



## **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 (03.2024)**

## Version management

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

Table of contents

<b>1</b>	<b>Object and scope</b> .....	<b>4</b>
1.1	Object.....	4
1.2	Scope.....	4
<b>2</b>	<b>Instructions for compiling the technical file C2/113-3</b> .....	<b>5</b>
2.1	File structure and (sub)folder names.....	5
2.2	Test reports and declarations.....	6
<b>3</b>	<b>Instructions for completing the assessment guide</b> .....	<b>7</b>
<b>4</b>	<b>General requirements</b> .....	<b>9</b>
4.1	Normative references and Synergrid specifications.....	9
4.2	Ratings.....	10
<b>5</b>	<b>Specific test specifications</b> .....	<b>14</b>
5.1	General.....	14
5.2	Folder B - NBN EN 62271-200 §7.2 – Dielectric tests.....	14
5.2.1	<i>Partial discharge tests</i> .....	14
5.2.2	<i>Dielectric test on cable testing circuits</i> .....	14
5.3	Folder D - NBN EN 62271-200 §7.6 - Short-time withstand and peak withstand current tests.....	14
5.4	Folder E - NBN EN 62271-200 §7.7 - Verification of the degrees of protection IP and IK.....	14
5.5	Folder F - NBN EN 62271-200 §7.8 and EN 60068-2-17 §8.5.2 - Tightness test at 40°C.....	17
5.6	Folder L - NBN EN 62271-200 §7.102 - Mechanical endurance tests and operating force.....	17
5.6.1	<i>Maximal allowable force for operation</i> .....	17
5.7	Folder M - NBN EN 62271-200 §7.102.2 - Mechanical and electromechanical interlocks.....	17
5.8	Folder P - NBN EN 62271-200 §7.104.3 - Measurement of leakage currents.....	17
5.9	Folder Q - NBN EN 62271-200 §7.105 - Internal arc test - criteria by AA category and IAC.....	17
5.9.1	<i>General</i> .....	17
5.9.2	<i>Category AA10</i> .....	18
5.9.3	<i>Category AA11</i> .....	19
5.9.4	<i>Category AA13</i> .....	20
5.9.5	<i>Category AA15</i> .....	22
5.9.6	<i>Category AA20</i> .....	23
5.9.7	<i>Category AA30</i> .....	24
5.9.8	<i>Category AA31</i> .....	25
5.9.9	<i>Category AA33</i> .....	25
5.10	Folder S - NBN EN 62271-213 - Voltage detecting and indicating system (VDIS).....	25
5.11	Folder W - Testing of a HV circuit breaker overcurrent protection chain.....	26
5.11.1	<i>Introduction</i> .....	26
5.11.2	<i>Protection chain comprising a protection relay without auxiliary supply</i> .....	26
5.11.3	<i>Protection chain comprising a protection relay with dual power supply</i> .....	27
5.11.4	<i>Test report</i> .....	27
<b>6</b>	<b>Specific test specifications for a billing metering function</b> .....	<b>28</b>
6.1	Introduction.....	28
6.2	Folder O - NBN EN 62271-200 §7.103.1 - Pressure withstand test for gas-filled compartments... ..	28
6.3	Folder Q - NBN EN 62271-200 §7.105 - Internal arc test - criteria by AA category and IAC.....	28
6.3.1	<i>Internal arc test with arc ignition in the gas-filled compartment of FU M category AA10</i> .....	28
6.3.2	<i>Internal arc test with arc ignition in the gas-filled compartment of FU M category AA3x</i> .....	28
6.3.3	<i>Internal arc test for FU M intended for installation downstream a general protection by switch-fuse combination</i> .....	28
6.4	Folder X - NBN EN 61869-2 - current transformer (CT).....	28
6.4.1	<i>NBN EN 61869-2 §7.2.201 - Short-time thermal current (I<sub>th</sub>) and dynamic current (I<sub>dyn</sub>) test</i> .....	28
6.4.2	<i>NBN EN 61869-2 §7.2.6 and §7.3.5.201 - Test for accuracy</i> .....	28
6.5	Folder Y - NBN EN 61869-3 - voltage transformer (VT).....	28
6.5.1	<i>NBN EN 61869-3 §7.2.6 and §7.3.5.301 – Test for accuracy</i> .....	28

# 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

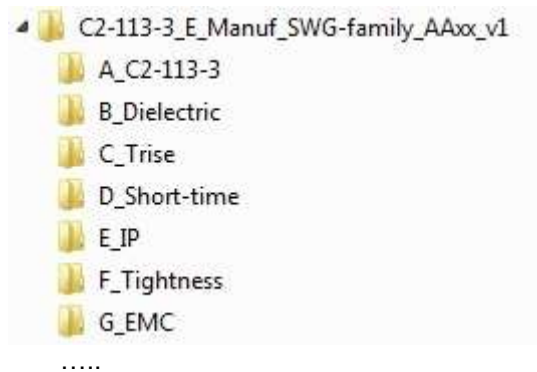
### 2.1 File structure and (sub)folder names

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:



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](http://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<sup>1</sup> (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/lk-tk - Iload (switch-disconnector) - Ima (switch-disconnector and earthing switches) - Ima & Isc (circuit-breaker) - Operating sequence	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				
§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		
§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

<sup>1</sup> Also refers to the protection of the unique distribution transformer in a Client installation

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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  
 1<sup>st</sup> and 2<sup>nd</sup> 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

- 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  $I_{rb}$  and rated current  $I_r$  of the FU, to be confirmed by the Applicant.
- If more than one version of an FU is proposed (e.g.  $I_r$ , 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"

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.

