internal arc tests for switchgear of categories AA33

Table of contents

1 Object and scope

1.1 Object

The purpose of this document is to define the references and conditions to be taken into consideration for the assessment of the high voltage switchgear to the relevant standards and specific technical specifications applicable for an installation connected to the distribution loop of Belgian distribution system operators (DSO), namely:

- the standards to be met by the switchgear,
- characteristics and test criteria,
- lists of required type test reports,
- specific test procedures.

1.2 Scope

The scope applies to metal enclosed switchgear according to EN 62271-200, and to the HV devices it contains:

- disconnectors and earthing switches
- switch-disconnectors
- switches
- switch-fuse combinations
- circuit breakers
- instrument transformers

2 Instructions for compiling the technical file C2/113-3

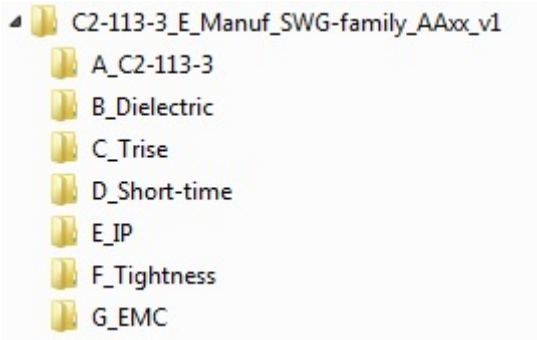
2.1 File structure and (sub)folder names

The composition of the technical file is based on the exact structure and contents of the assessment guide. See §3 for more details.

The root file shall at least contain the following information:

Manufacturer- Switchgear family - AA category – Version (date)

The picture below gives an example of how to build the mandatory structure of folders and subfolders when composing the technical file:



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Technical files with a deviating or incomplete structure will not be accepted.

2.2 Test reports and declarations

The applicant shall submit a general declaration of conformity to the requirements of the specification C2/113-3.

A test report shall contain the minimum following information:

- Reference number
- Description of test object (unambiguous designation, ratings and identification drawings, identification of critical components (vacuum interrupters, mechanisms, …)
- Type of test performed with reference to the applied IEC standard(s) (incl edition) and paragraph(s)
- Ratings tested
- Test arrangement
- Specific test criteria
- Conclusion of the tests
- Testing laboratory
- Date of test

A declaration shall contain the minimum following information:

- Reference number
- Comparison of the tested object and of the object for which the homologation is requested
- Conclusion with assessment of validity of the extension criteria
- Technical argumentation if required
- Name and function of issuer

The required test reports are mentioned in the assessment guide.

This assessment guide specifies:

- eventual specific test arrangement or test criteria, if applicable,
- which tests shall be ISO 17025
- specific requirements for the test procedure (e.g. proof of independence, …)

By ISO 17025 test is meant a test performed under the scope of the accreditation ISO 17025 :

- on the test object for which the homologation is requested, with report issued by an ISO 17025 accredited laboratory
- on a test object different than the one for which the homologation is requested, with report issued by an ISO 17025 accredited laboratory
  + declaration of validity of extension to the object for which the homologation is requested according to criteria of IEC 62271-307, issued by the same laboratory
- on a test object different than the one for which the homologation is requested, with report issued by an ISO 17025 accredited laboratory
  + declaration of validity of extension to the object for which the homologation is requested according to criteria of IEC 62271-307 with argumentation, issued by the manufacturer.

For the other tests, the same rules apply, except that ISO 17025 accreditation is not required.

3 Instructions for completing the assessment guide

The Applicant shall download the applicable assessment guide C2/113-3 (Excel file) from the website of Synergrid (www.synergrid.be).

The file shall be completed as explained and illustrated on the picture on the next page.

All cases of concern with regard to the proposed functional units (FUs) are marked in pink background colour, and shall be filled in by the Applicant.

The following FUs are to be considered:

- FU K intended to be connected to the distribution loop (KKNx)
- FU D or T for the general protection[1] (DxGx and TxGx)
- FU D for DSO feeder (DKNx)
- FUs R, KKUx, TKUx, DKUx and P, installed downstream the general protection and the HV billing metering
- FU M for HV billing metering (Mxxx)

The specific test specifications are described in chapter 5 of this document and summarized in Table 1 below. The folder codes (B, C, D, E, ..) are in accordance with the codes used in the assessment guide C2/113-3.

Chapter 6 is applicable for billing metering functions and contains additional and derogating requirements with reference to chapter 5. The (minimum) ratings are given in chapter 4 of this document.

The assessment is based on the ratings confirmed by the Applicant in the completed shortlist C2/113-2. Synergrid will only consider the pre-classified FUs introduced in the summary of the shortlist C2/113-2 and filled-in the assessment guide C2/113-3.

§	Folder (.item no) as in AG C2/113-3	Ratings / Specific requirements for the tests or verifications which are not covered or not completely described by the EN 62271-200	FU KKNx	FUs TxGx DxGx	FU DKNx	FU M	FUs R KKUx TKUx DKUx P
§4.2	-	Ratings - Ur/Ud/Up - Ir - Ip/Ik-tk - Iload (switch-disconnector) - Ima (switch-disconnector and earthing switches) - Ima & Isc (circuit-breaker) - Operating sequence	 X X X X X	 X X X X X X	 X X X X X X	 X X	 X X
§5.2.1	B.2	PD tests	X	X	X		
§5.2.2	B.3	Dielectric test on cable testing circuits (Uct,DC)	X		X		
§5.3	D	Short-time withstand and peak withstand current tests on switchgear cat. AA20 with arc mitigation system operational	X	X	X		X
§5.4	E	Degree IP & IK	X		X	X	
§5.5	F	Tightness test at 40°C	X	X	X		
§5.6.1	L.5	Maximal allowable force for operation	X		X		
§5.7	M	Mechanical and electromechanical interlocks	X		X		
§5.8	P	Measurement of leakage currents	X			X	
§5.9	Q	Internal arc test - criteria by AA category and IAC	X	X	X	X	X
§5.10	S	Voltage detecting and indicating system (VDIS)	X	X	X		
§5.11	W	Testing of a HV circuit breaker overcurrent protection chain		X			
§6.4	X	Current transformers (for metering)				X	
§6.5	Y	Voltage transformers (for metering)				X	
X = rating / specific requirements applicable for the FU(s)							

Table 1: overview table with ratings and specific test specifications requirements

[1] Also refers to the protection of the unique distribution transformer in a Client installation

Data to be confirmed by the Applicant:

