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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 a Client installation to be connected to
the public HV distribution grid of a Belgian DSO

-

Technical file

Edition 2 - DPC (10.2023)

29 **Version management**

1.0	First edition, published 07.2017
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85 **1 Object and scope**

86 **1.1 Object**

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

- 91 ▪ the standards to be met by the switchgear,
- 92 ▪ characteristics and test criteria,
- 93 ▪ lists of required type test reports,
- 94 ▪ Specific test procedures.

95 **1.2 Scope**

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

- 97 ▪ disconnectors and earthing switches
- 98 ▪ switch-disconnectors
- 99 ▪ switch-fuse combinations
- 100 ▪ circuit breakers
- 101 ▪ instrument transformers

102 **2 Instructions for compiling the technical file C2/113-3**

103 **2.1 File structure and (sub)folder names**

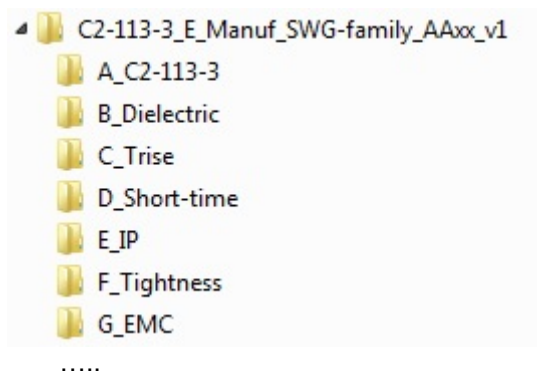
104 The composition of the technical file is based on the exact structure and contents of the assessment guide.
105 See §3 for more details.

106 The root file shall at least contain the following information:

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

108
109 The picture below gives an example of how to build the mandatory structure of folders and subfolders when
110 composing the technical file:

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

117 **2.2 Test reports and declarations**

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

120 A test report shall contain the minimum following information:

- 121 • Reference number
- 122 • Description of test object (unambiguous designation, ratings and identification drawings,
123 identification of critical components (vacuum interrupters, mechanisms, ...)
- 124 • Type of test performed with reference to the applied IEC standard(s) (incl edition) and paragraph(s)
- 125 • Ratings tested
- 126 • Test arrangement
- 127 • Specific test criteria
- 128 • Conclusion of the tests
- 129 • Testing laboratory
- 130 • Date of test

131 A declaration shall contain the minimum following information:

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

137 The required test reports are mentioned in the assessment guide.

138 This assessment guide specifies:

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

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

- 143 • on the test object for which the homologation is requested, with report issued by an ISO 17025
144 accredited laboratory
- 145 • on a test object different than the one for which the homologation is requested, with report issued by
146 an ISO 17025 accredited laboratory
147 + declaration of validity of extension to the object for which the homologation is requested according
148 to criteria of IEC 62271-307, issued by the same laboratory
- 149 • on a test object different than the one for which the homologation is requested, with report issued by
150 an ISO 17025 accredited laboratory
151 + declaration of validity of extension to the object for which the homologation is requested according
152 to criteria of IEC 62271-307 with argumentation, issued by the manufacturer.

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

154 **3 Instructions for completing the assessment guide**

155 The Applicant shall download the applicable assessment guide from the website of Synergrid
156 (www.synergrid.be).

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

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

160 The following FUs are to be considered:

- 161 • FU K intended to be connected to the distribution loop (KKNx)
- 162 • FU D or T for the general protection¹ (DxTx and TxTx)
- 163 • FU D for DSO feeder (DKNx)
- 164 • FUs R, K, T, DxTx and P, installed downstream the general protection and the HV billing metering
- 165 • FU M for HV billing metering (Mxxx)

166 The specific test specifications are described in chapter 5 of this document.

167 The (minimum) ratings are given in chapter 4 of this document.

168 The assessment is based on the ratings confirmed mentioned in the shortlist C2/113-2 completed by the
169 Applicant.

170 Synergrid will only consider the pre-classified FUs introduced in the summary of the shortlist C2/113-2 and
171 filled-in the assessment guide C2/113-3.

