SYSTEMS FOR PROTECTION AND AUTOMATION OF DISTRIBUTION ELECTRIC NETWORKS 22 KV

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Annotation
This article deals with the new concept of fault location in overhead and cable 22 kV distribution systems, which are operated by ZSE Distribúcia, a.s.. In the past the localisation of faults was a demanding and lengthy procedure, because the electric protection indicated only the affected output feeder. The exact fault point was then localised by manipulation in the field and by test switching in the power line where the fault took place. The current development of electric facilities and sharp fall in prices give us the possibility to broadly apply the simple digital metering devices equipped with the electric protection function. Once these devices are positioned densely along the individual power lines of the network, it is possible to localise the failure position quite exactly and electricity supply can be quickly restored.

Keywords
electric power system, power system fault, earth-fault, electric protection

1 NEW CONCEPTION OF FAILURE LOCALISATION IN THE 22 KV NETWORK

The new conception of 22 kV network automation is based on a unified technology of telemetric units produced by ELVAC company. The main common feature of these telemetric units is the possibility to measure and evaluate the voltage and the current along the individual power lines, a simple semi-automatic fault location; as well as the possibility to analyse faults by means of oscillographic fault records, which are easily accessible. The main benefit of unification is the use of the unified firmware, and servicing and monitoring software, which simplifies the launch of operation of the new equipment, its operation and maintenance. There are the following individual projects of 22 kV network automation:

THE SYSTEM OF REMOTE FAULT LOCATION FOR CABLE NETWORKS 22 kV
The system enables metering of operational current and signalisation of fault current occurrence.

INTELLIGENT REMOTE CONTROLLED SUBSTATIONS 22/0,42 kV
The system enables remote controlling of selected power switches; gives information about the status of individual technological junctions, measures the operational current and signalizes the occurrence of fault current.

INTELLIGENT REMOTE CONTROLLED SECTION DISCONNECTOR
The remote controlled section disconnector, which also measures the operational electric values, equipped with protective functions signalizing the occurrence of the fault current. It is also equipped with an automatic trip function in case of unseccessful autoreclosing cycle.

AUTORECLOSER
The remote controlled circuit breaker, which also measures the operational electric values, equipped with protective functions enabling the selective disconnection of only those parts of power line, which is affected by fault, signalizing the occurrence of the fault current. It is equipped with autoreclosing function.

The simple scheme below shows the new concept of fault management and fault location in 22 kV cable networks (Fig. 1). The remote control (equipped with fault location function) is placed into the important junction substations (coloured red in Fig. 1) and approx. each second substation in the individual cable sections is equipped by the system of remote fault location (coloured yellow in Fig. 1). The fault current flowing from the feeding substation to the fault is recorded by the RTU7.4 units, the dispatcher of the remote controlled substation defines the section where failure occurs and subsequently, he solves the failure according to the information about the occurrence of the fault current. This lay-out provides high reliability of the network and optimizes the investment costs.

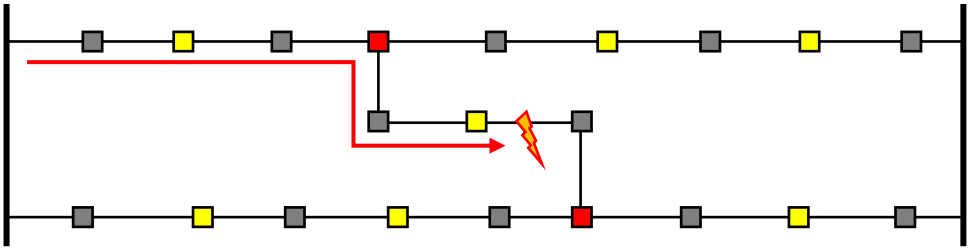

Fig.1 Failure management in the 22 kV cable network

The new concept of fault management and fault location in 22 kV overhead power lines is explained in the simple scheme (Fig. 2) below. It shows a normal overhead 22 kV power line with the circuit breaker in the substation (1). In the basic configuration the remote controlled disconnector (3) is switched off and the line is divided into two parts by the recloser (2). The main power line is equipped with the remote controlled disconnectors with protection functions, which only have a signalling function (4 and 5). At the beginning of the branches the remote controlled section disconnectors are placed, equipped with the fault current signalisation, as well as with the disconnecting function in case of unseccessful reclosing cycle (6 and 7).

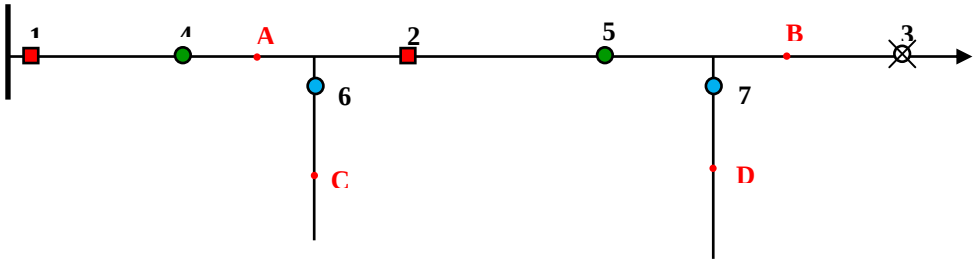

Fig.2 Failure management in the 22 kV overhead power line

2 PROCESS OF PROTECTIONAL DEVICES SETTING DEVELOPMENT

The following functions of electric protection are deployed in the telemetric units – overcurrent (two stages), directional ground-fault protection, conductance ground-fault protection. The setting of overcurrent electric protection is quite simple, because the interphase failures are manifested in the same way in all three-phase electric networks at all voltage levels. The correct setting of ground-fault protections is more complex, because the network behaviour during the single-pole ground fault needs deeper understanding, as well as the impact of earthing of a neutral point of the feeding transformer, the transient processes at the beginning and end of the ground-fault connection, and the determination of a failure resistance and ground-fault parameters of the network.

In order to fully understand the ground-fault failures we took the following steps – the theoretical analysis of the network, network modelling in the Matlab computer environment and measuring of the experimental ground-fault connections. According to the results of the analysis we set the ground-fault protections in the devices for fault location. In the following operation the real ground-fault failures were recorded and evaluated, the results have shown that the previous assumptions were correct and have given us the possibility to finally tune the ground-fault protections correctly in order to solve any failures in the network in the correct manner.

3 REFERENCES

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