

PREVENTING FAULTS IN A DISTRIBUTION NETWORK

Ing. František Rajský

ABSTRACT

The human factor is one of the main elements which can cause a fault in a distribution network. If we need a distribution network without any fault, we must improve the knowledge and skills of workers in any distribution system. The knowledge can be improved during lectures and skills during tutorials at school (University) and know-how can be improved by the employer. The tutorials must be focused on distribution simulators, excursions, special extension lectures.

PREVENTION

Otto's encyclopaedia says: "Prevention is a set of actions focused on preventing faults, damage and consequences caused by the human factor." Prevention can be theoretic knowledge of design, construction and control of a distribution system and parts of the network. For this reason we need closer cooperation between our faculty and power engineering companies. Our department has links with several companies, which give special lectures for students. The students who take part in those lectures get a good insight into power engineering practice, learn something about the company and can start cooperating with them.

FAULT IDENTIFICATION

Students know about fault identification from the subject "Electrical protection and power control alarm system." Lectures by company representatives are complementary to theoretical lectures. The new multimedia laboratory enables students to diagnose fault on the digital protection simulator.

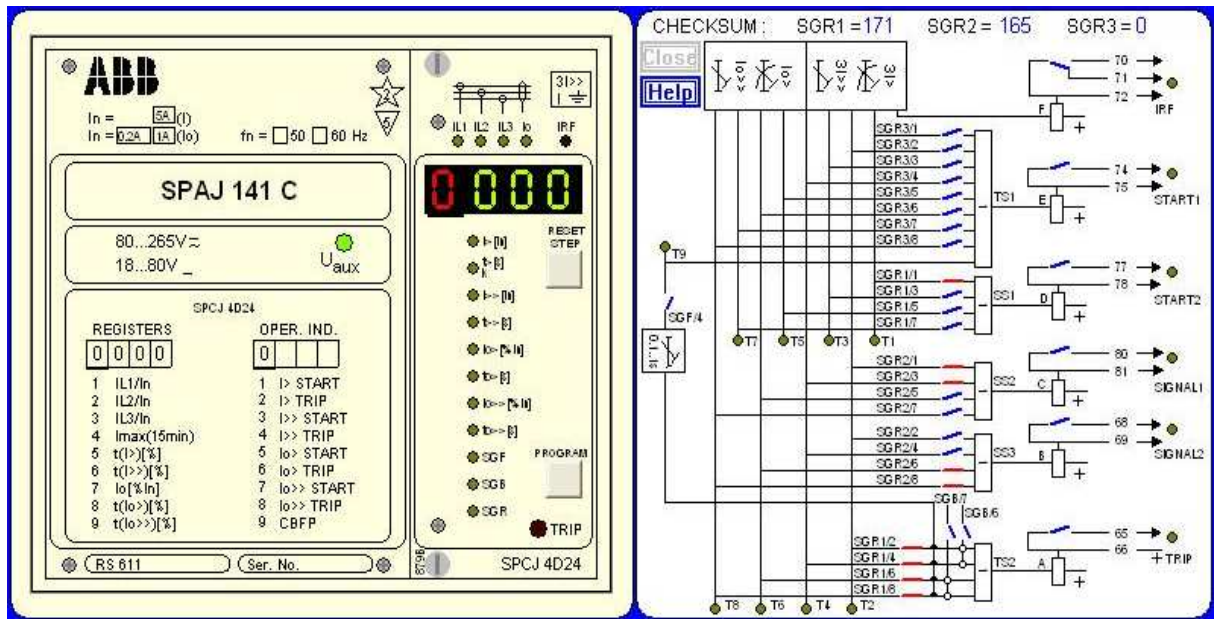


Fig. 1 Digital protection simulator

Fig. 1 shows the simulator of SPAJ 141 C digital protection where students can switch and change any internal logical connection.

The following figure shows the time behaviour of the short circuit current in all three phases and the time behaviour of the voltage during short circuit.