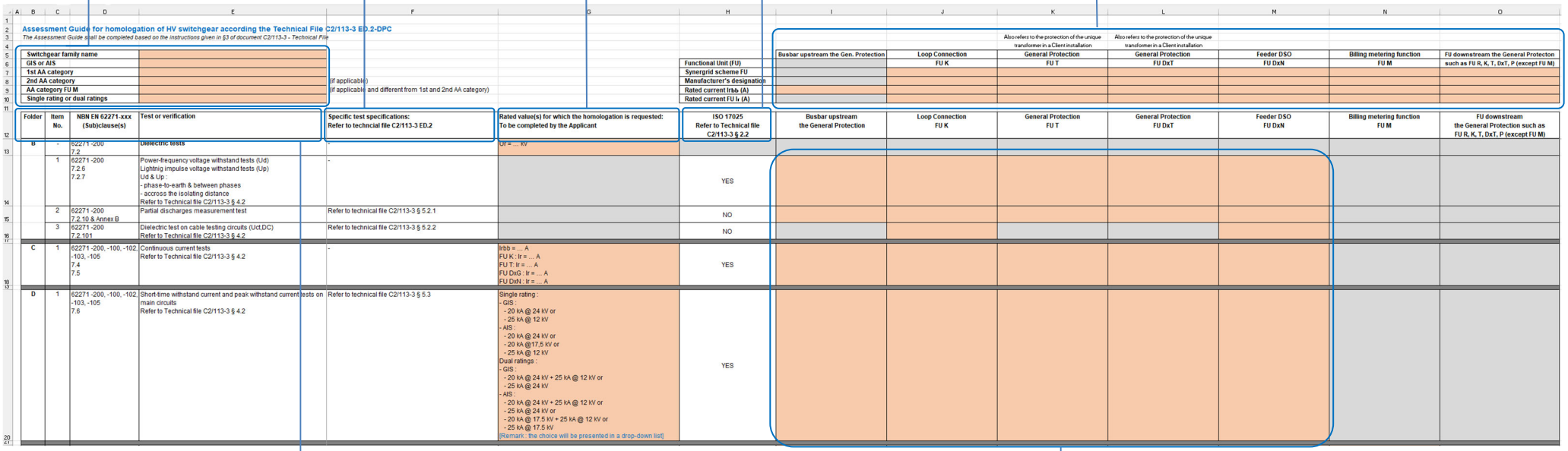
Switchgear family name:	manufacturer designation of the switchgear family (Belgian version)
GIS or AIS:	indicate if the switchgear family is AIS or GIS
1st and 2nd AA category:	in accordance with the technical prescription Synergrid C2/113-7
AA category FU M:	in accordance with the technical prescription Synergrid C2/113-7
Single or dual ratings:	indicate if the switchgear family has single or dual ratings: see §4.2 “Ratings” of this document

Reference to the specific test specifications in addition to NBN EN standards, described in this document C2/113-3

To be confirmed by the Applicant: Rated values of the switchgear family, FUs and its switching devices for which the homologation is requested. See §4.2 “Ratings” of this document.

Requirement if test shall be performed or not under scope of accreditation ISO 17025. See §2.2 “Test reports and declarations” of this document.

- Only the pre-classified FU for which the lines 5 to 9 are filled in by the Applicant will be considered.
- Synergrid scheme FU: see document C2/119.
- Manufacturer designation: unambiguous commercial designation, to be confirmed by the Applicant.
- Rated busbar current Irbb and rated current Ir of the FU, to be confirmed by the Applicant.
- If more than one version of an FU is proposed (e.g. Ir, cable or busbar connection), a column shall be added to have one column per version. In this case, if no dedicated report or document is of concern, the cell of the added column has to be filled in with "see FU xxx"



Assessment Guide for homologation of HV switchgear according the Technical File C2/113-3 ED.2-DPC

The Assessment Guide shall be completed based on the instructions given in §3 of document C2/113-3 - Technical File

Switchgear family name	
GIS or AIS	
1st AA category	
2nd AA category	(if applicable)
AA category FU M	(if applicable and different from 1st and 2nd AA category)
Single rating or dual ratings	

Folder	Item No.	NBN EN 62271-xxx (Sub)clause(s)	Test or verification	Specific test specifications: Refer to techncial file C2/113-3 ED.2	Rated value(s) for which the homologation is requested: To be completed by the Applicant	ISO 17025 Refer to Technical file C2/113-3 § 2.2	Busbar upstream the General Protection	Loop Connection FU K	General Protection FU T	General Protection FU DxT	Feeder DSO FU DxN	Billing metering function FU M	FU downstream the General Protection such as FU R, K, T, DxT, P (except FU M)
						Functional Unit (FU)			Also refers to the protection of the unique transformer in a Client installation	Also refers to the protection of the unique transformer in a Client installation			
						Synergrid scheme FU							
						Manufacturer's designation							
						Rated current Irbb (A)							
						Rated current FU Ir (A)							
B	-	62271-200 7.2	Dielectric tests		Ud = ... kV								
	1	62271-200 7.2.6 7.2.7	Power-frequency voltage withstand tests (Ud) Lightning impulse voltage withstand tests (Up) Ud & Up : - phase-to-earth & between phases - accross the isolating distance Refer to Technical file C2/113-3 § 4.2	-		YES							
	2	62271-200 7.2.10 & Annex B	Partial discharges measurement test	Refer to technical file C2/113-3 § 5.2.1		NO							
	3	62271-200 7.2.101	Dielectric test on cable testing circuits (Uct,DC) Refer to Technical file C2/113-3 § 4.2	Refer to technical file C2/113-3 § 5.2.2		NO							
C	1	62271-200, -100, -102, -103, -105 7.4 7.5	Continuous current tests Refer to Technical file C2/113-3 § 4.2	-	Irbb = ... A FU K : Ir = ... A FU T: Ir = ... A FU DxG : Ir = ... A FU DxN : Ir = ... A	YES							
D	1	62271-200, -100, -102, -103, -105 7.6	Short-time withstand current and peak withstand current tests on main circuits Refer to Technical file C2/113-3 § 4.2	Refer to technical file C2/113-3 § 5.3	Single rating : - GIS : - 20 kA @ 24 kV or - 25 kA @ 12 kV - AIS : - 20 kA @ 24 kV or - 20 kA @17,5 kV or - 25 kA @ 12 kV Dual ratings : - GIS : - 20 kA @ 24 kV + 25 kA @ 12 kV or - 25 kA @ 24 kV - AIS : - 20 kA @ 24 kV + 25 kA @ 12 kV or - 25 kA @ 24 kV or - 20 kA @ 17.5 kV + 25 kA @ 12 kV or - 25 kA @ 17.5 kV [Remark : the choice will be presented in a drop-down list]	YES							

- Folder index and item no.
- (Sub)clause(s) of NBN EN 62271-series
- Description of test or verification

See §5 “Specific test specifications” of this document
See §6 “Specific test specifications for FU M” of this document

References of the applying test reports provided in the corresponding folders B to W to be filled in by the Applicant:

- REPxxx: The report reference has to be preceded by the prefix "REP".
- DECLxxx: If a Clarification (i.e.: need of a compilation of several reports) or a Declaration of conformity is submitted, the reference of this document has to be preceded by the prefix "DECL". If the test object is not in accordance with the proposed FU or Switchgear family, it is mandatory to provide a "DECL" document.

4 General requirements

4.1 Normative references and Synergrid specifications

The standards and Synergrid specifications listed in Table 2 below are applicable.

NBN EN 62271-200 Ed.3 (2021) + Amd.1 (2024)	High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
NBN EN 62271-1 Ed.2 (2017) + Amd.1 (2021)	High-voltage switchgear and controlgear - Part 1: Common specifications
NBN EN 62271-100 Ed.3 (2021)	High-voltage switchgear and controlgear - Part 100: Alternating-current circuit-breakers
NBN EN 62271-102 Ed.2 (2018) + Amd.1 (2022)	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches
NBN EN 62271-103 Ed.2 (2021)	High-voltage switchgear and controlgear - Part 103: Switches for rated voltages above 1 kV up to and including 52 kV
NBN EN 62271-105 Ed.3 (2021)	High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV
NBN EN 62271-202 Ed.3 (2022)	High-voltage switchgear and controlgear - Part 202: AC prefabricated substations for rated voltages above 1 kV and up to and including 52 kV
NBN EN 62271-213 Ed.1 (2021)	High-voltage switchgear and controlgear - Part 213: Voltage detecting and indicating system
NBN EN 62271-307 Ed.1 (2015)	High-voltage switchgear and controlgear - Part 307: Guidance for the extension of validity of type tests of AC metal and solid-insulation enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
NBN C20-529 Ed.5 (1991) EN 60529 Ed.2 (1989) + Amd.1 (2013) + Cor.1 (2019)	Degrees of protection provided by enclosures (IP Code)
NBN EN 62262 Ed.1 (2002) + Amd.1 (2021)	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK Code)
EN 60068-2-17 Ed.5 (2023)	Environmental testing - Part 2-17: Tests – Test Q: Sealing
NBN EN 61869-2 Ed.1 (2012)	Instrument transformers - Part 2: Additional requirements for current transformers
NBN EN 61869-3 Ed.1 (2011)	Instrument transformers - Part 3: Additional requirements for inductive voltage transformers
NBN EN ISO/CEI 17025 Ed.3 (2018)	General requirements for the competence of testing and calibration laboratories
Synergrid C10/20-A (2013-09)	Specification for overcurrent protection relays without auxiliary supply

Table 2: normative references and Synergrid specifications

4.2 Ratings

The applicable ratings for the HV switchgear comply with the standards mentioned under paragraph 4.1.