¹ 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
 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 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"

Assessment Guide for homologation of HV switchgear according to the Technical File C2/113-3 ED.2-DPC				Functional Unit (FU)		Busbar upstream the Gen. Protection		Loop Connection		General Protection		Feeder DSO		Billing metering function		FU downstream the General Protection	
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)				
Switchgear family name GIS or AIS 1st AA category 2nd AA category AA category FU M Single rating or dual ratings				Synergrid scheme FU Manufacturer's designation Rated current I_{rb} (A) Rated current I_r (A)		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)		Also refer to the protection of the unique transformer in a Client installation General Protection FU T		Also refer to the protection of the unique transformer in a Client installation General Protection FU Dxt							
B	1	62271-200 7.2	ULTRAVIOLET tests Power-frequency voltage withstand tests (Ud) Lighting 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	-	$U_N = \dots$ kV	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 (UJ,DC)	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 $I_r T = \dots$ A $I_r Dxt = \dots$ A $I_r Dxn = \dots$ 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 <small>(Remark: the choice will be presented in a drop-down list)</small>	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.

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4 General requirements

4.1 Normative references and Synergrid specifications

The standards and Synergrid specifications listed in table 1 below are applicable.

NBN EN 62271-200 Ed.3 (2021) + Amd.1 (2024) ²	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

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218

Table 1: normative references and Synergrid specifications

² Amendment 1 to be published, presently in CDV stage

219 **4.2 Ratings**

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

221 The ratings here below are:

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

224 Possible rated voltage GIS (Ur)

Rated voltage Ur (kV)
12 ³
24

225 Possible rated voltage AIS (Ur)

Rated voltage Ur (kV)
12 ¹
17,5 ¹
24

226

227 The minimum required ratings are the following:

228

229 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

230

231 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

232

233 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

234 Rated current of the busbar (Irb) :

- 235 • Busbar upstream the general protection: 630 A

236 Rated current of the FU (Ir) :

FU	K _{loop}	T	DxN	DxT
Rated current Ir (A)	630	80	630	400 ⁴

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

- 238 • The tables below shall be read in conjunction with the tables of the rated short-circuit making current
 239 I_{ma} further down.
 240 The first column lists the rated voltage Ur of the switchgear, the second column lists the minimum
 241 required value for Ik and I_{ma} to be met by the switchgear:
 242 ○ with single rating: there is one assigned value for I_{ma} @ Ur of the switchgear

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

⁴ The use of FU DxT with Ir = 400 A is limited. The limits are described in C2/113-5, DSO specific requirements

- 243 ○ with dual rating: there is one assigned value for I_{ma} @ U_r of the switchgear and a higher
 244 value for I_{ma} tested at a lower value of U_r
 245
 246

- Single rating

Rated voltage U_r (kV)	$I_p(k\hat{A})/I_k(kA)-tk(s)$
12	62,5/25-1
17,5	50/20-1
24	50/20-1

- 247
- Dual rating

Rated voltage U_r (kV)	$I_p(k\hat{A})/I_k(kA)-tk(s)$
17,5	62,5/25-1
24	62,5/25-1

248 Rated mainly active load breaking current (I_{load}) :

- 249
- Switching devices and FUs of concern :
 250 ○ switch-disconnector : FU K
 251
 - $I_{load} = I_r$

252 Rated short-circuit making current (I_{ma})

- 253
- Switching devices and FUs of concern :
 254 ○ switch-disconnector : FU K
 255 ○ earthing-switches : FUs K, DxN
 256

- Single rating

Rated voltage U_r (kV)	I_{ma} (k \hat{A})
12	62,5 @ 12 kV
17,5	50 @ 17,5 kV
24	50 @ 24 kV

- 258
- Dual rating

Rated voltage U_r (kV)	I_{ma} (k \hat{A})
17,5	50 @ 17,5 kV + 62,5 @ 12 kV
24	50 @ 24 kV + 62,5 @ 12 kV

259 Rated short-circuit making & breaking currents (I_{ma} & I_{sc})

- 260
- Switching devices and FUs of concern :
 261 ○ Circuit-breaker : FUs DxN & DxT
 262
 - Rated operating sequence :
 263 ○ DxT : O- 3 min – CO – 3 min – CO
 264 ○ DxN : O – 0.3s – CO – 15 s – CO
 265

- Single rating

Rated voltage U_r (kV)	I_{ma} (k \hat{A}) / I_{sc} (kA)
12	62,5 / 25 @ 12 kV
17,5	50 / 20 @ 17,5 kV
24	50 / 20 @ 24 kV

- 268
- Dual rating

Rated voltage U_r (kV)	I_{ma} (k \hat{A}) / I_{sc} (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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270

