On line diagnosis experimentations for MV cables in ERDF distribution network.

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ABSTRACT

This paper presents the on line diagnosis experimentations which are conducted in ERDF HV/MV substations in order to develop a failure prevention system based on the detection and location of self extinguishing faults.

A general presentation of the diagnosis systems is done and some typical transient phenomena recorded on site are presented. The research of a solution to localize the weak points is under study and some interesting results based on reflectometry analyses are presented.

KEYWORDS

Self extinguishing faults, MV cables networks, fault location.

INTRODUCTION

The reduction of the number of persistent faults on the distribution system is an important issue for the French DSO ERDF to keep a high quality of service.
To detect and eliminate underground network weak points, and also to provide a precious help for general replacement program leaded by ERDF asset management agencies, off line diagnostic techniques using tan delta and Partial Discharges measurements are widely used at ERDF since several years. Experience feedback with this off line diagnosis shows the method gives satisfaction for short time failure and also for ranking the different types of cable for renewal operations [1].
To provide a larger scale survey and increase the detection of its underground network weak points before failure, ERDF decided to start a new project in 2012 based on the on-line diagnosis method, knowing that failures are often preceded by warning signs of low energy (Partial Discharges) or high energy such as self extinguishing faults which can be detected with current and/or voltage sensors located in the HV/MV substations.

PRESENTATION OF THE DIAGNOSIS SYSTEMS

HV/MV substations

The diagnosis systems described in this paper have been installed in two HV/MV substations with the following main characteristics:

- The first system is installed in a 63/20 kV substation equipped with two 36 MVA transformers. Both transformers are grounded with a combination of resistance and inductance: $|Zn| = |40 + j\,40|\ \Omega$.
- The second system is installed in a 225/20 kV substation equipped with two 70 MVA transformers. Both transformers are grounded with a single resistance of 12 Ω.

Measurement systems

The systems have been designed with 2 main objectives: detection and location of self extinguishing faults. To achieve those tasks, the diagnosis systems are composed of 2 measurement units:

- A low frequency data acquisition unit, where the neutral current (In), the supply current of the main busbars (I1, I2) and the phase to ground voltages are recorded with a 50 kHz sampling rate.
- A high frequency data acquisition unit which records the current circulating in the common ground connexions of cable screens for each feeder (I_screen) with a 40 MHz sampling rate.

When a transient phenomenon is detected, all the measured quantities are stored in a central database accessible through the internet.

Figure 1 illustrates the general arrangement of the main sensors in a HV/MV substation.

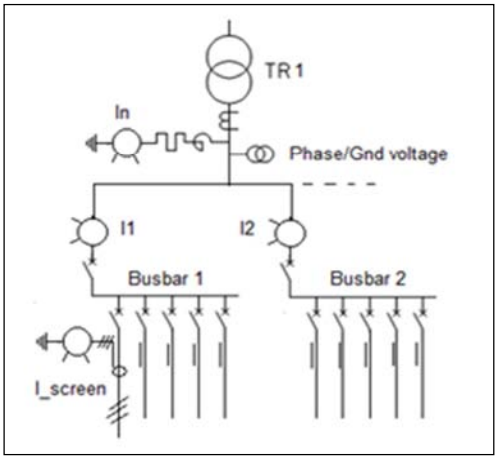

Fig. 1: General arrangement of measurement sensors

Figure 2 shows current sensors installed on the MV cables of the different feeders.

Fig. 2: Current sensors on cables