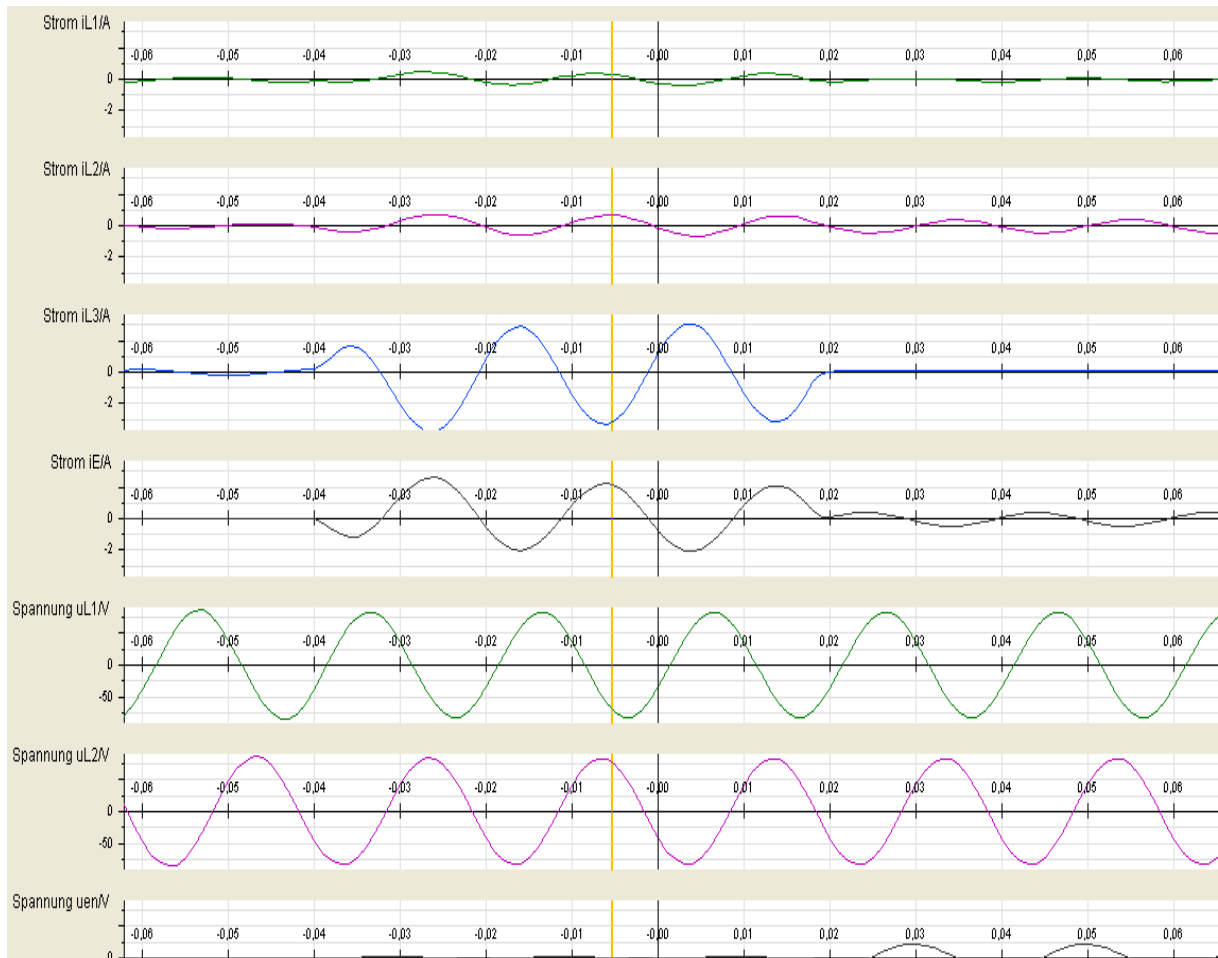


Fig. 2 Time behaviour of the short circuit

The short circuit is in its third phase. The figure shows 40 ms before the short circuit, 20 ms for protection calculations, 20 ms for circuit breaker switching and 50 ms after the short circuit breaker has switched off the transmission line. I chose three phase currents, one earth current, voltage in a healthy phase and earth voltage.

The third figure shows the Circular diagram, in the Czech Republic known as “Impedance characteristic”. Before the digital age protection deviance used relays with circular switching characteristic. The digital protection uses a modern angular characteristic, which is better for recognizing one phase and two phase short circuits.

The figure 3 show depicts impedances of all three phases. But only one phase is within the fault area which means the short circuit is in the third phase. The impedance passes from the first quadrant to the fourth quadrant which means that there is one phase earth connection. The line is 110 kV which means that there is the short circuit.