Assessment Guide for homologation of HV switchgear according to 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				Also refer to the protection of the unique transformer in a Client installation					Also refer to the protection of the unique transformer in a Client installation				
				Busbar upstream the Gen. 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)	Synergrid scheme FU	Manufacturer's designation	Rated current $I_{rb}$ (A)	Rated current $I_r$ (A)					
Folder	Item No.	NBN EN 62271-xxx (Sub)clause(s)	Test or verification	Specific test specifications: Refer to technical 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)
B		62271-200 7.2	UNBIECTIC TESTS		$U_f = \dots$ kV								
	1	62271-200 7.2.6 & Annex B 7.2.7	Power-frequency voltage withstand tests (Ud) Lightning impulse voltage withstand tests (Up) Ud & Up: - phase-to-earth & between phases across 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 (Ud,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		$I_{rb} = \dots$ A $I_r = \dots$ A $I_{DxT} = \dots$ A $I_{DxN} = \dots$ 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.



42 **4 General requirements**

43 **4.1 Normative references and Synergrid specifications**

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

45

NBN EN 62271-200 Ed.3 (2021) + Amd.1 (2024) <sup>2</sup>	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 62271-213 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

46 Table 2: normative references and Synergrid specifications

47

<sup>2</sup> Amendment 1 to be published, presently in CDV stage

48 **4.2 Ratings**

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

50 The ratings here below are:

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

53 Possible rated voltage AIS and GIS (Ur)

Rated voltage Ur (kV)
12 <sup>3</sup>
17,5 <sup>3</sup>
24

54

55 The minimum required ratings are the following:

56

57 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

58

59 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

60

61 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

62 Rated current of the busbar (Irb) :

- 63 • Busbar upstream the general protection: 630 A

64 Rated current of the FU (Ir) :

FU	KKNx	TxGx	DKNx	DxGx
Rated current Ir (A)	630	80	630	315 <sup>4</sup>

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

- 66 • The tables hereafter shall be read in conjunction with the tables of the rated short-circuit making current  
 67 Ima further down.  
 68 The first column lists the rated voltage Ur of the switchgear, the second column lists the minimum  
 69 required value for Ik and Ima to be met by the switchgear:  
 70 ○ with single rating: there is one assigned value for Ima @ Ur of the switchgear  
 71 ○ with dual rating: there is one assigned value for Ima @ Ur of the switchgear and a higher  
 72 value for Ima tested at a lower value of Ur  
 73

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<sup>3</sup> The use of switchgear with Ur < 24 kV is limited. The limits are described in C2/112

<sup>4</sup> The use of FU DxGx with Ir = 315 A applies for networks with Us ≥ 10kV. Other minimum values of Ir can be required for networks with Us < 10Kv. Those values are described in C2/113-5, DSO specific requirements

- 75 • Single rating

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

- 76 • Dual rating

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

77 Rated mainly active load breaking current (Iload) :

- 78 • Switching devices and FUs of concern :  
 79 ○ switch-disconnector : FU KKNx  
 80 • Iload = Ir

81 Rated short-circuit making current (Ima)

- 82 • Switching devices and FUs of concern :  
 83 ○ switch-disconnector : FU KKNx  
 84 ○ earthing-switches : FUs KKNx, DKNx  
 85

- 86 • Single rating

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

- 87 • Dual rating

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

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

- 89 • Switching devices and FUs of concern :  
 90 ○ Circuit-breaker : FUs DKNx & DxGx  
 91  
 92 • Rated operating sequence :  
 93 ○ DxGx : O- 3 min – CO – 3 min – CO  
 94 ○ DKNx : O – 0.3s – CO – 15 s – CO  
 95

- 96 • Single rating

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

- 97 • Dual rating

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

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

- 137 • Rated primary terminal insulation level:  $U_m = U_r$  (see possible rated voltage AIS above)
- 138 • Ratio (rated  $I_{prim}/I_{sec}$ ): 25/5<sup>11</sup>, 50/5, 125/5, 250/5 or 500/5 A
- 139 • Rated output: 5 VA
- 140 • Rated accuracy class: 0,2S
- 141 • Instrument security factor: FS 5 (FS 10 is not acceptable)
- 142 • Rated continuous thermal current:  $1,2 * \text{rated } I_{prim}$
- 143 • Rated short time thermal current:  $I_{th} = I_k$
- 144 • Duration of  $I_{th}$ : 1s
- 145 • Rated dynamic current:  $I_{dyn} = I_p$

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

- 147 • Rated primary terminal insulation level:  $U_m = U_r$  (see possible rated voltage AIS above)
- 148 • Ratio (rated  $U_{n,prim}/U_{n,sec}$ ):  $U_n/\sqrt{3} // 110/\sqrt{3} V$
- 149  $U_n = 5.500, 6.600, 11.000, 12.100 \text{ or } 15.400 V$
- 150 • Rated output: 10 VA (burden class I)
- 151 • Rated accuracy class: 0,2
- 152 • Rated voltage factor – rated time:  $1,2 * U_n$  – continuous
- 153  $1,9 * U_n$  – 30s
- 154 • Rated thermal limiting output: 100 VA

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<sup>11</sup> 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.

## 155 **5 Specific test specifications**

### 156 **5.1 General**

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

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

### 161 **5.2 Folder B - NBN EN 62271-200 §7.2 – Dielectric tests**

#### 162 5.2.1 *Partial discharge tests*

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

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

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

- 168 • **For AIS :**

169 A PD level of 1.000 pC measured for a phase-to-ground voltage of 1.1 Ur (one phase under voltage  
170 and the others connected with the frame and earthed following procedure A) is the limit taken into  
171 account.

- 172 • **For GIS:**

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

177  
178 The test report shall mention the PD level at 1.1 Ur for each phase.

#### 179 5.2.2 *Dielectric test on cable testing circuits*

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

181  
182 The tests shall be performed in accordance with the standard EN 62271-200, clause 7.2.101.