The ratings here below are:

- either complementary to the requirements of the applicable standards (e.g. IAC)
- or requirements based upon the grid parameters (e.g. Ur, dual ratings, …)

Possible rated voltage AIS and GIS (Ur)

Rated voltage Ur (kV)
12 [2]
17,5 [3]
24

The minimum required ratings are the following:

Rated short duration power frequency withstand voltage (Ud)

Rated voltage Ur (kV)	Ud common value (kV rms)	Ud across the isolating distance (kV rms)
12	28	32
17,5	38	45
24	50	60

Rated lightning impulse withstand voltage (Up)

Rated voltage Ur (kV)	Up common value (kV peak)	Up across the isolating distance (kV peak)
12	75	85
17,5	95	110
24	125	145

Rated cable test voltage (Uct,DC)

Rated voltage Ur (kV)	Rated cable test voltage Uct,DC
12 & 17,5	27 kV rms - 0.1 Hz – 15 min
24	36 kV rms - 0.1 Hz – 15 min

Rated current of the busbar (Irbb) :

- Busbar upstream the general protection: 630 A

Rated current of the FU (Ir) :

FU	KKNx	TxGx	DKNx	DxGx
Rated current Ir (A)	630	80	630	630

Rated peak/short-time withstand currents (Ip/Ik-tk)

- The tables with ratings Ip/Ik-tk hereafter shall be read in conjunction with the tables of the rated short-circuit making current Ima further down.
  The tables Ip/Ik-tk / Ur (of the switchgear) and Ur (of the switchgear) / Ima list the minimum required value for Ik and Ima to be met by the switchgear:
  - with single rating: there is one assigned value for Ima @ Ur of the switchgear
  - with dual rating: there is one assigned value for Ima @ Ur of the switchgear and a higher value for Ima tested at a lower value of Ur

[2] The use of switchgear with Ur < 24 kV is limited. The limits are described in C2/113-5, DSO specific requirements

- Single rating

Ip(kÂ)/Ik(kA)-tk(s)	Rated voltage Ur (kV)
62,5/25-1	12
50/20-1	17,5
50/20-1	24

- Dual rating

Ip(kÂ)/Ik(kA)-tk(s)	Rated voltage Ur (kV)
62,5/25-1	17,5
62,5/25-1	24

Rated mainly active load breaking current (Iload) :

- Switching devices and FUs of concern :
  - switch-disconnector : FU KKNx
- Iload = Ir

Rated short-circuit making current (Ima)

- Switching devices and FUs of concern :
  - switch-disconnector : FU KKNx
  - earthing-switches : FUs KKNx, DKNx

- Single rating

Rated voltage Ur (kV)	Ima (kÂ)
12	62,5 @ 12 kV
17,5	50 @ 17,5 kV
24	50 @ 24 kV

- Dual rating

Rated voltage Ur (kV)	Ima (kÂ)
17,5	50 @ 17,5 kV + 62,5 @ 12 kV
24	50 @ 24 kV + 62,5 @ 12 kV

Rated short-circuit making & breaking currents (Ima & Isc)

- Switching devices and FUs of concern :
  - Circuit-breaker : FUs DKNx & DxGx

- Rated operating sequence :
  - DxGx : O- 3 min – CO – 3 min – CO
  - DKNx : O – 0.3s – CO – 15 s – CO

- Single rating

Rated voltage Ur (kV)	Ima (kÂ) / Isc (kA)
12	62,5 / 25 @ 12 kV
17,5	50 / 20 @ 17,5 kV
24	50 / 20 @ 24 kV

- Dual rating

Rated voltage Ur (kV)	Ima (kÂ) / Isc (kA)
17,5	50 / 20 @ 17,5 kV + 62,5 / 25 @ 12 kV
24	50 / 20 @ 24 kV + 62,5 / 25 @ 12 kV

Rated electrical endurance class :

- Switching devices and FUs of concern :
  - switch-disconnector : FU KKNx — Class E3
  - earthing-switches : FUs KKNx, DKNx — Class E2
  - circuit-breaker : FUs DKNx — Class E2 (CB for auto-reclosing duty)
    FUs DxGx — Class E2 (CB not for auto-reclosing)

Rated cable charging breaking currents (Icc)

- Switching devices and FUs of concern :
  - switch-disconnector : FU KKNx
  - Circuit-breaker : FUs DKNx

- Switch-disconnector

Rated voltage Ur (kV)	Icc (A)	Class
12	10	C2
17,5	10	C2
24	16	C2

- Circuit-breaker

Rated voltage Ur (kV)	Icc (A)	Class
12	25	C2
17,5	31,5	C2
24	31,5	C2

Rated mechanical endurance class :

- Switching devices and FUs of concern :
  - Switch(-disconnector) : FU KKNx — Class M1 (1.000 x CO)
  - Disconnector : FU DKNx — Class M0 (1.000 x CO)
  - Earthing-switches : FUs KKNx, DKNx — Class M0 (1.000 x CO)
  - Circuit-breaker : FUs DxGx & DKNx — Class M1 (2.000 x CO)

Internal arc classification IAC:

- Types of accessibility: A
- Classified sides[3]: F, L, R
- Rated arc fault current (I_A, I_{Ae}) and rated arc fault duration (t_A, t_{Ae})
  - Switchgear of category AA1x:
    - Gas filled compartment: I_A, t_A = 20kA, 1s
    - Cables compartment: I_A, t_A = 20kA,1s
    - Busbar compartment[4], if present: I_{Ae}, t_{Ae} = 2kA,1s
    - Metering compartment: I_{Ae}, t_{Ae} = 2kA,1s
  - Switchgear of category AA20:
    - Gas filled compartment: I_A, t_A = 20kA, x[5] ms
    - Cables compartment:
      - Without arc mitigation system: I_A, t_A = 20kA,1s
      - With arc mitigation system: I_A, t_A = 20kA, x[6] ms
    - Busbar compartment[7], if present: I_{Ae}, t_{Ae} = 2kA,1s
  - Switchgear of category AA3x:
    - All HV compartments[8]: I_A, t_A = 20kA, 1s

[3] AFL is the minimum requirement. The exposure xFLR and the accessibility Bxxx are also accepted but not required.
[4] either in the specific busbar compartment (comprising a screened solid insulated busbar system) or the lateral busbar extension component out of the gas filled compartment
[5] with arc mitigation system in service, duration of the arc fault determined by the characteristics of the arc mitigation system
[6] with arc mitigation system in service, duration of the arc fault determined by the characteristics of the arc mitigation system
[7] either in the specific busbar compartment (comprising a screened solid insulated busbar system) or the lateral busbar extension component out of the gas filled compartment
[8] including any component comprising the 3 phases in one single volume

Ratings for measuring CTs of air insulated billing metering function (FU M):

- Rated primary terminal insulation level: $U_m = U_r$ (see possible rated voltage AIS above)
- Ratio (rated I_{prim}/I_{sec}): 25/5[9], 50/5, 125/5, 250/5 or 500/5 A
- Rated output: 5 VA
- Rated accuracy class: 0,2S
- Instrument security factor: FS 5 (FS 10 is not acceptable)
- Rated continuous thermal current: 1,2 * rated I_{prim}
- Rated short time thermal current: $I_{th} = I_k$
- Duration of I_{th}: 1s
- Rated dynamic current: $I_{dyn} = I_p$

Ratings for measuring VTs of air insulated billing metering function (FU M):

- Rated primary terminal insulation level: $U_m = U_r$ (see possible rated voltage AIS above)
- Ratio (rated $U_{n,prim}/U_{n,sec}$): Un/√3 // 110/√3 V
  Un = 5.500 , 6.600 , 11.000 , 12.100 or 15.400 V
- Rated output: 10 VA (burden class I)
- Rated accuracy class: 0,2
- Rated voltage factor – rated time: 1,2 * Un – continuous
  1,9 * Un – 30s
- Rated thermal limiting output: 100 VA

[9] If the short circuit level of the MV grid equals 25 kA and the metering CTs do not comply with this short-time withstand current, then the billing metering function equipped with this CT is only allowed to be installed downstream of a fuse switch combination.

