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WHITE PAPER

Telcordia GR-1089-CORE Issue 4 Topics
Primary Protection

Bourns engages in standards development and produces components that will help customers' products comply with published standard requirements. For these reasons, Bourns took part in Issue 3 and Issue 4 revisions of GR-1089-CORE. Bourns has created the Telcordia GR-1089-CORE Issue 4 Topics series to help customers understand the changes in section 4 from Issue 3 to Issue 4. The series author, Mick Maytum, is Bourns standards representative on the IEC, ITU-T, IEEE, ATIS, JEDEC and TIA surge protection committees.

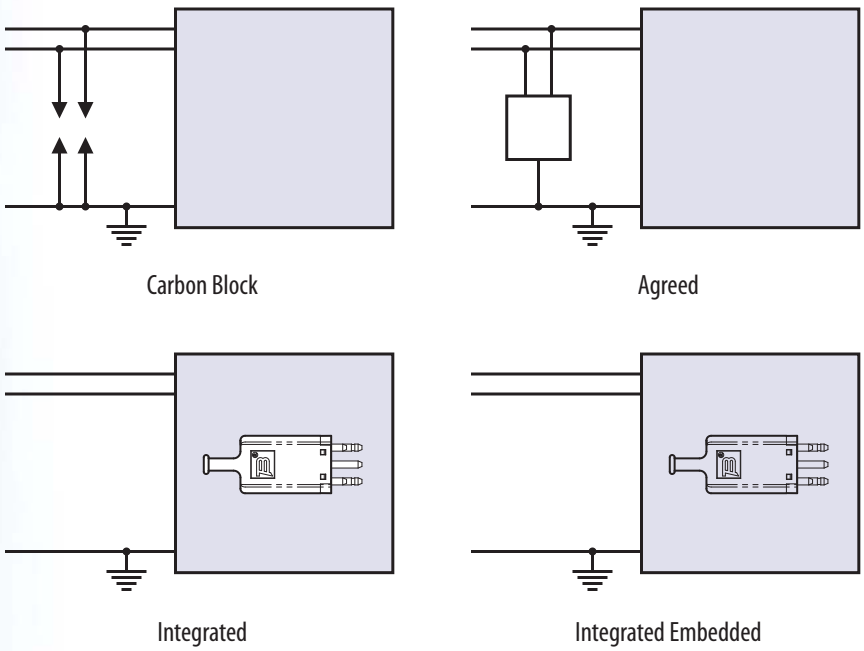
Telcordia GR-1089-CORE Issue 4 Topics —
Agreed, Integrated and Embedded Primary Protection

Section 1: Introduction
Readers who design or test equipment to the ITU-T Recommendations K.20, K.21, K.44 or K.45 will be familiar with the new Issue 4 primary protection terms. Issue 3 harmonized with the ITU-T recommendations on power induction and introduced the impulse coordination concept. Issue 4 harmonizes primary protection concepts with the ITU-T.

This document describes Agreed, Integrated and Embedded Primary Protection, contrasts it with the ITU-T terminology and discusses the testing implications for the equipment electronics. To assist in locating the GR-1089-CORE clauses referenced here, the GR-1089-CORE, Issue 4 PDF file page numbers are given.

Section 2: Overview
Besides the default carbon-block primary protector, Issue 4 covers three other primary protector types, Agreed, Integrated and Embedded. Figure 1 shows the four primary protection arrangements.

Figure 1. Carbon-block, Agreed, Integrated and Integrated Embedded Primary Protection



The Agreed, Integrated and Embedded protection arrangements will usually have lower limiting voltage values than the ancient carbon-block primary protector. Testing should take account of the reduced voltage stress on the equipment electronic circuits. Reduced voltage level testing is discussed later in section 5: Possible test approaches for Agreed, Integrated and Integrated Embedded Primary Protection.

Agreed, Integrated and Embedded protection only applies to Port Types 3 (Customer Premises) and 5 (Outside Plant). It does not apply to Port Type 1 (Central Office).

Section 3: Test voltages set by carbon-block limiting voltage
The GR-1089-CORE default primary protector is the carbon-block. The carbon-block primary 1 kV maximum impulse let-through sets the surge amplitude for:

- Tests 2, 3 and 5 in Table 4-2 First-Level Lightning Surge (PDF file page 123)
- Test 1 of Table 4-3 Protection Test Criteria (PDF file page 125)
- Clause 4.7 Lightning Protection Tests for Equipment To Be Located in High-Exposure Customer Premises and OSP Facilities (PDF file page 156)

The carbon-block 600 V rms AC maximum (800 V peak) let-through sets the surge amplitude for many AC tests including:

- Tests 3, 5, 6 and 8 in Table 4-7 First-Level AC Power Fault (PDF file page 136)
- Clause 4.6.11 Current-Limiting Protector Tests for Equipment To Be Located at Network Facilities (PDF file page 137)
- Tests 2, 3, 4 and 5 in Table 4-8 Second-Level AC Power Fault (PDF file page 144)
- Clause 4.6.14 Fusing Coordination Tests for Equipment To Be Located on Customer Premises and OSP Facilities (PDF file page 147)
- Tests 3, 6 and 8 in Table 4-10 Second-Level AC Power Fault (PDF file page 151)
- Test 5 in Table 4-11 Second-Level AC Power Fault for Equipment Ports With Secondary Protection (PDF file page 153)
- Tests 3, 8, 10, 11, and 13 in Table 4-13 Parameter Values Used for Equipment Intended for Agreed Primary Protection (PDF file page 160)
- Tests 3, 8, 9, 10, 11, and 12 in Table 4-15 Parameter Values Used for Equipment With Integrated Primary Protection (PDF file page 167)
- Clause 4.9.3.1 Overcurrent Protection Coordination Test for Protected Circuits test (PDF file page 169)

Section 4: Terms and Definitions
This clause gives Issue 4 primary protection definitions and near ITU-T equivalents.