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

### 187 **5.3 Folder D - NBN EN 62271-200 §7.6 - Short-time withstand and peak withstand current tests**

188  
189 For switchgear of category AA20 equipped with an arc mitigation system, the tests shall be performed with this  
190 mitigation system operational. In addition to the criterion provided by the standard, this system shall not be  
191 triggered off. This condition shall be confirmed in an additional declaration.  
192

### 193 **5.4 Folder E - NBN EN 62271-200 §7.7 - Verification of the degrees of protection IP and IK**

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

196

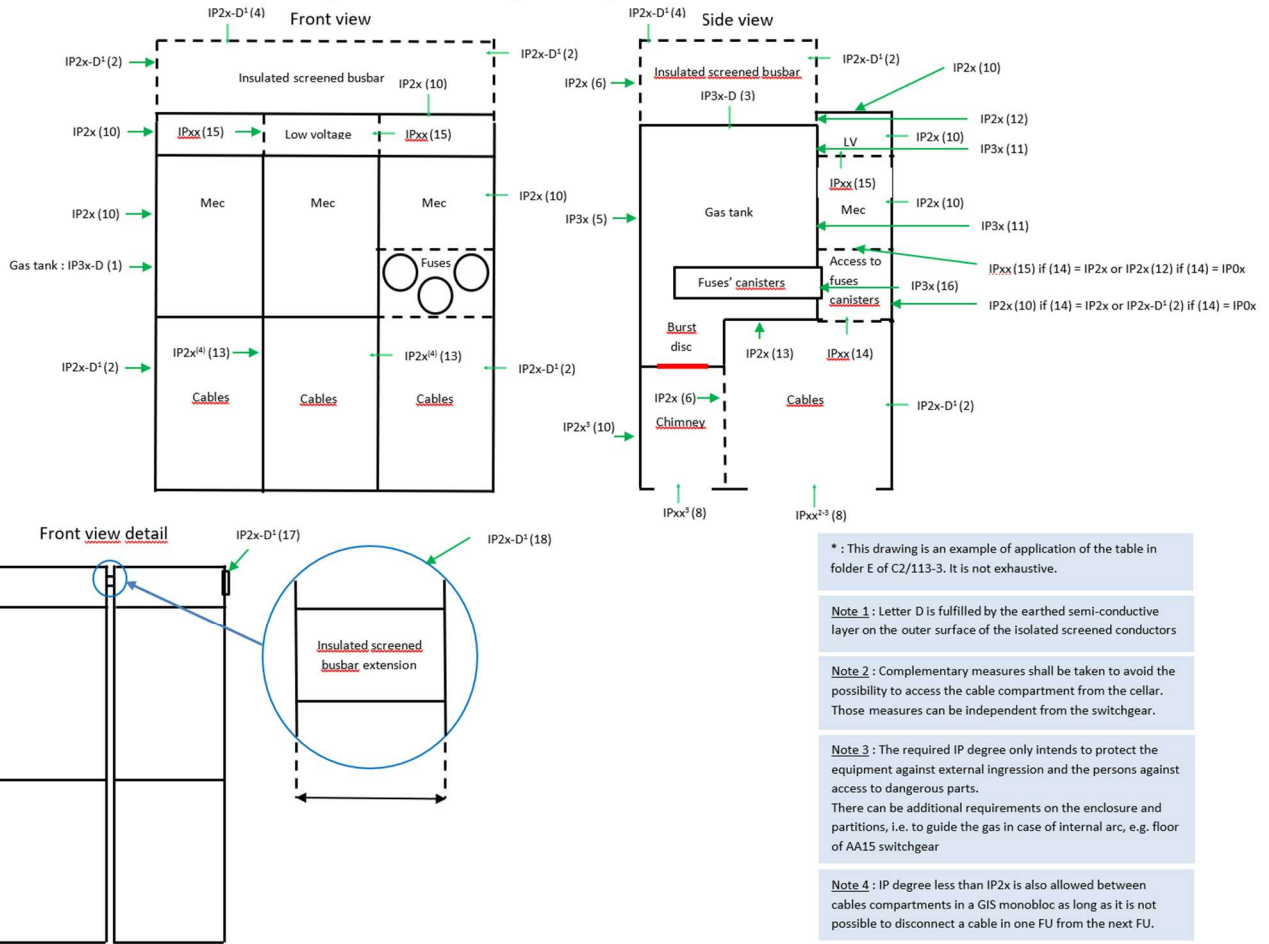
<b>External enclosure of HV compartments</b>	Nr	IP-degree
Accessible sides except the upper side :		
<ul style="list-style-type: none"> <li>For equipment with bare active parts inside the enclosure (gas tank or single phase compartment with earthed metal partition between the phases)</li> </ul>	1	IP3X-D
<ul style="list-style-type: none"> <li>For equipment with insulated screened active parts inside the enclosure (including the metal enclosure of the busbar extension)</li> </ul>	2	IP2X-D <sup>(1)</sup>
Upper side :		
<ul style="list-style-type: none"> <li>For equipment with bare active parts inside the enclosure (gas tank or single phase compartment with earthed metal partition between the phases)</li> </ul>	3	IP3X-D
<ul style="list-style-type: none"> <li>for equipment with insulated screened active parts inside the enclosure (including the metal enclosure of the busbar extension)</li> </ul>	4	IP2X-D <sup>(1)</sup>
Rear side when non accessible :		
<ul style="list-style-type: none"> <li>for equipment with bare active parts inside the enclosure (gas tank or single phase compartment with earthed metal partition between the phases)</li> </ul>	5	IP3X
<ul style="list-style-type: none"> <li>for equipment with insulated screened active parts inside the enclosure (incl. the metal enclosure of the busbar extension)</li> </ul>	6	IP2X
Bottom sides :		
<ul style="list-style-type: none"> <li>for equipment with bare active parts inside the enclosure</li> </ul>	7	IP3X
<ul style="list-style-type: none"> <li>for equipment with insulated screened active parts inside the enclosure</li> </ul>	8	IPXX <sup>(2)</sup>
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
<b>External enclosure delimiting non-HV compartments</b>		
LV compartment with/without mechanism and empty compartments, i.e. chimney <sup>(3)</sup>	10	IP2X
<b>Inner partitioning</b>		
Partitions between LV/mechanisms compartments and HV compartments		
<ul style="list-style-type: none"> <li>with bare active parts</li> </ul>	11	IP3X
<ul style="list-style-type: none"> <li>with insulated screened active parts</li> </ul>	12	IP2X
Partitions between an accessible HV compartment and an adjacent HV compartment	13	IP2X <sup>(4)</sup>
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
<b>Special case of the busbar extension systems for AA1x and AA20</b>		
Extremity obturator of extension bushing	17	IP2X-D <sup>(1)</sup>
Connection in operation for switchgear extensible from the lateral side or from the top face	18	IP2X-D <sup>(1)</sup>
Metal enclosure of the busbar extension		IK07

- 197 1. The additional letter D can be ensured by the conductive layer of the fully insulated and screened part extension device
- 198 2. Complementary measures shall be taken to avoid the possibility to access the cable compartment from the cellar. Those measures
- 199 can be independent from the switchgear
- 200 3. The required IP degree only intends to protect the equipment against external ingress and the persons against access to
- 201 dangerous parts. There can be additional requirements on the enclosure and partitions, i.e. to guide the gas in case of internal arc.
- 202 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
- 203 a cable in one FU from the next FU.