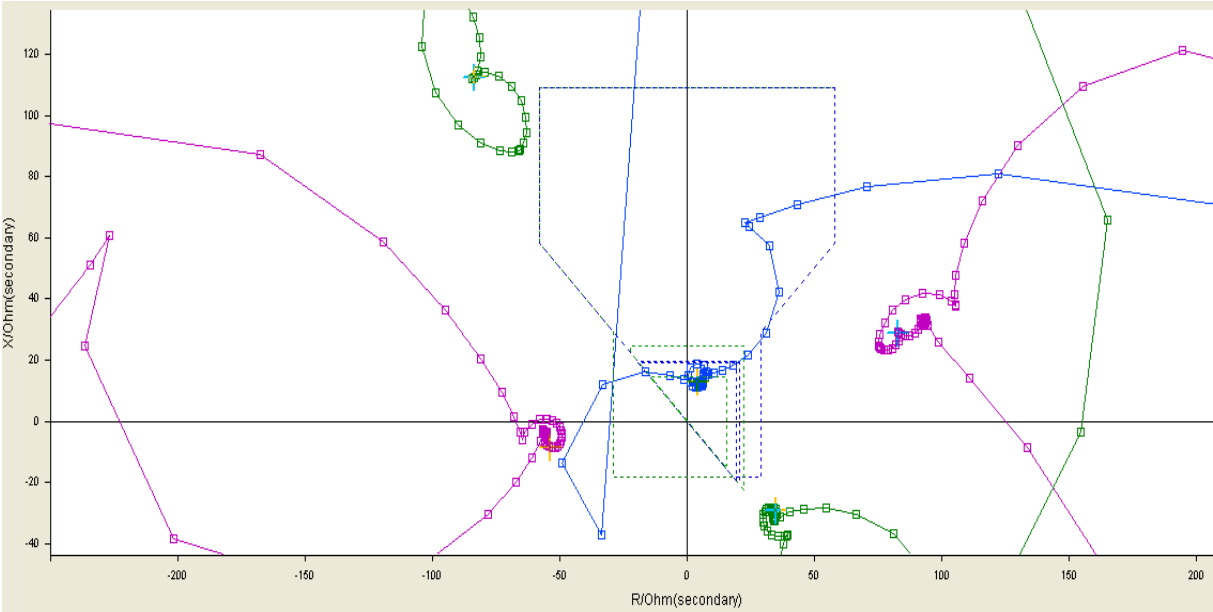


Fig. 3 Circular diagram

The next figure shows the probable fault place which is calculated from the current and the voltage at the beginning of the short circuit.

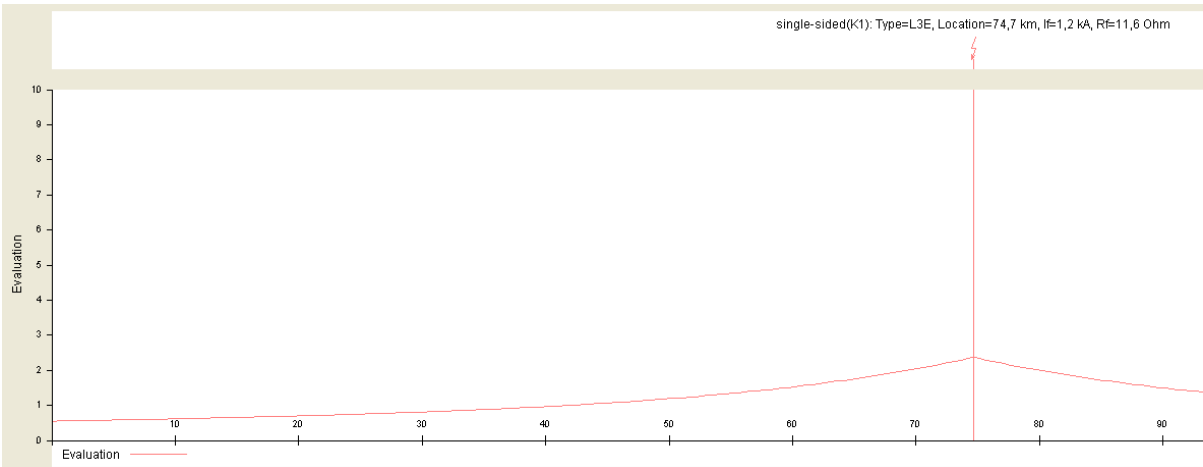


Fig. 4 Fault location

The following figure shows the frequency analysis during the short circuit. You can see harmonic, subharmonic and DC components of the current.

The frequency analysis is very important for the investigation into electrical energy quality.

All figures have been produced by the Siemens Company SIGRA program, the short circuit processes were provide by the E.ON Czech republic.