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

- 312 • Rated primary terminal insulation level: $U_m = U_r$ (see possible rated voltage AIS above)
- 313 • Ratio (rated I_{prim}/I_{sec}): 25/5⁹, 50/5, 125/5, 250/5 or 500/5 A
- 314 • Rated output: 5 VA
- 315 • Rated accuracy class: 0,2S
- 316 • Instrument security factor: FS 5 (FS 10 is not acceptable)
- 317 • Rated continuous thermal current: 1,2 * rated I_{prim}
- 318 • Rated short time thermal current: $I_{th} = I_k$
- 319 • Duration of I_{th} : 1s
- 320 • Rated dynamic current: $I_{dyn} = I_p$

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

- 322 • Rated primary terminal insulation level: $U_m = U_r$ (see possible rated voltage AIS above)
- 323 • Ratio (rated $U_{n,prim}/U_{n,sec}$): $U_n/\sqrt{3} // 110/\sqrt{3} V$
- 324 • $U_n = 5.500, 6.600, 11.000, 12.100$ or $15.400 V$
- 325 • Rated output: 10 VA (burden class I)
- 326 • Rated accuracy class: 0,2
- 327 • Rated voltage factor – rated time: 1,2 * U_n – continuous
- 328 • 1,9 * U_n – 30s
- 329 • 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.

330 **5 Specific test specifications**

331 **5.1 General**

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

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

336 **5.2 Folder B - NBN EN 62271-200 §7.2 – Dielectric tests**

337 **5.2.1 Partial discharge tests**

338 The partial discharge test shall be performed on the entire functional unit.

339 The tests will be realized in accordance with the standard EN 62271-200, clause 8.101 and annex BB, single
340 phase following the procedure A.

- 341 • **For AIS :**

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

- 345 • **For GIS:**

346 The partial discharge type test is not required
347

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

349 **5.2.2 Dielectric test on cable testing circuits**

350 The rated cable test voltage shall be confirmed for FUs KxN, DxN only.
351

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

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

357 **5.3 Folder D - NBN EN 62271-200 §7.6 - Short-time withstand and peak withstand current tests**

359 For switchgear of category AA20 equipped with an arc mitigation system, the tests shall be performed with
360 this mitigation system operational. In addition to the criterion provided by the standard, this system shall not
361 be triggered off. This condition shall be confirmed in an additional declaration.
362

363 **5.4 Folder E - NBN EN 62271-200 §7.7 - Verification of the degrees of protection IP and IK**

364 The various degrees of protection (IP and IK) listed in table 2 below, shall be confirmed by means of a specific
365 declaration of conformity within folder E of the technical file C2/113-3.
366

External enclosure of HV compartments	Nr	IP-degree
Accessible sides except the upper side :		
<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> For equipment with insulated screened active parts inside the enclosure (including the metal enclosure of the busbar extension) 	2	IP2X-D ⁽¹⁾
Upper side :		
<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> 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 :		
<ul style="list-style-type: none"> for equipment with bare active parts inside the enclosure (gas tank or single phase compartment with earthed metal partition between the phases) 	5	IP3X
<ul style="list-style-type: none"> for equipment with insulated screened active parts inside the enclosure (incl. the metal enclosure of the busbar extension) 	6	IP2X
Bottom sides :		
<ul style="list-style-type: none"> for equipment with bare active parts inside the enclosure 	7	IP3X
<ul style="list-style-type: none"> 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		
<ul style="list-style-type: none"> with bare active parts 	11	IP3X
<ul style="list-style-type: none"> 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

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

374 Table 2: required degrees of protection IP and IK

376 **5.5 Folder F - NBN EN 62271-200 §7.8 and EN 60068-2-17 §8.5.2 - Tightness test at 40°C**

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

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

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

386 **5.6 Folder L - NBN EN 62271-200 §7.102 - Mechanical endurance tests and operating force**

387 **5.6.1 Maximal allowable force for operation**

388 The maximum force applied during operation (opening and closing) shall be according to the standards IEC
389 62271-1 § 6.6.4 and 62271-102 § 6.105.

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

392 **5.7 Folder M - NBN EN 62271-200 §7.102.2 - Mechanical and electromechanical interlocks**

393 The following test report is acceptable:

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

399 **5.8 Folder P - NBN EN 62271-200 §7.104.3 - Measurement of leakage currents**

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

401 Those compartments include:

- 402 • the cables compartment of the FUs K connected to the loop
- 403 • the accessible HV metering compartment of the FU M in presence of insulating partitions between
404 the busbar compartment of the general protection and of the FU M.