204 Table 3: required degrees of protection IP and IK

205

IP requirements for switchgear of category AA1x/AA20 with non-accessible rear side \*



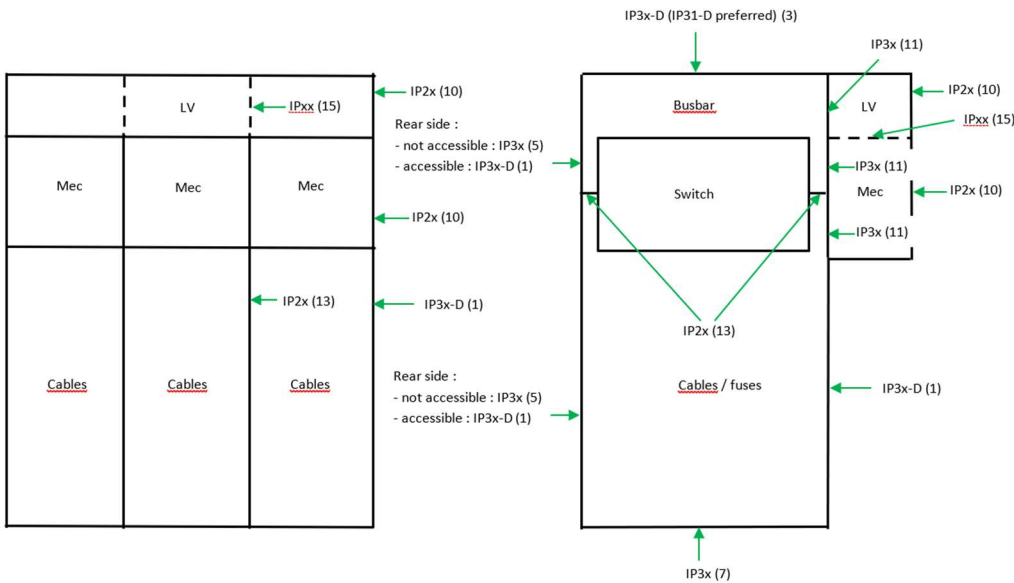
206

207

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

208

IP requirements for switchgear of category AA3x



\* : This drawing is an example of application of the table in folder E of C2/113-3. It is not exhaustive.

209

210

Figure 2: required IP degrees for switchgear of category AA3x



211 **5.5 Folder F - NBN EN 62271-200 §7.8 and EN 60068-2-17 §8.5.2 - Tightness test at 40°C**

212 The tightness test shall be performed in every sealed pressure gas-filled compartment<sup>12</sup> with application of the  
213 accumulation test method in accordance with § 8.5.2 of NBN EN 60068-2 -17, Test *Qm, test method 1*. The  
214 leakage rate is calculated using the equation given in § 8.5.2.2 of EN 60068-2 -17 and shall not exceed the  
215 permissible leakage rate  $F_p$  which guarantees an expected operating duration of at least 20 years at 40 °C.

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

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

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

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

225 **5.6 Folder L - NBN EN 62271-200 §7.102 - Mechanical endurance tests and operating force**

226 **5.6.1 Maximal allowable force for operation**

227 The maximum force applied during operation (opening and closing) shall be according to the standards IEC  
228 62271-1 § 6.6.4 and 62271-102 § 6.105.

229 The applicant shall provide evidence, e.g. test report, technical clarification that this requirement is met with  
230 the manufacturer standard operation handles.

231 **5.7 Folder M - NBN EN 62271-200 §7.102.2 - Mechanical and electromechanical interlocks**

232 The following test report is acceptable:

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

238 **5.8 Folder P - NBN EN 62271-200 §7.104.3 - Measurement of leakage currents**

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

240 Those compartments include:

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

244 NOTE: Under the conditions for opening the earthing switch with an open door, the equipment may be declared compartmented in the  
245 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

246 **5.9 Folder Q - NBN EN 62271-200 §7.105 - Internal arc test - criteria by AA category and IAC**

247 **5.9.1 General**

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

250  
251 Declarations for extension of validity according to IEC 62271-307 are acceptable. Simulations are not  
252 acceptable, unless explicitly mentioned here after.  
253

---

<sup>12</sup> See Chapter 2 of C2/113-7

254 5.9.2 Category AA10

255 5.9.2.1 Internal arc test with arc ignition in the gas-filled compartment

256 The following internal arc test shall be performed:

- 257 • Test:
- 258 IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- 259 • Version of the switchgear:
- 260 As per internal arc category AA10 according to C2/113-7: with gas evacuation downwards
- 261 • Test arrangement:
- 262 In accordance with the manufacturer's installation instructions and with the configuration
- 263 corresponding to AA10 category as described in C2/113-7, i.e.:
- 264 - with gas evacuation downwards
- 265 - on an open simulated test floor
- 266 • Acceptance criteria:
- 267 Test report
- 268 - according to IEC 62271-200 with positive results
- 269 - providing evidence (e.g. clear pictures before and after test) that the gas evacuation duct
- 270 remains intact