Section 4.1: Agreed Primary Protection — Issue 4
A surge protector that is used to protect the equipment based on an agreement between the manufacturer and the network operator. Such protectors may comply with a specific Telcordia GR (e.g. GR-974-CORE), National or International standard.

Section 4.1.1: Agreed Primary Protection — ITU-T [K.44 (03), 3.1.4]
Agreed primary protection is a type of SPD (Surge Protective Device) that is used to protect the equipment based on an agreement between the manufacturer and the network operator. Agreed primary protection may be a specific SPD or a range of SPDs, which comply with a particular Recommendation or specification. The agreed primary protection can be nothing if it has been agreed that no external protection elements need to be used for the equipment.

Section 4.2: Integrated Primary Protection — Issue 4
Equipment with Integrated Primary Protection (EIPP) has:

- The primary protector and the following electronic circuitry are in the same enclosure
- The primary protector and the following electronic circuitry have a common bonding point or bar within the equipment enclosure

The equipment manufacturer may supply the equipment with primary protectors already installed or, for replaceable primary protectors, leave the customer to insert his preferred protector.

Section 4.2.1: High Current Carrying Protection Components — ITU-T [K.44 (03), 3.1.6]
A high current carrying protection component is an SPD that is designed to conduct/divert the majority of the surge energy, once it has operated, away from the circuit it is protecting. High current carrying protection components are mainly used as primary protection components, but in some cases may be integrated into the equipment as inherent protection.

Author's Comment: The above ITU-T definition muddles components and devices. An SPD is a device, which has a protection function that can be directly connected to the circuit wiring. In Telcordia parlance, an SPD is a TLPU (Telecommunication Line Protection Unit) and its mounting base. A Surge Protective Component, SPC, is a component incorporated in an SPD that gives the SPD its non-linear protective function. An SPC, such as a GDT (Gas Discharge Tube), may be mounted on the equipment printed circuit board to provide a primary protection function. Further, in operation, surge protection conducts and diverts current, not energy, the bulk of the energy threat being contained in the originating source.

The ITU-T states that for equipment with high current carrying protection devices or components, which eliminates the need for primary protection, the following applies:

- If this device is removable, it shall be removed and replaced by the special test protector for both the inherent and coordination tests.
- If this component is not removable, all tests are performed with the protection provided and the manufacturer must provide a test report to show that the inherent and coordination tests were performed with the special test protector during the design tests.

Section 4.3: Embedded Primary Protection — Issue 4
Equipment with Embedded Primary Protection (EEPP) is a subset of Equipment with Integrated Primary Protection (EIPP) and has the following criteria:

- The primary protector and the following electronic circuitry are in the same enclosure, box or module
- The primary protector is not a field replaceable part
- The embedded primary equipment has a single grounding terminal or a bus bar of terminal connections, which carry the port surge currents to ground

Embedded Primary Protection Equipment is supplied to the customer with the primary protection already installed.

Section 4.4: Special Test Protector — ITU-T [K.44 (03), 3.1.9]
A Special Test Protector is a component or circuit used to replace the agreed primary protector for the purposes of confirming coordination. The special test protector ensures that the voltage at the input of the equipment will be higher during the test than in service and provides a level of assurance that the equipment will be protected by the addition of primary protection.

The Special Test Protector is an end-of-life, agreed-upon primary protector with maximum voltage and current let-through values and used for primary-equipment protection coordination testing. The ITU-T has mandated the use of Special Test Protectors since 2000 and found these produce more realistic test assessments than setting generator voltages to the protector limiting level. A Special Test Protector can be used in the coordination test (Table 4-3 Protection Test Criteria, PDF file page 124, and Table 4-12 Protection Test Criteria for Equipment to Be Located on High-Exposure Customer Premises and OSP Facilities, PDF file page 158.)

Section 5: Possible test approaches for Agreed, Integrated and Integrated Embedded Primary Protection
For the tests listed in section 3 of this document, it would be reasonable to use the maximum AC and impulse let-through voltages of the protector used. For example, the Bourns® 2420 series 5-Pin Gas Discharge Tube (GDT) Protector has a maximum peak AC voltage sparkover of 400 V (283 V rms) and a sparkover voltage of 875 V at a ramp rate of 1000 V/µs.

Reducing the output voltage of a 600 V rms AC test generator to 283 V rms will reduce the output short-circuit current to half of the 600 V rms value. Test choices are:

- Reduce the generator series resistance to restore the short-circuit output current to the normal 600 V rms value
- Test at 600 V rms with a Special Test Protector fitted
- Accept a lower value of test current

Similar choices are available for the impulse condition where the voltage is reduced from 1 kV to 875 V (87.5 %).

Many of the generators used in GR-1089-CORE have their maximum voltage and current values set by two quantities, the maximum predicted surge current and the primary protector maximum let-through voltage. Yet in the real world many of the threat sources are high voltages or magnetically coupled currents. Such threats can deliver nearly the full short-circuit current at the primary protectors limiting voltage. When the EUT voltage approaches the maximum GR-1089-CORE generator voltage, the generator will deliver little current. Under these circumstances, the GR-1089-CORE generator will under-test the EUT.

Those who understood the 10/1000 coordination test of Issue 3 will realize that this impulse test can deliver the full short-circuit current at the primary protector let-through voltage. Further, the step-stress nature of the test setup interrogates the EUT for protection blind spots. The impulse coordination test imposed in Issue 4 will fully test the EUT electronics for different primary protector limiting voltage values. The AC test level solutions for different primary protector limiting voltage values are complex and these will be described in later Telcordia GR-1089-CORE Issue 4 Topics documents.

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