405 NOTE: Under the conditions for opening the earthing switch with an open door, the equipment may be declared compartmented in the
406 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

407 **5.9 Folder Q - NBN EN 62271-200 §7.105 - Internal arc test - criteria by AA category and**
408 **IAC**

409 **5.9.1 General**

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

412
413 Declarations for extension of validity according to IEC 62271-307 are acceptable. Simulations are not
414 acceptable, unless explicitly mentioned here after.

415 **5.9.2 Category AA10**

416 **5.9.2.1 Internal arc test with arc ignition in the gas-filled compartment**

417 The following internal arc test shall be performed:

- 418 • Test:
419 IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- 420 • Version of the switchgear:
421 As per internal arc category AA10 according to C2/113-7: with gas evacuation downwards
- 422 • Test arrangement:
423 In accordance with the manufacturer's installation instructions and with the configuration
424 corresponding to AA10 category as described in C2/113-7, i.e.:
 - 425 - with gas evacuation downwards
 - 426 - on an open simulated test floor

- 427 • Acceptance criteria:
428 Test report
429 - according to IEC 62271-200 with positive results
430 - providing evidence (e.g. clear pictures before and after test) that the gas evacuation duct
431 remain intact

432 5.9.2.2 *Internal arc test with arc ignition in the cables compartment*

433 The following internal arc test shall be performed:

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

445 In addition to test 1 described above, a second internal arc test shall be performed:

- 446 • Test 2:
447 Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases arc ignition according to IEC
448 62271-200
- 449 • Version of the switchgear:
450 As per internal arc category AA10 according to C2/113-7
- 451 • Test arrangement:
452 - In accordance with the manufacturer's installation instructions,
453 - With gas evacuation:
454 a) either to the rear with closed simulated test floor under cables compartment
455 b) or downwards with expansion volume $< 6 m^3$ under the test floor and with gas outlet
456 between $0,04m^2$ and $0,12 m^2$
- 457 • Acceptance criteria :
458 Test report according to IEC 62271-200 with positive results

459 5.9.2.3 *Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or* 460 *lateral busbar extension component out of the gas-filled compartment (if applicable)*

461 The internal arc test is applicable for:

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

466 The following internal arc test shall be performed:

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

478 5.9.2.4 *Demonstration of the pressure withstand of all elements involved in or that can communicate with* 479 *the gas exhaust path (e.g. ducts, compartments and AA10-R riser base frame), with an arc in the* 480 *sealed pressure gas-filled compartment*

481 These elements shall be tested together with the switchgear, for one configuration, with gas evacuation
482 downwards in a volume $< 6 m^3$, gas outlet between $0,04m^2$ and $0,12 m^2$, with measurement of the
483 overpressure in the elements. The overpressure and the withstand of the elements for other configurations
484 can be assessed by simulations

485 **5.9.2.5 Internal arc test with arc ignition in the metering compartment**

486 The following internal arc test shall be performed:

- 487 • Test:
488 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
489 other phases energized according to IEC 62271-200
- 490 • Version of switchgear:
491 As per internal arc category AA10 according to C2/113-7
- 492 • Test arrangement:
493 In accordance with the manufacturer's installation instructions
- 494 • Acceptance criteria:
495 Test report
496 - according to IEC 62271-200 with positive results
497 - providing evidence that the fault does not evolve in a multiphase fault

498 **5.9.3 Category AA11**

499 **5.9.3.1 Internal arc test with arc ignition in the gas-filled compartment**

500 The following internal arc test shall be performed:

- 501 • Test:
502 IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- 503 • Version of the switchgear:
504 As per internal arc category AA11 according to C2/113-7: with gas evacuation rear upwards
- 505 • Test arrangement:
506 In accordance with the manufacturer's installation instructions and with the configuration
507 corresponding to AA11 category as described in C2/113-7, i.e.:
508 - on an open simulated test floor over the whole depth of the switchgear
- 509 • Acceptance criteria:
510 Test report
511 - according to IEC 62271-200 with positive results
512 - providing evidence (e.g. clear pictures before and after test) that the covers and plates part
513 of the gas evacuation path and the bottom plates remain intact