271 5.9.2.2 Internal arc test with arc ignition in the cables compartment

272 The following internal arc test shall be performed:

- 273 • Test 1:
- 274 Internal arc fault test IAC A FL (or A FLR) IAe = 2kA tAe = 1s with single phase ignition and with both
- 275 other phases energized according to IEC 62271-200
- 276 • Version of the switchgear:
- 277 As per internal arc category AA10 according to C2/113-7
- 278 • Test arrangement:
- 279 In accordance with the manufacturer's installation instructions.
- 280 • Acceptance criteria :
- 281 Test report
- 282 - according to IEC 62271-200 with positive results
- 283 - providing evidence that the fault does not evolve in a multiphase fault

284 In addition to test 1 described above, a second internal arc test shall be performed if the cables compartment

285 communicates with the gas evacuation path in case of an internal arc in the gas-filled compartment:

- 286 • Test 2:
- 287 Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases arc ignition according to IEC
- 288 62271-200
- 289 • Version of the switchgear:
- 290 As per internal arc category AA10 according to C2/113-7
- 291 • Test arrangement:
- 292 - In accordance with the manufacturer's installation instructions,
- 293 - With gas evacuation:
- 294 a) either to the rear with closed simulated test floor under cables compartment
- 295 b) or downwards with expansion volume < 6 m<sup>3</sup> under the test floor and with gas outlet
- 296 between 0,04m<sup>2</sup> and 0,12 m<sup>2</sup>
- 297 • Acceptance criteria :
- 298 Test report according to IEC 62271-200 with positive results

299 5.9.2.3 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or

300 lateral busbar extension component out of the gas-filled compartment (if applicable)

301 The internal arc test is applicable for:

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

306 The following internal arc test shall be performed:

- 307 • Test:
- 308 Internal arc fault test IAC A FL (or A FLR) IAe = 2kA, tAe = 1s with single phase ignition and with both
- 309 other phases energized according to IEC 62271-200
- 310 • Version of switchgear:
- 311 As per internal arc category AA10 according to C2/113-7

- 312 • Test arrangement:
- 313 In accordance with the manufacturer's installation instructions
- 314 • Acceptance criteria:
- 315 Test report
- 316 - according to IEC 62271-200 with positive results
- 317 - providing evidence that the fault does not evolve in a multiphase fault

318 **5.9.2.4** *Demonstration of the pressure withstand of all elements involved in or that can communicate with*  
 319 *the gas exhaust path (e.g. ducts, compartments and AA10-R riser base frame), with an arc in the*  
 320 *sealed pressure gas-filled compartment*

321 These elements shall be tested together with the switchgear, for one configuration, with gas evacuation  
 322 downwards in a volume < 6 m<sup>3</sup>, gas outlet between 0,04 m<sup>2</sup> and 0,12 m<sup>2</sup>, with measurement of the overpressure  
 323 in the elements. The overpressure and the withstand of the elements for other configurations can be assessed  
 324 by simulations

325 **5.9.2.5** *Internal arc test with arc ignition in the metering compartment*

326 The following internal arc test shall be performed:

- 327 • Test:
- 328 Internal arc fault test IAC A FL (or A FLR) I<sub>Ae</sub> = 2kA, t<sub>Ae</sub> = 1s with single phase ignition and with both
- 329 other phases energized according to IEC 62271-200
- 330 • Version of switchgear:
- 331 As per internal arc category AA10 according to C2/113-7
- 332 • Test arrangement:
- 333 In accordance with the manufacturer's installation instructions
- 334 • Acceptance criteria:
- 335 Test report
- 336 - according to IEC 62271-200 with positive results
- 337 - providing evidence that the fault does not evolve in a multiphase fault

338 **5.9.3** *Category AA11*

339 **5.9.3.1** *Internal arc test with arc ignition in the gas-filled compartment*

340 The following internal arc test shall be performed:

- 341 • Test:
- 342 IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- 343 • Version of the switchgear:
- 344 As per internal arc category AA11 according to C2/113-7: with gas evacuation rear upwards
- 345 • Test arrangement:
- 346 In accordance with the manufacturer's installation instructions and with the configuration
- 347 corresponding to AA11 category as described in C2/113-7, i.e.:
- 348 - on an open simulated test floor over the whole depth of the switchgear
- 349 • Acceptance criteria:
- 350 Test report
- 351 - according to IEC 62271-200 with positive results
- 352 - providing evidence (e.g. clear pictures before and after test) that the covers and plates part of
- 353 the gas evacuation path and the bottom plates remain intact

354 **5.9.3.2** *Internal arc test with arc ignition in the cables compartment*

355 A first internal arc test shall be performed:

- 356 • Test 1:
- 357 Internal arc fault test IAC A FL (or A FLR) I<sub>Ae</sub> = 2kA, t<sub>Ae</sub> = 1s with single phase ignition and with both
- 358 other phases energized according to IEC 62271-200
- 359 • Version of the switchgear:
- 360 As per internal arc category AA11 according to C2/113-7
- 361 • Test arrangement:
- 362 In accordance with the manufacturer's installation instructions
- 363 • Acceptance criteria :
- 364 Test report
- 365 - according to IEC 62271-200 with positive results
- 366 - shall provide evidence that the fault does not evolve in a multiphase fault

367 A second internal arc test shall be performed in addition to test 1 if the cables compartment communicates  
368 with the gas evacuation path in case of an internal arc in the gas-filled compartment:

- 369 • Test 2:  
370 Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition according to IEC 62271-  
371 200
- 372 • Version of the switchgear:  
373 As per internal arc category AA11 according to C2/113-7
- 374 • Test arrangement:  
375 - In accordance with the manufacturer's installation instructions,  
376 - With gas evacuation:  
377 a) either to the rear with closed simulated test floor under cables compartment  
378 b) or through the raising base frame with the smallest volume when it is part of the gas  
379 evacuation path. The requirement of the presence of such a raising base frame is  
380 covered by §9.4 of C2/113-4.
- 381 • Acceptance criteria :  
382 Test report according to IEC 62271-200 with positive results

### 383 5.9.3.3 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or 384 lateral busbar extension component out of the gas-filled compartment (if applicable)

385 The internal arc test is applicable for:

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

390 The following internal arc test shall be performed:

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

### 402 5.9.3.4 Demonstration of the pressure withstand of all elements involved in or that can communicate with 403 the gas exhaust path (e.g. ducts, compartments and AA11-R riser base frame), with an arc in the 404 sealed pressure gas-filled compartment

405 These elements shall be tested together with the switchgear, for one configuration, with gas evacuation to the  
406 rear, with measurement of the overpressure in the elements (only in case those elements communicate with  
407 the gas evacuation path during an arc fault in the sealed pressure gas-filled compartment). The overpressure  
408 and the withstand of the elements for other configurations can be assessed by simulations.