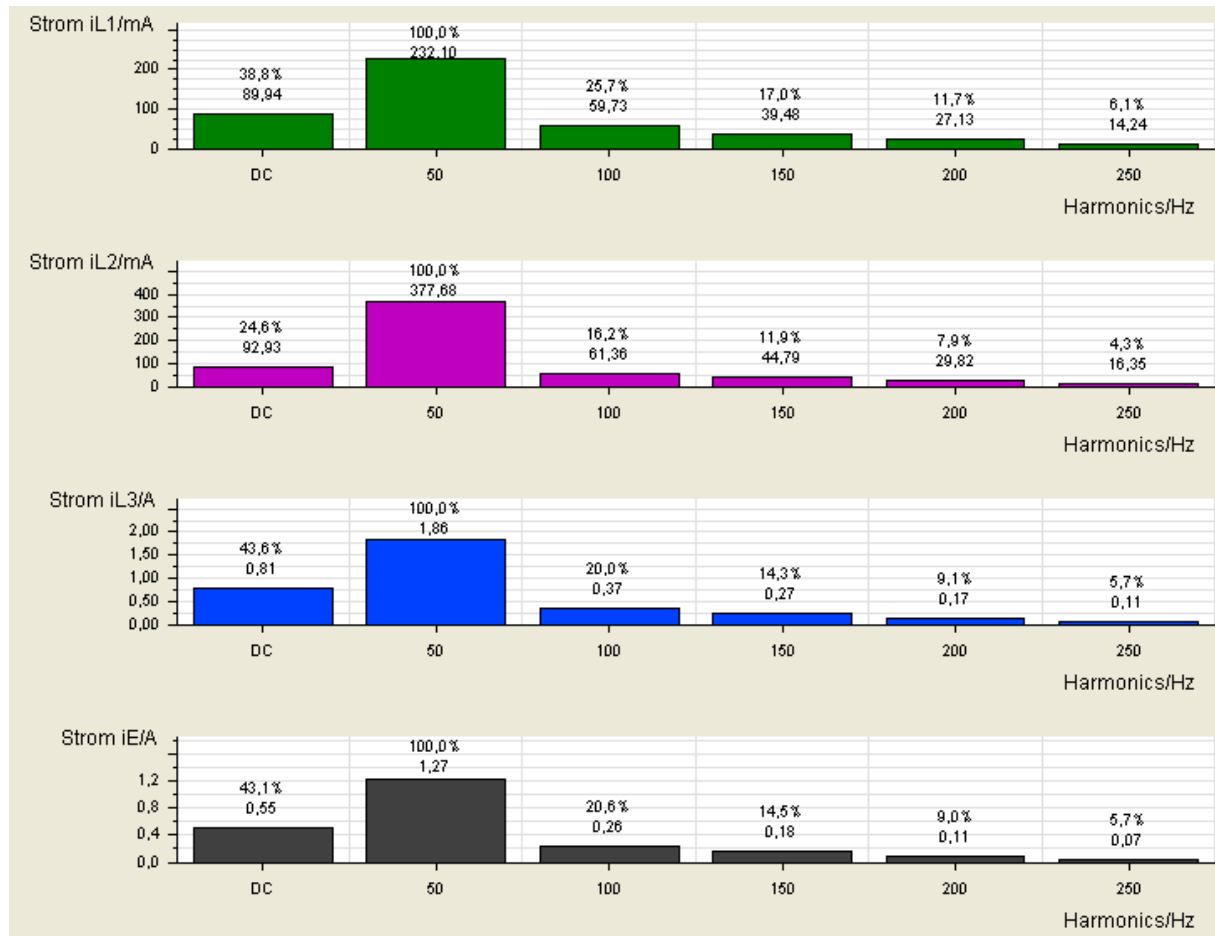


Fig. 5 Frequency analysis

CONSLUSION

The human factor is one of the main elements which can cause a fault in a distribution network. If we need a distribution network without any fault, we must improve the knowledge and skills of workers in any distribution system.

Excellent training of electrical engineer at University of West Bohemia is very important for successful prevention.

REFERENCES

[1] Rajský: Prevence poruch v elektrosoustavách vs lidský faktor. – EGU Praha 2007



Ing. František RAJSKÝ

PhD student at the University of West Bohemia in Pilsen,
Department of Power System and Environmental Engineering.

rajsky@kee.zcu.cz

Designer and build specialist in Chládek & Tintěra a.s. ,Litoměřice
Branch of Power Engineering and Traction company

rajsky@cht.cz