514 **5.9.3.2 Internal arc test with arc ignition in the cables compartment**

515 A first internal arc test shall be performed:

- 516 • Test 1:
517 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
518 other phases energized according to IEC 62271-200
- 519 • Version of the switchgear:
520 As per internal arc category AA11 according to C2/113-7
- 521 • Test arrangement:
522 In accordance with the manufacturer's installation instructions
- 523 • Acceptance criteria :
524 Test report
525 - according to IEC 62271-200 with positive results
526 - shall provide evidence that the fault does not evolve in a multiphase fault

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

- 529 • Test 2:
530 Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition according to IEC 62271-
531 200
- 532 • Version of the switchgear:
533 As per internal arc category AA11 according to C2/113-7
- 534 • Test arrangement:
535 - In accordance with the manufacturer's installation instructions,
536 - With gas evacuation:
537 a) either to the rear with closed simulated test floor under cables compartment
538 b) or downwards with a volume representing the smallest raising base frame
- 539 • Acceptance criteria :
540 Test report according to IEC 62271-200 with positive results

541 **5.9.3.3** *Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or*
542 *lateral busbar extension component out of the gas-filled compartment (if applicable)*

543 The internal arc test is applicable for:

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

548 The following internal arc test shall be performed:

- 549 • Test:
550 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
551 other phases energized according to IEC 62271-200,
- 552 • Version of switchgear:
553 As per internal arc category AA11 according to C2/113-7
- 554 • Test arrangement:
555 In accordance with the manufacturer's installation instructions
- 556 • Acceptance criteria:
557 Test report
 - 558 - according to IEC 62271-200 with positive results
 - 559 - providing evidence that the fault does not evolve in a multiphase fault

560 **5.9.3.4** *Demonstration of the pressure withstand of all elements involved in or that can communicate with*
561 *the gas exhaust path (e.g. ducts, compartments and AA11-R riser base frame), with an arc in the*
562 *sealed pressure gas-filled compartment*

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

567 **5.9.4** Category AA13

568 **5.9.4.1** *Internal arc test with arc ignition in the gas-filled compartment*

569 The following internal arc test shall be performed:

- 570 • Test:
571 IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- 572 • Version of the switchgear:
573 As per internal arc category AA13 according to C2/113-7: with gas evacuation duct, including relief
574 flap
- 575 • Test arrangement:
576 In accordance with the manufacturer's installation instructions and with the configuration
577 corresponding to AA13 category as described in C2/113-7, i.e.:
 - 578 - on an open simulated test floor over the whole depth of the switchgear
- 579 • Acceptance criteria:
580 Test report
 - 581 - according to IEC 62271-200 with positive results
 - 582 - providing evidence (e.g. clear pictures before and after test) that the covers and plates part
583 of the gas evacuation path and the bottom plates remain intact

584 **5.9.4.2** *Internal arc test with arc ignition in the cables compartment*

585 A first internal arc test shall be performed:

- 586 • Test 1:
587 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
588 other phases energized according to IEC 62271-200
- 589 • Version of the switchgear:
590 As per internal arc category AA13 according to C2/113-7
- 591 • Test arrangement:
592 In accordance with the manufacturer's installation instructions
- 593 • Acceptance criteria :
594 Test report
 - 595 - according to IEC 62271-200 with positive results
 - 596 - providing evidence that the fault does not evolve in a multiphase fault

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

- 599 • Test 2:
- 600 Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition according to IEC 62271-
601 200
- 602 • Version of the switchgear:
- 603 As per internal arc category AA13 according to C2/113-7
- 604 • Test arrangement:
- 605 - In accordance with the manufacturer's installation instructions,
- 606 - With gas evacuation:
- 607 a) either to the rear with closed simulated test floor under cables compartment
- 608 b) or downwards with a volume representing the smallest base frame
- 609 • Acceptance criteria :
- 610 Test report according to IEC 62271-200 with positive results

611 5.9.4.3 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) $I_{Ae} = 2\text{kA}$, $t_{Ae} = 1\text{s}$ 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 AA13 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 5.9.4.4 Demonstration of the pressure withstand of all elements involved in or that can communicate with 631 the gas exhaust path (e.g. evacuation duct, compartments), with an arc in the sealed pressure gas- 632 filled compartment