5 Specific test specifications

5.1 General

This chapter includes the specific requirements for the tests which are not covered or not completely described by the EN 62271-200.

The applied folder codes (B, C, D, E, …) are in accordance with the codes used in the assessment guide. For billing metering functional units, specific requirements apply according to chapter 6.

5.2 Folder B - NBN EN 62271-200 §7.2 – Dielectric tests

5.2.1 Partial discharge tests

The partial discharge test is mandatory and shall be performed on the entire functional unit.

The test shall cover all possible configurations (all FUs subject to homologation, busbar extension elements, busbar end connectors)

The tests will be realized in accordance with the standard EN 62271-200, clause 7.2.10 and annex BB, single phase following the procedure A.

- **For AIS :**
  A PD level of 1.000 pC measured for a phase-to-ground voltage of 1.1 Ur (one phase under voltage and the others connected with the frame and earthed following procedure A) is the limit taken into account.
- **For GIS:**
  A partial discharge routine test in accordance with the standard EN 62271-200, clause 8.101 is acceptable. A PD level of 20 pC measured for a phase-to-ground voltage of 1.1 Ur (one phase under voltage and the others connected with the frame and earthed following procedure A) is the limit taken into account.

The test report shall mention the PD level at 1.1 Ur for each phase.

5.2.2 Dielectric test on cable testing circuits

The rated cable test voltage shall be confirmed for FUs KKNx, DKNx only.

The tests shall be performed in accordance with the standard EN 62271-200, clause 7.2.101.

- If Ur = 24 kV or 17,5 kV, the dielectric test on the cable testing circuits is covered by the power frequency voltage withstand test across the isolating distance.
- If Ur = 12 kV : dielectric tests Uct(DC) @ 27 kV rms - 0.1 Hz - 15 min on cable testing circuits with simultaneous application of Ur/fr on the busbar system is applicable

5.3 Folder D - NBN EN 62271-200 §7.6 - Short-time withstand and peak withstand current tests

For switchgear of category AA20 equipped with an arc mitigation system, the tests shall be performed with this mitigation system operational. In addition to the criterion provided by the standard, this system shall not be triggered off. This condition shall be confirmed in an additional declaration.

5.4 Folder E - NBN EN 62271-200 §7.7 - Verification of the degrees of protection IP and IK

The various degrees of protection (IP and IK) listed in table 3 below, shall be confirmed by means of a specific declaration of conformity within folder E of the technical file C2/113-3.

External enclosure of HV compartments	Nr	IP-degree
Accessible sides except the upper side :		
• For equipment with bare active parts inside the enclosure (gas tank or single phase compartment with earthed metal partition between the phases)	1	IP3X-D
• For equipment with insulated screened active parts inside the enclosure (including the metal enclosure of the busbar extension)	2	IP2X-D(1)
Upper side :		
• For equipment with bare active parts inside the enclosure (gas tank or single phase compartment with earthed metal partition between the phases)	3	IP3X-D
• for equipment with insulated screened active parts inside the enclosure (including the metal enclosure of the busbar extension)	4	IP2X-D(1)
Rear side when non accessible :		
• for equipment with bare active parts inside the enclosure (gas tank or single phase compartment with earthed metal partition between the phases)	5	IP3X
• for equipment with insulated screened active parts inside the enclosure (incl. the metal enclosure of the busbar extension)	6	IP2X
Bottom sides :		
• for equipment with bare active parts inside the enclosure	7	IP3X
• for equipment with insulated screened active parts inside the enclosure	8	IPXX(2)
Characteristics of the exhaust channel 's cover to the outside for switchgear category AA13 & AA33	9	IP23-D
Shutters or other devices preventing access to the operating interface		IK07
External enclosure delimiting non-HV compartments		
LV compartment with/without mechanism and empty compartments, i.e. chimney(3)	10	IP2X
Inner partitioning		
Partitions between LV/mechanisms compartments and HV compartments		
• with bare active parts	11	IP3X
• with insulated screened active parts	12	IP2X
Partitions between an accessible HV compartment and an adjacent HV compartment	13	IP2X(4)
Partitions between cables compartment and compartment to access fuses canisters	14	IPXX
Separation partitions between two LV/mechanisms compartments	15	IPXX
Enclosure of fuses (= fuse canisters or compartment directly including fuses)	16	IP3X
Special case of the busbar extension systems for AA1x and AA20		
Extremity obturator of extension bushing	17	IP2X-D(1)
Connection in operation for switchgear extensible from the lateral side or from the top face	18	IP2X-D(1)
Metal enclosure of the busbar extension		IK07

1. The additional letter D can be ensured by the conductive layer of the fully insulated and screened part extension device
2. Complementary measures shall be taken to avoid the possibility to access the cable compartment from the cellar. Those measures can be independent from the switchgear
3. The required IP degree only intends to protect the equipment against external ingression and the persons against access to dangerous parts. There can be additional requirements on the enclosure and partitions, i.e. to guide the gas in case of internal arc.
4. IP degree less than IP2x is also allowed between cables compartments in a GIS monobloc as long as it is not possible to disconnect a cable in one FU from the next FU.

