



Standardized testing of a 220 kV mobile substation for a project in Algeria with the CPC 100 and the CMC 356.

**SIEMENS**

# Reliable companion

Substation commissioning with the CPC 100

SIEMENS Transmission & Distribution (T&D) from Grenoble in France has many years of experience in building gas- and air-insulated substations (GIS and AIS). For many years, SIEMENS T&D's Field Services Team has used the CPC 100 and other OMICRON testing devices for comprehensive high-voltage (HV) substation testing and commissioning. Its multi-functionality, reliability and efficiency make the compact test set a key tool for the on-site commissioning tasks of SIEMENS T&D. Aside from typical commissioning tests on different primary assets, the Field Services Team uses the CPC 100 for specific projects to ensure the quality of their substations all over the world.



### CPC 100 and accessories

- > Replaces numerous individual testing devices
- > Versatile tests on different high-voltage assets
- > Powerful and flexible: 800 A, 2 kV, 15 Hz – 400 Hz / 400 ADC
- > Easy to use and handle by one person
- > Expandable with many accessories

 [www.omicron.at/CPC100](http://www.omicron.at/CPC100)



### The challenge: excellence under pressure

In the turnkey project business of substations, there is a high degree of technical responsibility, while at the same time competitiveness and the pressure to keep prices low are also a strong factor. The fact that requests for project durations are getting shorter and shorter, can't be ignored either. Thus, technical expertise, perfect project management, and reliable and efficient testing systems are key success factors.

One of the most important processes in the project schedule is the testing and commissioning of different substation elements. Hidden defects in HV assets as well as failures in installation or wiring could lead to a system malfunction or even

to the destruction of system components. The consequences of that may include insecure situations for the staff, high repair and system outage costs, or a project delay resulting in penalties. Eliminating a maximum of risk in a minimum amount of time is the challenge. Therefore anticipation, i.e. extended and early factory testing to enable faster and more reliable testing on site, is of the highest importance. Furthermore, perfect coordination, and optimized and automated testing are the key.

### Commissioning tests all over the world

At SIEMENS T&D, a dedicated Field Services Team of about 80 logistical experts and specialized technicians and engineers is preparing, executing, and supervising the on-site commissioning tasks of several projects that are running parallel to each other. Most of the team members travel from site to site. Thus, the test equipment being used not only has to be highly reliable but also very portable.

SIEMENS T&D bought their first CMC 156 for relay testing in 1998. Since then, their CMC testing devices have been used for optimizing factory and site tests by using the OMICRON Control Center. Standardized ▶

### Typical commissioning tests of SIEMENS T&D with the CPC 100

After extensive factory testing to save time on site, the following typical commissioning tests are performed by SIEMENS T&D:

#### Current and voltage transformers

- > Wiring sequence
- > Winding resistance
- > Magnetization curve
- > Electric burden (secondary devices connected)
- > Primary injection test of the complete chain from high voltage to low voltage

#### Power transformers

- > Winding resistance
- > Ratio

#### Disconnectors (GIS / AIS)

- > Contact resistance

#### Grounding system

- > Earth resistance

#### Transmission lines

- > Line and ground impedance (with CP CU1)

## 14 Application

► test sequences allow for extensive testing of the protection and control panels for each type of bay in the factory. For each identical bay, the sequences also permit fast functional checks to be made. These tests can then be repeated on site under real conditions. The first CPC 100 arrived in 2001. Today, their fleet of OMICRON devices consists of six CPC 100 units, one CP TD1 for tan delta tests, one CP CU1 for line and ground impedance tests, six CMC units, two CT Analyzers, and one FRAnalyzer. If necessary, this pool can be extended temporarily with long-term rental devices for specific projects or when there is a high commissioning load.

### Testing in two phases

"In project business, two testing phases are generally distinguished," explains Mohammad Djamalil-Ayli, who has been a commissioning engineer for 7 years and is in charge of preparing the tests and training the new commissioning experts on the

team. "In the first phase, factory acceptance tests (FAT) are carried out. With these tests, important system components are individually pre-tested in the own factory or at the supplier before they are sent to site. For complex sub-systems like the protection and control system, an anticipated interconnection between all panels in the factory and functional simulation testing avoids surprises and expensive last-minute modifications on site. The responsible site commissioning engineer and often also the end customer or an external witness are associated to these tests in order to validate this important step at an early stage," Mohammad Djamalil-Ayli adds.

"The second phase consists of the commissioning tests or site acceptance tests (SAT). During this phase, the system function is tested in three steps: the correct wiring and connection of the primary assets, the interconnection with the secondary system, and the overall system function."