## 409 5.9.4 Category AA13

### 410 5.9.4.1 Internal arc test with arc ignition in the gas-filled compartment

411 The following internal arc test shall be performed:

- 412 • Test:  
413 IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- 414 • Version of the switchgear:  
415 As per internal arc category AA13 according to C2/113-7: with gas evacuation duct, including relief  
416 flap
- 417 • Test arrangement:  
418 In accordance with the manufacturer's installation instructions and with the configuration  
419 corresponding to AA13 category as described in C2/113-7, i.e.:  
420 - on an open simulated test floor over the whole depth of the switchgear
- 421 • Acceptance criteria:  
422 Test report  
423 - according to IEC 62271-200 with positive results

424 - providing evidence (e.g. clear pictures before and after test) that the covers and plates part of  
425 the gas evacuation path and the bottom plates remain intact

#### 426 5.9.4.2 *Internal arc test with arc ignition in the cables compartment*

427 A first internal arc test shall be performed:

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

439 A second internal arc test shall be performed in addition to test 1 if the cables compartment communicates  
440 with the gas evacuation path in case of an internal arc in the gas-filled compartment:

- 441 • Test 2:
- 442 Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition according to IEC 62271-
- 443 200
- 444 • Version of the switchgear:
- 445 As per internal arc category AA13 according to C2/113-7
- 446 • Test arrangement:
- 447 - In accordance with the manufacturer's installation instructions,
- 448 - With gas evacuation:
- 449 a) either to the rear with closed simulated test floor under cables compartment
- 450 b) or through the raising base frame with the smallest volume when it is part of the gas
- 451 evacuation path. The requirement of the presence of such a raising base frame is
- 452 covered by §9.4 of C2/113-4.
- 453 • Acceptance criteria :
- 454 Test report according to IEC 62271-200 with positive results

#### 455 5.9.4.3 *Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or* 456 *lateral busbar extension component out of the gas-filled compartment (if applicable)*

457 The internal arc test is applicable for:

- 458 • The metal enclosed compartment of the screened solid insulated busbar in ambient air, outside the
- 459 sealed pressure gas-filled compartment
- 460 • The screened solid insulated lateral busbar extension components in ambient air between 2 adjacent
- 461 sealed pressure gas-filled compartments, separated with a distance  $< 12,5\text{ mm}$ .

462 The following internal arc test shall be performed:

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

#### 474 5.9.4.4 *Demonstration of the pressure withstand of all elements involved in or that can communicate with* 475 *the gas exhaust path (e.g. evacuation duct, compartments), with an arc in the sealed pressure gas-* 476 *filled compartment*

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

479

480 5.9.5 Category AA15

481 5.9.5.1 Internal arc test with arc ignition in the gas-filled compartment

482 The following internal arc test shall be performed:

- 483 • Test:
- 484 IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- 485 • Version of the switchgear:
- 486 As per internal arc category AA15 according to C2/113-7: with an energy absorber
- 487 • Test arrangement:
- 488 In accordance with the manufacturer's installation instructions and with the configuration
- 489 corresponding to AA15 category as described in C2/113-7, i.e.:
- 490 - on an open simulated test floor over the whole depth of the switchgear
- 491 • Acceptance criteria:
- 492 Test report
- 493 - according to IEC 62271-200 with positive results
- 494 - providing evidence (e.g. clear pictures before and after test) that the walls and the bottom
- 495 plates of the gas evacuation path remain intact

496 5.9.5.2 Internal arc test with arc ignition in the cables compartment

497 A first internal arc test shall be performed:

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

509 A second internal arc test shall be performed in addition to test 1 if the cables compartment communicates

510 with the gas evacuation path in case of an internal arc in the gas-filled compartment:

- 511 • Test 2:
- 512 Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition according to IEC 62271-
- 513 200
- 514 • Version of the switchgear:
- 515 As per internal arc category AA15 according to C2/113-7
- 516 • Test arrangement:
- 517 - In accordance with the manufacturer's installation instructions,
- 518 - With gas evacuation:
- 519 a) either to the rear with closed simulated test floor under cables compartment
- 520 b) or downwards with a volume representing the smallest base frame
- 521 • Acceptance criteria :
- 522 Test report according to IEC 62271-200 with positive results

523 5.9.5.3 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or

524 lateral busbar extension component out of the gas-filled compartment (if applicable)

525 The internal arc test is applicable for:

- 526 • The metal enclosed compartment of the screened solid insulated busbar in ambient air, outside the
- 527 sealed pressure gas-filled compartment
- 528 • The screened solid insulated lateral busbar extension components in ambient air between 2 adjacent
- 529 sealed pressure gas-filled compartments, separated with a distance  $< 12,5\text{ mm}$ .

