ICS 19.020
CCS K 40

NB

ENERGY INDUSTRY STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

NB/T 42099-2024

Replacing NB/T 42099-2016

Guide to the synthetic testing of high-voltage alternating current circuit-breakers

高压交流断路器合成试验导则

Issued on: May 24, 2024 **Implemented on: November 24, 2024**

Issued by: National Energy Administration of the PRC

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Foreword

This document was issued on 24 May 2024 by the National Energy Administration of the PRC and takes effect on 24 November 2024.

It is a NB/T standard: recommended rather than compulsory, but it is the text a Chinese

reviewer applies when assessing a submission.

It is classified under ICS 19.020, Chinese classification K 40.

It replaces NB/T 42099-2016, which is superseded.

This document was drafted in accordance with the rules given in GB/T 1.1-2020 Directives for standardization - Part 1: Rules for the structure and drafting of standardizing documents.

This document replaces NB/T 42099-2016 Guide to the synthetic testing of high-voltage alternating current circuit-breakers. Compared with NB/T 42099-2016, apart from structural adjustments and editorial changes, the main technical changes are as follows:

a) a requirement has been added for the initial instantaneous value of the power-frequency recovery voltage of the second and third breaking poles in the three-phase symmetrical current breaking test of the high-voltage stage, see 5.1;

b) Figure 9 has been modified and the requirements for the unit test have been modified, see 7.1 and 6.1 of the 2016 edition;

c) an explanation has been added of the additional test requirements and their implementation for circuit-breakers in medium-arcing and/or long-arcing tests, see 7.4;

d) the required values of the parameters of the last half-wave of current in the T100a test have been modified, see 7.6 and 6.6 of the 2016 edition;

e) a new Annex A has been added, giving the additional test procedure for abnormal breaking in three-phase synthetic tests, see Annex A;

f) Figures B.3 and B.4 have been added, giving examples of test circuits for capacitive current switching, and Annex C has been merged into Annex B, see Annex B and Annexes B and C of the 2016 edition;

g) the former Annex B, Conversion values of TRV and di/dt for test duty T100a, has been deleted, see Annex B of the 2016 edition.

Please note that some of the content of this document may be the subject of patent rights. The issuing body of this document assumes no responsibility for identifying patents.

This document was proposed by the China Electrical Equipment Industry Association.

This document is under the administration of the Standardization Technical Committee on Short-circuit Testing Technology of the Energy Industry (NEA/TC 10).

The versions of this document and of the document it replaces are as follows: first issued in 2016 as NB/T 42099-2016; this is the first revision.

1 Scope

NB/T 42099-2024 is the Chinese energy sector guide to synthetic testing of high-voltage

alternating current circuit-breakers. It exists because of an arithmetic problem that no laboratory in the world can spend its way out of. To prove that a 550 kV breaker can interrupt a short circuit, the test has to impose the full fault current and then, microseconds after the arc goes out, the full recovery voltage across the contacts; a direct test would need a source of tens of gigavolt-amperes, which no test station has and no utility would build. The synthetic method separates the two demands: one circuit supplies the current while the arc burns, a second injects the voltage the moment the current passes through zero, and the breaker experiences something electrically equivalent to the real fault. That equivalence is exactly where the argument lies, because a synthetic test that is set up slightly differently is a different test, and a breaker certified on a lenient interpretation is a breaker that may not clear the fault it was bought for. This document is the interpretation that removes the ambiguity: it explains the technical requirements of GB/T 4473-2018 so that they are read consistently alongside GB/T 1984-2014, and it unifies the test and measurement methods so that reports issued by different laboratories mean the same thing. It covers the high-voltage stage and the current injection method for breaking tests, including the initial instantaneous values of the power-frequency recovery voltage for each breaking pole at first-pole-to-clear factors of 1.5, 1.3 and 1.2; the circuits for short-circuit making tests; and the special requirements attached to clauses 6.102 to 6.111 of GB/T 1984-2014, covering unit tests, multipart tests, T100s with a substitute operating mechanism, the setting and validation of arcing time, test duties T100s and T100a with the tabulated parameters of the last half-wave of current, short-line fault, out-of-phase and capacitive current switching tests. Two informative annexes give the additional procedure for abnormal breaking in three-phase synthetic tests and the synthetic test method for capacitive current switching. It was issued on 24 May 2024 by the National Energy Administration, took effect on 24 November 2024, and replaces NB/T 42099-2016.

This document specifies the procedure by which a laboratory tests high-voltage alternating current circuit-breakers in accordance with GB/T 4473-2018.

This document applies to the synthetic testing of high-voltage alternating current circuit-breakers under short-circuit and switching conditions according to the test methods given in GB/T 4473-2018, and to the issuing of a type test report.

This document is an interpretation of the technical requirements of GB/T 4473-2018, intended to ensure a consistent interpretation when GB/T 4473-2018 and GB/T 1984-2014 are used together, and to unify the test methods and the measurement methods.

2 Normative references

The contents of the following documents constitute indispensable provisions of this document through normative reference in the text. For dated references, only the edition corresponding to that date applies to this document. For undated references, the latest edition, including all amendments, applies to this document.

GB/T 4473-2018 Synthetic testing of high-voltage alternating current circuit-breakers

GB/T 1984-2014 High-voltage alternating current circuit-breakers

NB/T 42101 General guide to type tests and type test reports for high-voltage switchgear

3 Terms and definitions

No terms and definitions need to be defined in this document.

4 Type test certification procedure

When a circuit-breaker is tested using synthetic test techniques in accordance with GB/T 4473-2018 and with this document, a type test report may be issued in accordance with NB/T 42101 only if the provisions of the corresponding test of GB/T 1984-2014 are complied with at the same time.

5 Synthetic test techniques and methods for short-circuit breaking tests

5.1 High-voltage stage

If, because of a recovery voltage that is direct or a combination of alternating and direct (see Figure 2 of GB/T 4473-2018), a breakdown occurs after one eighth of a cycle following the current zero, the test may be repeated using a recovery voltage at rated frequency, either alternating or a combination of alternating and direct. In the repeated test the requirements relating to the TRV may be disregarded.

In a three-phase symmetrical current breaking test, apart from the first pole to clear, the other two phases do not extinguish the arc at the peak of the power-frequency voltage; the correction factor for the transient recovery voltage (TRV) therefore has to be adjusted, while the power-frequency recovery voltage does not need to be corrected.

Table 1 gives the initial instantaneous values of the power-frequency recovery voltage of the different breaking poles when the test is carried out.

Table 1 - Initial instantaneous value of the power-frequency recovery voltage of the different breaking poles

First-pole-to-clear factor kpp = 1.5: first pole to clear, 1.5 ur x root 2 / root 3; later poles, ur x root 2 / root 3.

First-pole-to-clear factor kpp = 1.3: first pole to clear, 1.3 ur x root 2 / root 3; third breaking pole, ur x root 2 / root 3; second breaking pole, 1.26 ur x root 2 / root 3.

First-pole-to-clear factor kpp = 1.2: first pole to clear, 1.2 ur x root 2 / root 3; third breaking pole, ur x root 2 / root 3; second breaking pole, 1.14 ur x root 2 / root 3.