### Extensive commissioning tests with one system

Due to the wide range of functionality offered by the CPC 100, SIEMENS T&D uses the testing device for many different tasks during a typical turnkey project. "We test our voltage, current, and power transformers extensively with the CPC 100 (see infobox "Typical commissioning tests of SIEMENS T&D with the CPC 100"). In addition to our standard tests on transformers, our end customers often request an additional tan delta test, a frequency response analysis (FRA), or a tap changer test. For these tests we use the FRAnalyzer and the CPC 100 together with the CP TD1 accessory. Testing transformers is not the only thing we use the CPC 100 for. We also test the contact resistance of our GIS and AIS disconnectors for fine tuning in order to ensure correct mounting and exclude phase inversions. As soon as the civil engineering activities are finished, the grounding system can be tested. The CPC 100 saves a lot of time and effort during these tests. It replaces numerous testing devices which would otherwise be needed to conduct all the different tests. Finally, when the lines are connected, the line impedance is measured in order to get the correct parameters for the distance protection. In most of the cases, our customers do this themselves using the CPC 100 + CP CU1," Mohammad Djamalil-Ayli continues.

### Special applications at SIEMENS

The CPC 100 can be extended with several accessories that further expand its fields of application. This versatility also makes the CPC 100 the ideal solution for many specific projects of SIEMENS T&D.



A 500/220/132 kV AIS substation in Pakistan commissioned with the CPC 100.



Testing a 72.5 kV type 8DN8-4 GIS in Peru with the CPC 100 + CP RC test system.

In many new GIS systems SIEMENS T&D has integrated a so-called “Power VT” as a standard option. This VT allows up to 235 kV voltage to be applied to the GIS when using the CPC 100 with its CP RC resonance circuit accessory. This easy-to-set-up and transport system acts as a HV generation source for dielectric withstand testing, which is necessary during commissioning. The concept was developed from SIEMENS in collaboration with OMICRON experts. “It has many logistical

advantages during commissioning compared with traditional methods. To date, a cargo flight was often needed to transport the test equipment which weighs about 2.5 tons. The CPC 100 + CP RC system is small and light-weight. Therefore, crane and modification work on the GIS are no longer necessary for performing the test. Thus it is also well appreciated when it comes to later maintenance tests by our end customers,” Mohammad Djamalil-Ayli adds. ▶



**Mohammad Djamalil-Ayli**  
Commissioning Engineer,  
SIEMENS T&D France



«The CPC 100 helps us to work efficiently, be competitive, and most importantly: to satisfy our customers.»

**Thierry Canaguier**

Head of the Field Services Team, SIEMENS T&D France

▶ Another new concept developed by SIEMENS T&D are mobile substations. These impressive 220 kV mobile substations on trucks (built and commissioned in France) can act as quickly available temporary or permanent solutions. “We especially supply large substation series with this concept for projects in Algeria. Here we are able to use the CPC 100 and the CMC 356 very efficiently, since all mobile substations are tested in the same standardized way. Once a mobile substation has been delivered and connected, the end customer can measure the line impedance with the CPC 100 + CP CU1. Measuring the parameters is much more precise than calculating them and helps to set the protection parameters correctly.”

In 2013, SIEMENS T&D conducted a large project in France with a particular logistical challenge. “OMICRON really supported us well during this project. We had to test ten 400 kV capacitor banks at several sites in France in a very short time period. Thus we rented six additional CPC 100 units in addition to our own devices to measure the capacitance and inductance,” Mohammad Djamilil-Ayli continues.

**Ensured quality for satisfied customers**

“In conclusion, the OMICRON devices and especially the CPC 100 are very essential and reliable tools for our commissioning tasks, no matter if we conduct quick manual tests or use it for more complex testing. It supports us reliably in our efforts to exclude potential system errors in a minimum amount of time,” Mohammad Djamilil-Ayli concludes. Thierry Canaguier,

Head of the Field Services Team adds: “Preparing test templates in advance and using the automatic test report functions helps us to anticipate, standardize, and speed up our tests. Due to this, we can be sure to deliver a well-tested and high-quality system to our customers. Hence, the CPC 100 helps us to work efficiently, be competitive, and most importantly: to satisfy our customers.”

### SIEMENS Transmission & Distribution

SIEMENS Transmission & Distribution (T&D) SAS, based in Grenoble, belongs to the Energy Sector of SIEMENS France. For many years, SIEMENS T&D has specialized in international project business and services. The tasks comprise building, commissioning, and maintaining electrical gas- and air-insulated high-voltage substations (GIS / AIS) in France and all over the world. Many of the substations are delivered as ready-to-use turnkey solutions, i.e. installation of the substations includes mounting, testing, and commissioning of the high- and low-voltage devices that have been supplied.