Table 3: required degrees of protection IP and IK

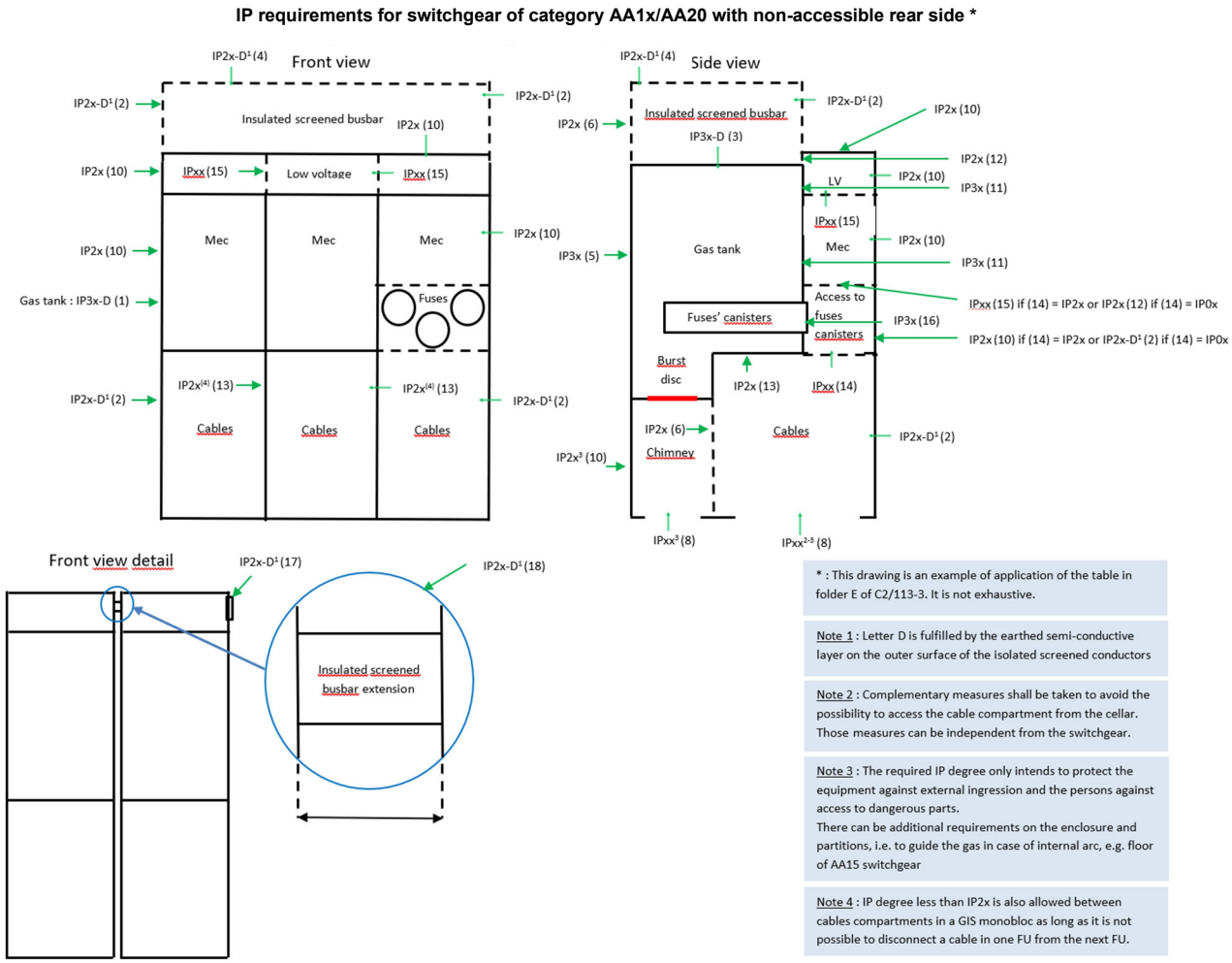


Figure 1: required IP degrees for switchgear of category AA1x and AA20 with non-accessible rear side

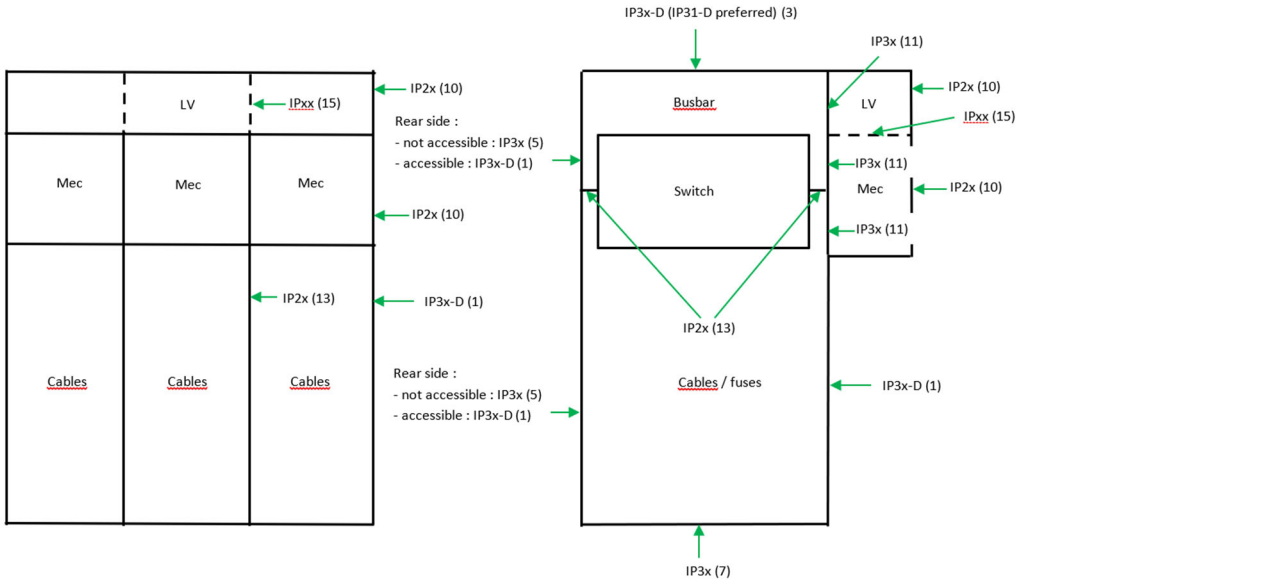


Figure 2: required IP degrees for switchgear of category AA3x

5.5 Folder F - NBN EN 62271-200 §7.8 and EN 60068-2-17 §8.5.2 - Tightness test at 40°C

The tightness test shall be performed in every sealed pressure gas-filled compartment[10] with application of the accumulation test method in accordance with § 8.5.2 of NBN EN 60068-2 -17, Test *Qm, test method 1*. The leakage rate is calculated using the equation given in § 8.5.2.2 of EN 60068-2 -17 and shall not exceed the permissible leakage rate Fp which guarantees an expected operating duration of at least 20 years at 40 °C.

It is the switchgear manufacturer's responsibility to declare that the leakage rate is independent of the position of the main contacts.

The test shall take into account the different types of leakage:

- Leakage at the interface between components of the pressurized vessel (operating shafts, bushings, fuse canisters, manometer, …)
- permeation through the materials (stainless steel enclosure, resins, joints, …)
- leakage through microcracks (welding, …)

It is the switchgear manufacturer's responsibility to determine the duration of incubation at 40°C. This duration shall be sufficient to cover all possible leakages.

5.6 Folder L - NBN EN 62271-200 §7.102 - Mechanical endurance tests and operating force

5.6.1 Maximal allowable force for operation

The maximum force applied during operation (opening and closing) shall be according to the standards IEC 62271-1 § 6.6.4 and 62271-102 § 6.105.
The applicant shall provide evidence, e.g. test report, technical clarification that this requirement is met with the manufacturer standard operation handles.

5.7 Folder M - NBN EN 62271-200 §7.102.2 - Mechanical and electromechanical interlocks

The following test report is acceptable:

- Either a test report according to NBN EN 62271-200 in an ISO 17025 accredited laboratory for this test,
- or a test report according to NBN EN 62271-200 for this test performed in another laboratory + verification during the final inspection (C2/113-4) with measurement of the force with a dynamometric tool with operating interface prepared by the Applicant.

5.8 Folder P - NBN EN 62271-200 §7.104.3 - Measurement of leakage currents

This test is only applicable for accessible compartments with insulating partitions in AIS switchgear.

Those compartments include:

- the cables compartment of the FUs KKNx
- the accessible HV metering compartment of the FU M in presence of insulating partitions between the busbar compartment of the general protection and of the FU M.

NOTE: Under the conditions for opening the earthing switch with an open door, the equipment may be declared compartmented in the sense of NBN EN 62271-200 only if the partitions of the gas filled compartment meet criteria a), b), c) and (d) of § 6.103.3.3

5.9 Folder Q - NBN EN 62271-200 §7.105 - Internal arc test - criteria by AA category and IAC

5.9.1 General

Internal arc tests are mandatory, except for FU M intended to be used exclusively downstream a general protection with switch-fuse combination.

Declarations for extension of validity according to IEC 62271-307 are acceptable. Simulations are not acceptable, unless explicitly mentioned here after.