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

635 5.9.5 Category AA15

636 5.9.5.1 Internal arc test with arc ignition in the gas-filled compartment

637 The following internal arc test shall be performed:

- 638 • Test:
- 639 IAC A FL (or A FLR) 20 kA 1s with 3-phases ignition according to IEC 62271-200
- 640 • Version of the switchgear:
- 641 As per internal arc category AA15 according to C2/113-7: with an energy absorber
- 642 • Test arrangement:
- 643 In accordance with the manufacturer's installation instructions and with the configuration
644 corresponding to AA15 category as described in C2/113-7, i.e.:
- 645 - on an open simulated test floor over the whole depth of the switchgear
- 646 • Acceptance criteria:
- 647 Test report
- 648 - according to IEC 62271-200 with positive results
- 649 - providing evidence (e.g. clear pictures before and after test) that the walls and the bottom
650 plates of the gas evacuation path remain intact

651 **5.9.5.2** *Internal arc test with arc ignition in the cables compartment*

652 A first internal arc test shall be performed:

- 653 • Test 1:
- 654 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
- 655 other phases energized according to IEC 62271-200
- 656 • Version of the switchgear:
- 657 As per internal arc category AA15 according to C2/113-7
- 658 • Test arrangement:
- 659 In accordance with the manufacturer's installation instructions
- 660 • Acceptance criteria :
- 661 Test report
- 662 - according to IEC 62271-200 with positive results
- 663 - providing evidence that the fault does not evolve in a multiphase fault

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

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

- 666 • Test 2:
- 667 Internal arc fault test IAC A FL (or A FLR) 20 kA 1s with 2-phases ignition according to IEC 62271-
- 668 200
- 669 • Version of the switchgear:
- 670 As per internal arc category AA15 according to C2/113-7
- 671 • Test arrangement:
- 672 - In accordance with the manufacturer's installation instructions,
- 673 - With gas evacuation:
- 674 a) either to the rear with closed simulated test floor under cables compartment
- 675 b) or downwards with a volume representing the smallest base frame
- 676 • Acceptance criteria :
- 677 Test report according to IEC 62271-200 with positive results

678 **5.9.5.3** *Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or*

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

680 The internal arc test is applicable for:

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

685 The following internal arc test shall be performed:

- 686 • Test:
- 687 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
- 688 other phases energized according to IEC 62271-200
- 689 • Version of switchgear:
- 690 As per internal arc category AA15 according to C2/113-7
- 691 • Test arrangement:
- 692 In accordance with the manufacturer's installation instructions
- 693 • Acceptance criteria:
- 694 Test report
- 695 - according to IEC 62271-200 with positive results
- 696 - providing evidence that the fault does not evolve in a multiphase fault

697 **5.9.5.4** *Demonstration of the pressure withstand of all elements involved in or that can communicate with*

698 *the gas exhaust path (e.g. duct, compartments, AA15-A absorber base frame), with arc in the*

699 *sealed pressure gas-filled compartment*

700 These elements shall be tested together with the switchgear, for one configuration. The overpressure and

701 the withstand of the elements for other configurations can be assessed by simulations.

702 5.9.6 Category AA20

703 5.9.6.1 Internal arc test with arc ignition in the gas-filled compartment for an arc test current equal to 4,8kA

704 The following internal arc test shall be performed:

- 705 • Test:
706 IAC A FL (or A FLR) 4,8 kA, x ms (duration of the fault is 1s) with 3-phases ignition according to IEC
707 62271-200
- 708 • Version of the switchgear:
709 As per internal arc category AA20 according to C2/113-7: gas-filled compartment with arc mitigation
710 system in service
- 711 • Test arrangement:
712 In accordance with the manufacturer's installation instructions and with the configuration
713 corresponding to AA20 category as described in C2/113-7
- 714 • Acceptance criteria:
715 Test report
 - 716 - according to IEC 62271-200 with positive results
 - 717 - providing evidence (e.g. clear pictures) that:
 - 718 a) the arc suppressor has operated
 - 719 b) the hot gases resulting from the arc remain inside the sealed pressurised gas-filled
720 compartment in which the arc was ignited (the pressure relief device of the sealed
721 pressure gas-filled compartment did not open)
 - 722 c) the indication of operation of the arc suppressor shall remain readable after the internal
723 arc fault test

724 5.9.6.2 Internal arc test with arc ignition in the gas-filled compartment for an arc test current equal to 100%
725 of the rated arc fault current IA

726 The following internal arc test shall be performed:

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

746 5.9.6.3 Internal arc test with arc ignition in the cables compartment

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

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

750 The following internal arc test shall be performed:

- 751 • Test:
752 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
753 fault is 1s) for (2) with single phase ignition and with both other phases energized according to IEC
754 62271-200
- 755 • Version of the switchgear:
756 As per internal arc category AA20 according to C2/113-7: (1) or (2)
- 757 • Test arrangement:
758 In accordance with the manufacturer's installation instructions
759

