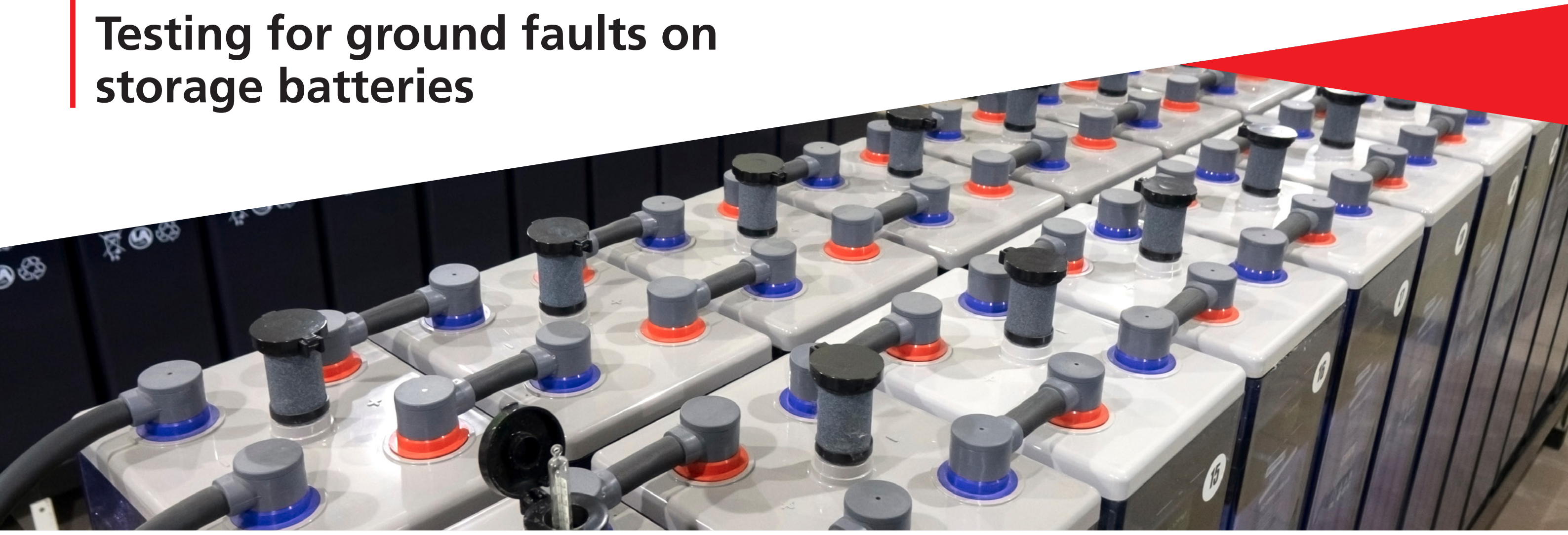
Testing for ground faults on storage batteries



Introduction

In many applications, ranging from circuit breaker tripping systems to uninterruptible power supplies for data and telecommunication installations, storage batteries are used as a standby power source. And, in most cases, the battery systems are designed to float – that is, to operate without an earth connection. A fault is usually indicated on a control panel and may create an alarm condition.

A common problem however, is that a ground fault develops somewhere in the battery system, typically as a result of dirt and moisture. Such faults can be very difficult to locate, especially in large battery installations for example power stations and large substations.

The most obvious approach to ground fault location is to disconnect the battery from its load, and to split it into sections so that the fault can be localised. While this approach undoubtedly works, it is inconvenient as the equipment powered by the battery will have to be taken out of service while the tests are performed.

Several alternative testing techniques have been proposed in an attempt to solve these problems. One of these is to inject a low-frequency test pulse, typically around 5 Hz, and use a signal tracker to determine how this propagates through the battery system, thereby locating the fault.

This arrangement has the benefit that the tests can, at least in theory, be carried out while the battery remains in service, and that no removal of connecting straps is needed. However, the use of low-frequency pulses has a major drawback, as the pulses are very likely to upset the operation of protection relays associated with the battery, leading to spurious tripping. The designers of some test battery ground fault location test sets have sought to avoid this problem by using test signals of much higher frequency, in the 5 kHz range. This eliminates the adverse effects on protection relays, but it introduces another problem.

At these frequencies, the capacitors that are often used in battery systems for surge suppression present a low impedance and, therefore, during testing they appear as "phantom" ground faults, making it much harder to localise the real ground faults. The most effective solution, and the one adopted in Megger's BGFT battery ground fault tester, is to use a test signal frequency in the range 20 Hz to 30 Hz. This is high enough to prevent interaction with protective relays, but low enough to minimise the phantom ground fault problems associated with capacitors. The technique of locating ground faults with test sets operating at these frequencies is straightforward. The test equipment comprises a signal generator, which is mains powered, and a separate battery-powered probe, which is essentially a clamp meter that has been tuned so that it discriminates against signals at frequencies other than that of the test signal. The transmitter incorporates a resistance bridge; it shows the resistance of all the parallel circuits to ground from the point where it is clamped. A capacitance bridge is also provided as an additional aid to discrimination against phantom faults.

To locate a fault, the signal generator is connected between earth and either the positive or the negative pole of the battery system, the correct choice being the pole that has the ground fault. The probe is then used to track the test signal from the source, always following the circuit branches that show the lowest resistance. Systematically applied, this procedure leads quickly and positively to the fault location. Note that tests can be carried out equally well on batteries that are in service and those that have been isolated.

Testing for ground faults on storage batteries

While this method of locating battery ground faults is simple in principle, it nevertheless makes substantial demands on the test equipment used. To ensure success, the equipment must, for example, be immune to distributed noise in the battery system and it must also be able to deliver consistent results even in the presence of large ripple currents. With good quality equipment, however, there is no doubt that testing at frequencies in the 20 Hz to 30 Hz range provides a fast, dependable and convenient solution to the perennial problem of locating ground faults in battery systems.

TITLE: Testing for ground faults on storage batteries.

AUTHOR: Andrew Sagl.

DATE: January 2010

KEYWORDS: BGFT, circuit breaker uninterruptable power supply, storage battery, ground fault location.

ABSTRACT: Identifying faults in storage batteries can be problematic. Using a test signal frequency in the range 20 Hz to 30 Hz can minimise interruption from ‘phantom’ faults in batteries.

EMAIL: andrew.sagl@megger.com.