[10] See Chapter 2 of C2/113-7

5.9.2 Category AA10

5.9.2.1 Internal arc test with arc ignition in the gas-filled compartment

The following internal arc test shall be performed:

- Test:
  IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA10 according to C2/113-7: with gas evacuation downwards
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA10 category as described in C2/113-7, i.e. with gas evacuation downwards
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.2.2 Internal arc test with arc ignition in the cables compartment

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases arc ignition (87% of 20 kA) and the third phase energized according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA10 according to C2/113-7
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA10 category as described in C2/113-7, i.e. with gas evacuation downwards
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.2.3 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or lateral busbar extension component out of the gas-filled compartment (if applicable)

The internal arc test is applicable for:

- The metal enclosed compartment of the screened solid insulated busbar in ambient air, outside the sealed pressure gas-filled compartment
- The screened solid insulated lateral busbar extension components in ambient air between 2 adjacent sealed pressure gas-filled compartments, separated with a distance > 12,5 mm.

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) I_{Ae} = 2kA, t_{Ae} = 1s with single phase ignition and with both other phases energized according to IEC 62271-200
- Version of switchgear:
  As per internal arc category AA10 according to C2/113-7
- Test arrangement:
  In accordance with the manufacturer's installation instructions
- Acceptance criteria:
  Test report
  - according to IEC 62271-200 with positive results
  - providing evidence that the fault does not evolve in a multiphase fault

5.9.2.4 Demonstration of the pressure withstand of all elements involved in or that can communicate with the gas exhaust path (e.g. ducts, compartments and AA10-R riser base frame), in case of an arc in the sealed pressure gas-filled compartment or in the cables compartment (the most severe of both)

These elements shall be tested together with the switchgear, for one configuration, in accordance with NBN EN 62271-200 or NBN EN 62271-202 :

- The version of the switchgear and of the elements involved in or that can communicate with the gas exhaust path shall be as per internal arc category AA10 according to C2/113-7.
- The test arrangement shall be in accordance with the manufacturer's installation instructions and with the configuration corresponding to AA10 category as described in C2/113-7.
- The acceptance criteria shall be according to IEC 62271-200 with positive results.

The overpressure and the withstand of the elements for other configurations can be assessed by simulations.

5.9.2.5 Internal arc test with arc ignition in the metering compartment

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) I_{Ae} = 2kA, t_{Ae} = 1s with single phase ignition and with both other phases energized according to IEC 62271-200
- Version of switchgear:
  As per internal arc category AA10 according to C2/113-7
- Test arrangement:
  In accordance with the manufacturer's installation instructions
- Acceptance criteria:
  Test report
  - according to IEC 62271-200 with positive results
  - providing evidence that the fault does not evolve in a multiphase fault

5.9.3 Category AA11

5.9.3.1 Internal arc test with arc ignition in the gas-filled compartment

The following internal arc test shall be performed:

- Test:
  IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA11 according to C2/113-7: with gas evacuation rear upwards
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA11 category as described in C2/113-7
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.3.2 Internal arc test with arc ignition in the cables compartment

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition (87% of 20 kA) and the third phase energized according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA11 according to C2/113-7 with gas evacuation rear upwards
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA11 category as described in C2/113-7
- Acceptance criteria :
  Test report according to IEC 62271-200 with positive results

5.9.3.3 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or lateral busbar extension component out of the gas-filled compartment (if applicable)

The internal arc test is applicable for:

- The metal enclosed compartment of the screened solid insulated busbar in ambient air, outside the sealed pressure gas-filled compartment
- The screened solid insulated lateral busbar extension components in ambient air between 2 adjacent sealed pressure gas-filled compartments, separated with a distance > 12.5 mm.

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) I_{Ae} = 2kA, t_{Ae} = 1s with single phase ignition and with both other phases energized according to IEC 62271-200,
- Version of switchgear:
  As per internal arc category AA11 according to C2/113-7
- Test arrangement:
  In accordance with the manufacturer's installation instructions
- Acceptance criteria:
  Test report
  - according to IEC 62271-200 with positive results
  - providing evidence that the fault does not evolve in a multiphase fault

5.9.3.4 Demonstration of the pressure withstand of all elements involved in or that can communicate with the gas exhaust path (e.g. ducts, compartments and AA11-R riser base frame), in case of an arc in the sealed pressure gas-filled compartment or in the cables compartment (the most severe of both)

These elements shall be tested together with the switchgear, for one configuration:

- The version of the switchgear and of the elements involved in or that can communicate with the gas exhaust path shall be as per internal arc category AA11 according to C2/113-7.
- The test arrangement shall be in accordance with the manufacturer's installation instructions and with the configuration corresponding to AA11 category as described in C2/113-7.
- The acceptance criteria shall be according to IEC 62271-200 with positive results.

The overpressure and the withstand of the elements for other configurations can be assessed by simulations.

5.9.4 Category AA13

5.9.4.1 Internal arc test with arc ignition in the gas-filled compartment

The following internal arc test shall be performed:

- Test:
  IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA13 according to C2/113-7: with gas evacuation duct, including relief flap
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA13 category as described in C2/113-7
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.4.2 Internal arc test with arc ignition in the cables compartment

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition (87% of 20 kA) and the third phase energized according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA13 according to C2/113-7: with gas evacuation duct, including relief flap
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA13 category as described in C2/113-7
- Acceptance criteria :
  Test report according to IEC 62271-200 with positive results

5.9.4.3 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or lateral busbar extension component out of the gas-filled compartment (if applicable)

The internal arc test is applicable for:

- The metal enclosed compartment of the screened solid insulated busbar in ambient air, outside the sealed pressure gas-filled compartment
- The screened solid insulated lateral busbar extension components in ambient air between 2 adjacent sealed pressure gas-filled compartments, separated with a distance > 12,5 mm.

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) I_{Ae} = 2kA, t_{Ae} = 1s with single phase ignition and with both other phases energized according to IEC 62271-200
- Version of switchgear:
  As per internal arc category AA13 according to C2/113-7
- Test arrangement:
  In accordance with the manufacturer's installation instructions
- Acceptance criteria:
  Test report
  - according to IEC 62271-200 with positive results
  - providing evidence that the fault does not evolve in a multiphase fault

5.9.4.4 Demonstration of the pressure withstand of all elements involved in or that can communicate with the gas exhaust path (e.g. evacuation duct, compartments), in case of an arc in the sealed pressure gas-filled compartment or in the cables compartment (the most severe of both)

These elements shall be tested together with the switchgear, for one configuration:

- The version of the switchgear and of the elements involved in or that can communicate with the gas exhaust path shall be as per internal arc category AA13 according to C2/113-7.
- The test arrangement shall be in accordance with the manufacturer's installation instructions and with the configuration corresponding to AA13 category as described in C2/113-7.
- The acceptance criteria shall be according to IEC 62271-200 with positive results.

The overpressure and the withstand of the elements for other configurations can be assessed by simulations.

5.9.5 Category AA15

5.9.5.1 Internal arc test with arc ignition in the gas-filled compartment

The following internal arc test shall be performed:

- Test:
  IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA15 according to C2/113-7: with an energy absorber
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA15 category as described in C2/113-7
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.5.2 Internal arc test with arc ignition in the cables compartment

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition (87% of 20 kA) and the third phase energized according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA15 according to C2/113-7: with an energy absorber
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA15 category as described in C2/113-7
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.5.3 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or lateral busbar extension component out of the gas-filled compartment (if applicable)

The internal arc test is applicable for:

- The metal enclosed compartment of the screened solid insulated busbar in ambient air, outside the sealed pressure gas-filled compartment
- The screened solid insulated lateral busbar extension components in ambient air between 2 adjacent sealed pressure gas-filled compartments, separated with a distance > 12,5 mm.