530 The following internal arc test shall be performed:

- 531 • Test:
- 532 Internal arc fault test IAC A FL (or A FLR)  $I_{Ae} = 2\text{kA}$ ,  $t_{Ae} = 1\text{s}$  with single phase ignition and with both
- 533 other phases energized according to IEC 62271-200
- 534 • Version of switchgear:
- 535 As per internal arc category AA15 according to C2/113-7
- 536 • Test arrangement:
- 537 In accordance with the manufacturer's installation instructions

- 538 • Acceptance criteria:  
539 Test report  
540 - according to IEC 62271-200 with positive results  
541 - providing evidence that the fault does not evolve in a multiphase fault

542 **5.9.5.4** *Demonstration of the pressure withstand of all elements involved in or that can communicate with*  
543 *the gas exhaust path (e.g. duct, compartments, AA15-A absorber base frame), with arc in the sealed*  
544 *pressure gas-filled compartment*

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

547 **5.9.6** Category AA20

548 **5.9.6.1** *Internal arc test with arc ignition in the gas-filled compartment for an arc test current equal to 4,8kA*

549 The following internal arc test shall be performed:

- 550 • Test:  
551 IAC A FL (or A FLR) 4,8 kA, x ms (duration of the fault is 1s) with 3-phases ignition according to IEC  
552 62271-200
- 553 • Version of the switchgear:  
554 As per internal arc category AA20 according to C2/113-7: gas-filled compartment with arc mitigation  
555 system in service
- 556 • Test arrangement:  
557 In accordance with the manufacturer's installation instructions and with the configuration  
558 corresponding to AA20 category as described in C2/113-7
- 559 • Acceptance criteria:  
560 Test report  
561 - according to IEC 62271-200 with positive results  
562 - providing evidence (e.g. clear pictures) that:  
563 a) the arc suppressor has operated  
564 b) the hot gases resulting from the arc remain inside the sealed pressurised gas-filled  
565 compartment in which the arc was ignited (the pressure relief device of the sealed  
566 pressure gas-filled compartment did not open)  
567 c) the indication of operation of the arc suppressor shall remain readable after the internal  
568 arc fault test

569 **5.9.6.2** *Internal arc test with arc ignition in the gas-filled compartment for an arc test current equal to 100%*  
570 *of the rated arc fault current IA*

571 The following internal arc test shall be performed:

- 572 • Test:  
573 IAC A FL (or A FLR) 20 kA 1s, x ms (duration of the fault is 1s) with 3-phases ignition according to IEC  
574 62271-200
- 575 • Version of the switchgear:  
576 As per internal arc category AA20 according to C2/113-7: gas-filled compartment with arc mitigation  
577 system in service
- 578 • Test arrangement:  
579 In accordance with the manufacturer's installation instructions and with the configuration  
580 corresponding to AA20 category as described in C2/113-7
- 581 • Acceptance criteria:  
582 Test report  
583 - according to IEC 62271-200 with positive results  
584 - providing evidence (e.g. clear pictures) that:  
585 a) the hot gases resulting from the arc remain inside the sealed pressurised gas-filled  
586 compartment in which the arc was ignited (the pressure relief device of the sealed  
587 pressure gas-filled compartment did not open)  
588 b) the arc suppressor has operated  
589 c) the indication of operation of the arc suppressor shall remain readable after the internal  
590 arc fault test

591 **5.9.6.3** *Internal arc test with arc ignition in the cables compartment*

592 Internal arc test with arc ignition in the cables compartment:

- 593 (1) either without an arc mitigation system or with an arc mitigation system not in service  
594 (2) or with an arc mitigation system in service

595 The following internal arc test shall be performed:

- 596 • Test:
- 597 Internal arc fault test IAC A FL (or A FLR)  $I_{Ae} = 2kA$ ,  $t_{Ae} = 1s$  for (1) or  $t_{Ae} = x$  ms (duration of the fault
- 598 is 1s) for (2) with single phase ignition and with both other phases energized according to IEC 62271-
- 599 200
- 600 • Version of the switchgear:
- 601 As per internal arc category AA20 according to C2/113-7: (1) or (2)
- 602 • Test arrangement:
- 603 In accordance with the manufacturer's installation instructions
- 604
- 605 • Acceptance criteria :
- 606 Test report
- 607 - according to IEC 62271-200 with positive results
- 608 - providing evidence that the fault does not evolve in a multiphase fault

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

611 *5.9.6.4 Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or*  
612 *lateral busbar extension component out of the gas-filled compartment (if applicable)*

613 The internal arc test is applicable for:

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

618 The following internal arc test shall be performed:

- 619 • Test:
- 620 Internal arc fault test IAC A FL (or A FLR)  $I_{Ae} = 2kA$ ,  $t_{Ae} = 1s$  with single phase ignition and with both
- 621 other phases energized according to IEC 62271-200,
- 622 • Version of switchgear:
- 623 As per internal arc category AA20 according to C2/113-7
- 624 • Test arrangement:
- 625 In accordance with the manufacturer's installation instructions
- 626 • Acceptance criteria:
- 627 Test report
- 628 - according to IEC 62271-200 with positive results
- 629 - providing evidence that the fault does not evolve in a multiphase fault

630 *5.9.7 Category AA30*

631 *5.9.7.1 Three-phase internal arc tests in all HV compartments (including any component comprising the 3*  
632 *phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault*  
633 *current IA*

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

- 635 • Test:
- 636 IAC A FL (or A FLR)  $\geq 20$  kA 1s with 3-phases ignition according to IEC 62271-200
- 637 • Version of the switchgear:
- 638 As per internal arc category AA30 according to C2/113-7: with gas evacuation downwards
- 639 • Test arrangement:
- 640 In accordance with the manufacturer's installation instructions and with the configuration
- 641 corresponding to AA30 category as described in C2/113-7, i.e.:
- 642 - with gas evacuation downwards
- 643 - on an open simulated test floor
- 644 • Acceptance criteria:
- 645 Test report
- 646 - according to IEC 62271-200 with positive results
- 647 - providing evidence (e.g. clear pictures before and after test) that the walls of the gas
- 648 evacuation duct remain intact
- 649



650 5.9.8 Category AA31

651 5.9.8.1 Three-phase internal arc tests in all HV compartments (including any component comprising the 3  
652 phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault  
653 current IA

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

- 655 • Test:  
656 IAC A FL (or A FLR)  $\geq 20$  kA 1s with 3-phases ignition according to IEC 62271-200
- 657 • Version of the switchgear:  
658 As per internal arc category AA31 according to C2/113-7: with gas evacuation rear upwards
- 659 • Test arrangement:  
660 In accordance with the manufacturer's installation instructions and with the configuration  
661 corresponding to AA31 category as described in C2/113-7, i.e.:  
662 - on an open simulated test floor over the whole depth of the switchgear
- 663 • Acceptance criteria:  
664 Test report  
665 - according to IEC 62271-200 with positive results  
666 - providing evidence (e.g. clear pictures before and after test) that the covers and plates part of  
667 the gas evacuation path and the bottom plates remain intact