- 760 • Acceptance criteria :
761 Test report
762 - according to IEC 62271-200 with positive results
763 - providing evidence that the fault does not evolve in a multiphase fault

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

766 **5.9.6.4** Internal arc test with arc ignition in the specific screened solid insulated busbar compartment or
767 lateral busbar extension component out of the gas-filled compartment (if applicable)

768 The internal arc test is applicable for:

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

773 The following internal arc test shall be performed:

- 774 • Test:
775 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
776 other phases energized according to IEC 62271-200,
777 • Version of switchgear:
778 As per internal arc category AA20 according to C2/113-7
779 • Test arrangement:
780 In accordance with the manufacturer's installation instructions
781 • Acceptance criteria:
782 Test report
783 - according to IEC 62271-200 with positive results
784 - providing evidence that the fault does not evolve in a multiphase fault

785 **5.9.7** Category AA30

786 **5.9.7.1** Three-phase internal arc tests in all HV compartments (including any component comprising the 3
787 phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault
788 current IA

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

- 790 • Test:
791 IAC A FL (or A FLR) $\geq 20\text{ kA}$ 1s with 3-phases ignition according to IEC 62271-200
792 • Version of the switchgear:
793 As per internal arc category AA30 according to C2/113-7: with gas evacuation downwards
794 • Test arrangement:
795 In accordance with the manufacturer's installation instructions and with the configuration
796 corresponding to AA30 category as described in C2/113-7, i.e.:
797 - with gas evacuation downwards
798 - on an open simulated test floor
799 • Acceptance criteria:
800 Test report
801 - according to IEC 62271-200 with positive results
802 - providing evidence (e.g. clear pictures before and after test) that the walls of the gas
803 evacuation duct remain intact

804 **5.9.8** Category AA31

805 **5.9.8.1** Three-phase internal arc tests in all HV compartments (including any component comprising the 3
806 phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault
807 current IA

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

- 809 • Test:
810 IAC A FL (or A FLR) $\geq 20\text{ kA}$ 1s with 3-phases ignition according to IEC 62271-200
811 • Version of the switchgear:
812 As per internal arc category AA31 according to C2/113-7: with gas evacuation rear upwards

- 813 • Test arrangement:
814 In accordance with the manufacturer's installation instructions and with the configuration
815 corresponding to AA31 category as described in C2/113-7, i.e.:
816 - on an open simulated test floor over the whole depth of the switchgear
- 817 • Acceptance criteria:
818 Test report
819 - according to IEC 62271-200 with positive results
820 - providing evidence (e.g. clear pictures before and after test) that the covers and plates part
821 of the gas evacuation path and the bottom plates remain intact

822 5.9.9 Category AA33

823 5.9.9.1 Three-phase internal arc tests in all HV compartments (including any component comprising the 3 824 phases in one single volume, if present) with arc test current equal to 100% of the rated arc fault 825 current IA

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

- 827 • Test:
828 IAC A FL (or A FLR) ≥ 20 kA 1s with 3-phases arc ignition according to IEC 62271-200
- 829 • Version of the switchgear:
830 As per internal arc category AA33 according to C2/113-7: with gas evacuation duct, including relief
831 flap
- 832 • Test arrangement:
833 In accordance with the manufacturer's installation instructions and with the configuration
834 corresponding to AA33 category as described in C2/113-7, i.e.:
835 - on an open simulated test floor over the whole depth of the switchgear
- 836 • Acceptance criteria:
837 Test report
838 - according to IEC 62271-200 with positive results
839 - providing evidence (e.g. clear pictures before and after test) that the covers and plates part
840 of the gas evacuation path and the bottom plates remain intact

841 5.9.9.2 Demonstration of the pressure withstand of all elements involved in or that can communicate with 842 the gas exhaust path (e.g. evacuation ducts, compartments), with arc ignition in every 843 compartment

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

846 **5.10 Folder S - NBN EN 62271-213 - Voltage detecting and indicating system (VDIS)**

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

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

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

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

855 **5.11 Folder W - Testing of a HV circuit breaker overcurrent protection chain**

856 5.11.1 Introduction

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

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

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

866 5.11.2 Protection chain comprising a protection relay without auxiliary supply