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) I_{Ae} = 2kA, t_{Ae} = 1s with single phase ignition and with both other phases energized according to IEC 62271-200
- Version of switchgear:
  As per internal arc category AA15 according to C2/113-7
- Test arrangement:
  In accordance with the manufacturer's installation instructions
- Acceptance criteria:
  Test report
  - according to IEC 62271-200 with positive results
  - providing evidence that the fault does not evolve in a multiphase fault

5.9.5.4 Demonstration of the pressure withstand of all elements involved in or that can communicate with the gas exhaust path (e.g. duct, compartments, AA15-A absorber base frame), in case of an arc in the sealed pressure gas-filled compartment, or in the cables compartment (the most severe of both)

These elements shall be tested together with the switchgear, for one configuration :

- The version of the switchgear and of the elements involved in or that can communicate with the gas exhaust path shall be as per internal arc category AA15 according to C2/113-7.
- The test arrangement shall be in accordance with the manufacturer's installation instructions and with the configuration corresponding to AA15 category as described in C2/113-7
- The acceptance criteria shall be according to IEC 62271-200 with positive results.

The overpressure and the withstand of the elements for other configurations can be assessed by simulations

5.9.6 Category AA20

5.9.6.1 Internal arc test with arc ignition in the gas-filled compartment for an arc test current equal to 4,8kA

The following internal arc test shall be performed:

- Test:
  IAC A FL (or A FLR) 4,8 kA, x ms (duration of the fault is 1s) with 3-phases ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA20 according to C2/113-7: gas-filled compartment with arc mitigation system in service
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA20 category as described in C2/113-7
- Acceptance criteria:
  Test report
  - according to IEC 62271-200 with positive results
  - providing evidence (e.g. clear pictures) that:
    a) the arc suppressor has operated
    b) the hot gases resulting from the arc remain inside the sealed pressurized gas-filled compartment in which the arc was ignited (the pressure relief device of the sealed pressure gas-filled compartment did not open)
    c) the indication of operation of the arc suppressor shall remain readable after the internal arc fault test

5.9.6.2 Internal arc test with arc ignition in the gas-filled compartment for an arc test current equal to 100% of the rated arc fault current IA

The following internal arc test shall be performed:

- Test:
  IAC A FL (or A FLR) 20 kA 1s, x ms (duration of the fault is 1s) with 3-phases ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA20 according to C2/113-7: gas-filled compartment with arc mitigation system in service
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA20 category as described in C2/113-7
- Acceptance criteria:
  Test report
  - according to IEC 62271-200 with positive results
  - providing evidence (e.g. clear pictures) that:
    a) the hot gases resulting from the arc remain inside the sealed pressurised gas-filled compartment in which the arc was ignited (the pressure relief device of the sealed pressure gas-filled compartment did not open)
    b) the arc suppressor has operated
    c) the indication of operation of the arc suppressor shall remain readable after the internal arc fault test

5.9.6.3 Internal arc test with arc ignition in the cables compartment

Internal arc test with arc ignition in the cables compartment:
(1) either without an arc mitigation system or with an arc mitigation system not in service
(2) or with an arc mitigation system in service

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) I_A = 20kA, t_A = 1s for (1) or t_A = x ms (duration of the fault is 1s) for (2) with 2-phases ignition (87% of 20 kA) and with the third phase energized according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA20 according to C2/113-7: (1) or (2)
  The switchgear can be tested without raising base-frame AA20-R
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA20 category as described in C2/113-7
- Acceptance criteria :
  - Test report according to IEC 62271-200 with positive results

The internal arc test with arc ignition in the cables compartment with arc mitigation system not in service is not required if this test with arc mitigation system in service is carried out successfully.

5.9.6.4 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or lateral busbar extension component out of the gas-filled compartment (if applicable)

The internal arc test is applicable for:

- The metal enclosed compartment of the screened solid insulated busbar in ambient air, outside the sealed pressure gas-filled compartment
- The screened solid insulated lateral busbar extension components in ambient air between 2 adjacent sealed pressure gas-filled compartments, separated with a distance > 12,5 mm.

The following internal arc test shall be performed:

- Test:
  Internal arc fault test IAC A FL (or A FLR) I_Ae = 2kA, t_Ae = 1s with single phase ignition and with both other phases energized according to IEC 62271-200,
- Version of switchgear:
  As per internal arc category AA20 according to C2/113-7
- Test arrangement:
  In accordance with the manufacturer's installation instructions
- Acceptance criteria:
  Test report
  - according to IEC 62271-200 with positive results
  - providing evidence that the fault does not evolve in a multiphase fault

5.9.6.5 Riser base frame AA20-R

A pressure withstand capability for this base frame is not required. However, the switchgear manufacturer shall submit a calculation note demonstrating that the base frame is properly designed to support the dead weight of the switchgear cat. AA20.

This base frame shall have a plain metal sheet on the front side, preventing the possibility of a gas exhaust to the front side and a second plain metal sheet on the rear side to divide the pressure between the front and the rear support in case of a possible gas exhaust.

5.9.7 Category AA30

5.9.7.1 Three-phase internal arc tests in all HV compartments (including any component comprising the 3 phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault current IA

The following internal arc test shall be performed in all HV compartments:

- Test:
  IAC A FL (or A FLR) ≥ 20 kA 1s with 3-phases ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA30 according to C2/113-7: with gas evacuation downwards
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA30 category as described in C2/113-7, i.e. with gas evacuation downwards
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.8 Category AA31

5.9.8.1 Three-phase internal arc tests in all HV compartments (including any component comprising the 3 phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault current IA

The following internal arc test shall be performed in all HV compartments:

- Test:
  IAC A FL (or A FLR) ≥ 20 kA 1s with 3-phases ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA31 according to C2/113-7: with gas evacuation rear upwards
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA31 category as described in C2/113-7
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.9 Category AA33

5.9.9.1 Three-phase internal arc tests in all HV compartments (including any component comprising the 3 phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault current IA

The following internal arc test shall be performed in all HV compartments:

- Test:
  IAC A FL (or A FLR) ≥ 20 kA 1s with 3-phases arc ignition according to IEC 62271-200
- Version of the switchgear:
  As per internal arc category AA33 according to C2/113-7: with gas evacuation duct, including relief flap
- Test arrangement:
  In accordance with the manufacturer's installation instructions and with the configuration corresponding to AA33 category as described in C2/113-7
- Acceptance criteria:
  Test report according to IEC 62271-200 with positive results

5.9.9.2 Demonstration of the pressure withstand of all elements involved in or that can communicate with the gas exhaust path (e.g. evacuation ducts, compartments), with arc ignition in every compartment

These elements shall be tested together with the switchgear, for one configuration. The overpressure and the withstand of the elements for other configurations can be assessed by simulations.

5.10 Folder S - NBN EN 62271-213 - Voltage detecting and indicating system (VDIS)

The standard version of the voltage detecting and indicating system (VDIS) shall cover the operating voltage range between 10 kV and 16 kV.

Some DSOs require a second variant with the voltage range between 5 kV and 11 kV: see DSO specific requirements in document C2/113-5.

The integrated self-test of the VDIS shall be verified during the check of the indication "voltage present" and "voltage not present" of the VDIS.

A routine test report is accepted as long as this report details the thresholds for voltage indication. If this possibility is used, the DSO may require the Applicant to repeat the VDIS test during the final inspection.

5.11 Folder W - Testing of a HV circuit breaker overcurrent protection chain

5.11.1 Introduction

This chapter describes the program for the testing of a protection chain for HV circuit breakers equipped with an overcurrent and earth fault protection relay without auxiliary power supply or dual power supply. The test on the complete protection chain is required for each possible and authorized combination of protection relays, CT, low burden tripping coil and HV circuit breaker subject to approval.