668 5.9.9 Category AA33

669 5.9.9.1 Three-phase internal arc tests in all HV compartments (including any component comprising the 3  
670 phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault  
671 current IA

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

- 673 • Test:  
674 IAC A FL (or A FLR)  $\geq 20$  kA 1s with 3-phases arc ignition according to IEC 62271-200
- 675 • Version of the switchgear:  
676 As per internal arc category AA33 according to C2/113-7: with gas evacuation duct, including relief  
677 flap
- 678 • Test arrangement:  
679 In accordance with the manufacturer's installation instructions and with the configuration  
680 corresponding to AA33 category as described in C2/113-7, i.e.:  
681 - on an open simulated test floor over the whole depth of the switchgear
- 682 • Acceptance criteria:  
683 Test report  
684 - according to IEC 62271-200 with positive results  
685 - providing evidence (e.g. clear pictures before and after test) that the covers and plates part of  
686 the gas evacuation path and the bottom plates remain intact

687 5.9.9.2 Demonstration of the pressure withstand of all elements involved in or that can communicate with  
688 the gas exhaust path (e.g. evacuation ducts, compartments), with arc ignition in every compartment

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

691 **5.10 Folder S - NBN EN 62271-213 - Voltage detecting and indicating system (VDIS)**

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

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

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

698 A routine test report is accepted as long as this report details the thresholds for voltage indication. If this  
699 possibility is used, the DSO may require the Applicant to repeat the VDIS test during the final inspection.  
700

## 701 **5.11 Folder W - Testing of a HV circuit breaker overcurrent protection chain**

### 702 *5.11.1 Introduction*

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

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

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

### 712 *5.11.2 Protection chain comprising a protection relay without auxiliary supply*

#### 713 *5.11.2.1 Standard primary current injection tests*

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

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

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

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

- 723 • minimum value of the current setting range  $I >$
- 724 • time delay setting  $t_l >$  at minimum value (instantaneous) with selection of the definite time (DT) curve

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

- 726 • minimum value of the current setting range  $I >$
- 727 • time delay setting  $t_l >$  of 1 second with selection of the definite time (DT) curve

728 Criteria to pass the standard primary current injection tests:

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

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

#### 734 *5.11.2.2 Specific primary current injection tests*

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

- 738 1. Zero-sequence (homopolar) overcurrent protection function with a 1-phase primary current injection  
739 of  $60 \text{ A} \pm 3 \text{ A}$  without pre-powering:
  - 740 • current setting  $I_o >$  smaller than or equal to 60A
  - 741 • time delay setting  $t_{l_o} >$  at minimum value (instantaneous) with selection of the definite time  
742 (DT) curve

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

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

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

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

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

754 3. Overcurrent protection function through a 3-phase primary current injection of 20kA without pre-  
755 powering:

756 • maximum value of the current setting range  $I_{set}$

757 • time delay setting  $t_{set}$  of 1 second with selection of the definite time (DT) curve

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

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

761 **5.11.3 Protection chain comprising a protection relay with dual power supply**

762 **5.11.3.1 Standard primary current injection tests**

763 Operation mode without auxiliary supply:

764 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.

765 Operation mode with auxiliary supply:

766 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.

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

769 **5.11.3.2 Specific primary current injection tests**

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

772 **5.11.4 Test report**

773 The test report shall contain the following information:

774 • Information of the test object according NBN-EN 62271-1 - Annex A:

775 - Manufacturer's name and type designation:

776 o overcurrent protection relay (+ firmware version)

777 o CTs

778 o HV circuit breaker: operating mechanism, interrupting chamber (poles) and trip coil

779 - Ratings of HV circuit breaker and CTs

780 - Ratings of the trip coil (+ datasheet)

781 - Serial number of protection relay, CTs and HV circuit breaker

782 • Summary table with test results: protection relay settings, operation mode if dual power supply, CT  
783 ratio, injected current, measured HV circuit breaker tripping time

784 • HV circuit breaker opening time with respect to the tested version

785 • Current measurement error at minimal tripping threshold

786 • Pictures of :

787 - The different tests set-up

788 - The HV circuit breaker and CTs rating plate

789 - The trip coil rating plate

## 790 **6 Specific test specifications for a billing metering function**

### 791 **6.1 Introduction**

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

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

### 795 **6.2 Folder O - NBN EN 62271-200 §7.103.1 - Pressure withstand test for gas-filled** 796 **compartments**

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

### 800 **6.3 Folder Q - NBN EN 62271-200 §7.105 - Internal arc test - criteria by AA category and IAC**

#### 801 **6.3.1 Internal arc test with arc ignition in the gas-filled compartment of FU M category AA10**

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

#### 805 **6.3.2 Internal arc test with arc ignition in the gas-filled compartment of FU M category AA3x**

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

#### 808 **6.3.3 Internal arc test for FU M intended for installation downstream a general protection by switch-fuse** 809 **combination**

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

### 813 **6.4 Folder X - NBN EN 61869-2 - current transformer (CT)**

#### 814 **6.4.1 NBN EN 61869-2 §7.2.201 - Short-time thermal current (I<sub>th</sub>) and dynamic current (I<sub>dyn</sub>) test**

815 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  
816 external dimensions are identical to the CT (range) subject to homologation. The test result is valid for CTs  
817 with a rated primary current greater than the one of the type tested specimen.

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

#### 819 **6.4.2 NBN EN 61869-2 §7.2.6 and §7.3.5.201 - Test for accuracy**

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

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

### 824 **6.5 Folder Y - NBN EN 61869-3 - voltage transformer (VT)**

#### 825 **6.5.1 NBN EN 61869-3 §7.2.6 and §7.3.5.301 – Test for accuracy**

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

828 X: preferably the primary voltage U<sub>n</sub> for measuring VTs defined in §4.2