867 5.11.2.1 Standard primary current injection tests

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

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

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

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

- 877 • minimum value of the current setting range $I_{>}$
- 878 • time delay setting $t_{l>}$ at minimum value (instantaneous) with selection of the definite time (DT) curve

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

- 880 • minimum value of the current setting range $I_{>}$
- 881 • time delay setting $t_{l>}$ of 1 second with selection of the definite time (DT) curve

882 Criteria to pass the standard primary current injection tests:

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

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

888 5.11.2.2 Specific primary current injection tests

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

- 892 1. Zero-sequence (homopolar) overcurrent protection function with a 1-phase primary current injection
893 of $60\text{ A} \pm 3\text{ A}$ without pre-powering:
 - 894 • current setting $I_{0>}$ smaller than or equal to 60A
 - 895 • time delay setting $t_{l0>}$ at minimum value (instantaneous) with selection of the definite time
896 (DT) curve

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

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

- 900 2. Overcurrent protection function through a 3-phase primary current injection of 20kA without pre-
901 powering:
 - 902 • maximum value of the current setting range $I_{>>}$
 - 903 • time delay setting $t_{l>>}$ at minimum value (instantaneous) with selection of the definite time
904 (DT) curve

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

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

- 908 3. Overcurrent protection function through a 3-phase primary current injection of 20kA without pre-
909 powering:
 - 910 • maximum value of the current setting range $I_{>>}$
 - 911 • time delay setting $t_{l>>}$ of 1 second with selection of the definite time (DT) curve

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

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

915 5.11.3 Protection chain comprising a protection relay with dual power supply

916 5.11.3.1 Standard primary current injection tests

917 Operation mode without auxiliary supply:

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

919 §5.11.2.1.

920 Operation mode with auxiliary supply:

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

922 §5.11.2.1.

923 The tests shall be performed on the protection chain comprising CTs with the lowest ratio of the CT range

924 subject to homologation, regardless the operation mode of the protection relay.

925 5.11.3.2 Specific primary current injection tests

926 The tests described under §5.11.2.2 shall be performed only for the operation mode without auxiliary supply.

927 Criteria to pass the test: see §5.11.2.2.

928 5.11.4 Test report

929 The test report shall contain the following information:

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

931 - Manufacturer's name and type designation:

932 o overcurrent protection relay (+ firmware version)

933 o CTs

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

935 - Ratings of HV circuit breaker and CTs

936 - Ratings of the trip coil (+ datasheet)

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

938 • Summary table with test results: protection relay settings, operation mode if dual power supply, CT

939 ratio, injected current, measured HV circuit breaker tripping time

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

941 • Current measurement error at minimal tripping threshold

942 • Pictures of :

943 - The different tests set-up

944 - The HV circuit breaker and CTs rating plate

945 - The trip coil rating plate

946 **6 Specific test specifications for a billing metering function**

947 **6.1 Introduction**

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

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

952 **6.2 Folder O - NBN EN 62271-200 §7.103.1 - Pressure withstand test for gas-filled** 953 **compartments**

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

956 **6.3 Folder Q - NBN EN 62271-200 §7.105 - Internal arc test - criteria by AA category and** 957 **IAC**

958 **6.3.1 Internal arc test with arc ignition in the gas-filled compartment of FU M category AA10**

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

962 **6.3.2 Internal arc test with arc ignition in the gas-filled compartment of FU M category AA3x**

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

965 **6.3.3 Internal arc test for FU M intended for installation downstream a general protection by switch-fuse** 966 **combination**

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

970 **6.4 Folder X - NBN EN 61869-2 - current transformer (CT)**

971 **6.4.1 NBN EN 61869-2 §7.2.201 - Short-time thermal current (I_{th}) and dynamic current (I_{dyn}) test**

972 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
973 external dimensions are identical to the CT (range) subject to homologation. The test result is valid for CTs
974 with a rated primary current greater than the one of the type tested specimen.

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

976 **6.4.2 NBN EN 61869-2 §7.2.6 and §7.3.5.201 - Test for accuracy**

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

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

981 **6.5 Folder Y - NBN EN 61869-3 - voltage transformer (VT)**

982 **6.5.1 NBN EN 61869-3 §7.2.6 and §7.3.5.301 – Test for accuracy**

983 Type test performed on a measuring VT with ratio X/V3 / 110/V3, rated output 10 VA, class 0,2 and tested
984 according burden range I. A routine test report is acceptable considering §7.3.5.301 of NBN EN 61869-3.

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