CT with different characteristics (e.g. ratio) are accepted as far as the complete protection chain complies with the requirements mentioned hereafter and that the overcurrent protection relay is compliant with the technical specification C10/20-A *Overcurrent relays without auxiliary supply*.

The test on the complete protection chain consists of verifying its correct functioning for different types of fault currents (three phase fault currents and earth fault currents) and this for different current settings.

5.11.2 Protection chain comprising a protection relay without auxiliary supply

5.11.2.1 Standard primary current injection tests

The following standard primary current injection tests shall be performed on a HV circuit-breaker protection chain comprising a protection relay without auxiliary supply to verify the correct operation of the following protection functions:

1. Overcurrent protection function through 1-phase current injection with pre-powering through CTs
2. Overcurrent protection function through 1-phase current injection without pre-powering
3. Earth fault protection function through 1-phase current injection (also applicable for core balance CT)

These tests shall be performed on the protection chain comprising CTs with the lowest ratio of the CT range subject to homologation.

The tests no. 1, 2 and 3 shall be performed with the following relay settings:

- minimum value of the current setting range I>
- time delay setting tI> at minimum value (instantaneous) with selection of the definite time (DT) curve

In addition, test no. 2 shall be performed with the following relay settings:

- minimum value of the current setting range I>
- time delay setting tI> of 1 second with selection of the definite time (DT) curve

Criteria to pass the standard primary current injection tests:

- The HV circuit-breaker shall trip
- The total current measurement error on the complete protection chain at the minimum tripping threshold shall be smaller than 8 % (5 % relay + 3 % CT) at primary rated current of the CTs.

The test no. 2 shall be made (or repeated) after the specific primary current injection tests no. 2 and 3 described in §5.11.2.2.

5.11.2.2 Specific primary current injection tests

The following specific primary current injection tests shall be performed on a HV circuit-breaker protection chain comprising a protection relay without auxiliary supply to verify the correct operation of the following protection functions:

1. Zero-sequence (homopolar) overcurrent protection function with a 1-phase primary current injection of 60 A ± 3 A without pre-powering:
    - current setting Io> smaller than or equal to 60A
    - time delay setting tIo> at minimum value (instantaneous) with selection of the definite time (DT) curve

This test shall be performed on the protection chain comprising CTs (or core balance CT if applicable) with the highest ratio of the CT range subject to homologation.

Criteria to pass this test: the tripping time shall be less than 300ms

2. Overcurrent protection function through a 3-phase primary current injection of 20kA without pre-powering:
   - maximum value of the current setting range I>>
   - time delay setting tI>> at minimum value (instantaneous) with selection of the definite time (DT) curve

   This test shall be performed on the protection chain comprising CTs with the lowest ratio of the CT range subject to homologation.

   Criteria to pass this test: the tripping time shall be maximum 120ms

3. Overcurrent protection function through a 3-phase primary current injection of 20kA without pre-powering:
   - maximum value of the current setting range I>>
   - time delay setting tI>> of 1 second with selection of the definite time (DT) curve

   This test shall be performed on the protection chain comprising CTs with the lowest ratio of the CT range subject to homologation.

   Criteria to pass this test: the tripping time shall be maximum 1120ms

5.11.3 Protection chain comprising a protection relay with dual power supply

5.11.3.1 Standard primary current injection tests

Operation mode without auxiliary supply:

The tests no. 1, 2 and 3 described under §5.11.2.1 shall be performed. Criteria to pass the test: see §5.11.2.1.

Operation mode with auxiliary supply:

Only the tests no. 1 and 3 described under §5.11.2.1 shall be performed. Criteria to pass the test: see §5.11.2.1.

The tests shall be performed on the protection chain comprising CTs with the lowest ratio of the CT range subject to homologation, regardless the operation mode of the protection relay.

5.11.3.2 Specific primary current injection tests

The tests described under §5.11.2.2 shall be performed only for the operation mode without auxiliary supply. Criteria to pass the test: see §5.11.2.2.

5.11.4 Test report

The test report shall contain the following information:

- Information of the test object according NBN-EN 62271-1 - Annex A:
  - Manufacturer's name and type designation:
    - overcurrent protection relay (+ firmware version)
    - CTs
    - HV circuit breaker: operating mechanism, interrupting chamber (poles) and trip coil
  - Ratings of HV circuit breaker and CTs
  - Ratings of the trip coil (+ datasheet)
  - Serial number of protection relay, CTs and HV circuit breaker
- Summary table with test results: protection relay settings, operation mode if dual power supply, CT ratio, injected current, measured HV circuit breaker tripping time
- HV circuit breaker opening time with respect to the tested version
- Current measurement error at minimal tripping threshold
- Pictures of :
  - The different tests set-up
  - The HV circuit breaker and CTs rating plate
  - The trip coil rating plate

6 Specific test specifications for a billing metering function

6.1 Introduction

This chapter is applicable for billing metering functions (FU M) and contains additional and derogating requirements with reference to chapter 5. If nothing is mentioned, the requirements of chapter 5 are applicable.

The applied folder codes are in accordance with the codes used in the assessment guide.

6.2 Folder O - NBN EN 62271-200 §7.103.1 - Pressure withstand test for gas-filled compartments

A pressure withstand test for the gas-filled compartment is only applicable for a billing metering function of category AA10 with only the busbar system in the gas-filled compartment, i.e. FU M with code MBB, MBK or MKB.

6.3 Folder Q - NBN EN 62271-200 §7.105 - Internal arc test - criteria by AA category and IAC

6.3.1 Internal arc test with arc ignition in the gas-filled compartment of FU M category AA10

An internal arc test with 3-phases ignition in the gas-filled compartment is only applicable for a billing metering function of category AA10 with the busbar system in the gas-filled compartment, i.e. FU M with code MBB, MBK or MKB. Refer to §5.9.2.1.

6.3.2 Internal arc test with arc ignition in the gas-filled compartment of FU M category AA3x

FU M of category AA3x are treated as the other type FUs (K, T, D) of the same category, see general requirements §5.9.7, §5.9.8 and §5.9.9.

6.3.3 Internal arc test for FU M intended for installation downstream a general protection by switch-fuse combination

An internal arc test is not mandatory for a billing metering function intended for installation downstream of a general protection by switch-fuse combination. In this case, the Applicant shall submit a technical justification for the mechanical withstand of the billing metering function.

6.4 Folder X - NBN EN 61869-2 - current transformer (CT)

6.4.1 NBN EN 61869-2 §7.2.201 - Short-time thermal current (Ith) and dynamic current (Idyn) test

Type test performed on a measuring CT with ratio X/5A and rated output 5 to 15 VA or more in so far as the external dimensions are identical to the CT (range) subject to homologation. The test result is valid for CTs with a rated primary current greater than the one of the type tested specimen.

X: preferably the rated primary current for measuring CTs defined in §4.2

6.4.2 NBN EN 61869-2 §7.2.6 and §7.3.5.201 - Test for accuracy

Type test performed on a measuring CT with ratio X/5A, any rated output VA, class 0,2S and instrument security factor FS5. A type test report associated with the short current test is acceptable. A routine test report is acceptable considering §7.3.5.201 of NBN EN 61869-2.

X: preferably the rated primary current for measuring CTs defined in §4.2

6.5 Folder Y - NBN EN 61869-3 - voltage transformer (VT)

6.5.1 NBN EN 61869-3 §7.2.6 and §7.3.5.301 – Test for accuracy

Type test performed on a measuring VT with ratio X/√3 / 110/√3, rated output 10 VA, class 0,2 and tested according burden range I. A routine test report is acceptable considering §7.3.5.301 of NBN EN 61869-3.

X: preferably the primary voltage U_n for measuring VTs defined in §4.2