# Priorities of Faults on HV Lines

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**Abstract.** The paper solves issues connected with determination of priorities for faults occurring on 110 kV lines. The term "priority of fault" is explained, specific types of priorities as well as their classification is given.

**Key words.** Power line, preventive maintenance, faults, fault priority, work of operation

## 1. Introduction

For today's consumer, reliable and flawless operation of electricity network is a natural thing. However, for the distributing company responsible for safety and reliability of network, meeting this basic requirement is a complicated activity, which must be thoroughly organized and documented. Some of the necessary materials are: schedule of preventive maintenance for technicians to perform operations connected with operation, repairs, and fixing faults and break-downs; materials for possible renovation of the line (design draft), scheduling temporary shut-downs, or solving other unpredictable conditions on the line. The company has to follow the Regulations for distribution network operation. A detailed database of break-downs and faults, in this case on 110 kV has to be updated regularly. Such database is analysed in paper [1], while in this paper we want to outline the issues connected with determining priorities of faults and analyze the 110 kV line fault database with respect to priority of fault. Every fault or break-down recorded in the database is classified by different criteria.

## 2. Classification and types of priorities

The general criteria for determining "priority" is the time for which safe operation can be guaranteed on the basis of the condition of equipment and experience with the operation of DS equipment.

**Priority** – is determined by the magnitude of fault. Table 1 gives verbal expression of the scheduled repair of the fault (urgent, week, month, year, not urgent). With respect to selected priority the dates "Planned to" and "Performed to" for scheduled repair are generated [3].

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| Priority | Description | Use |
|---|---|---|
| **1** | **Urgent** | **Faults directly endangering safety** of persons, property and reliability of operation – public hazard, emergency hazard, frequent and extensive break-downs, deterioration of technical parameters over allowable limit<br>- Urgent alarm of the dispatching and an authorized LV, MV, HV technician |
| **2** | **Week** | **Faults not directly endangering safety** of persons, property and reliability of operation – great threat of frequent and extensive break-downs, major deterioration of technical parameters, distinctive hazard of normal durability<br>- **Immediate (not later than the following day)** inform an authorized LV, MV, HV technician |
| **3** | **Month** | **Faults not directly endangering safety** of persons, property and reliability of operation – hazard of local break-downs, deterioration of technical parameters or decrease in durability<br>- Record in the system **not later than 30 days** after detection |
| **4** | **Year** | **Faults not directly endangering safety** of persons, property and reliability of operation – **hazard of** deterioration of technical parameters or decrease in durability<br>- Record in the system **not later than 30 days** after detection |
| **5** | **Not urgent** | Faults which do not influence the safety, reliability, or technical parameters, but which can decrease durability of equipment<br>- Record in the system **not later than 30 days** after detection |

*Tab.1. Types of priorities*

With respect to possibility of a break-down caused by a fault, it is recommended to set realistic fault priority. Increasing fault priority is not appropriate, as it could affect fault rate, safety and reliability of DS operation. For example, for faults with 4.5 priority the recommended procedure is to plan the date, or set the date for repair on the day of the nearest scheduled maintenance of the line in question as per Preventive Maintenance Schedule.

The priority is **determined** by the authorized technician of the maintenance section of a LV, MV, or HV line who detected and recorded the fault. The technician will make a written record of the detected fault which must clearly reflect the actual extent of fault on the equipment and the reason for determined maintenance. The proposed priority is **confirmed** by the Control division technician on the basis of presented evidence.

For assessing priority by diagnostic measurements and inspections, a record of measured values must be enclosed and the condition of equipment has to be evaluated.

In case of doubts about assessed priority, a Control division technician decides upon the re-classification after the checking of the actual condition of equipment.

## 3. Analysis of a fault database by priorities

The fundamental document for the assessment of the technical condition is the fault database. When the line is not overloaded, the load of the line does not affect the technical condition.

Unlike in the former analysis of a fault database [2], for the assessment of the technical condition of a line the faults must be processed with respect not to "amount" but to "importance". For instance, one fault indicating deteriorated technical condition of the whole line is more "important" than a few dozen of "minor flaws of each pole (e.g. a missing hazard notice)". Such assessment uses updated fault database from the period 5/9/2007 – 10/6/2011, altogether 1460 faults.

Fault priority is a very important piece of information, because it determines the time in which the fault must be corrected. After discussions with the distribution company workers, we use "classification" of faults with priorities allocated with respect to their importance (Tab. 1). The numbers of faults with different priorities are in Fig. 2.

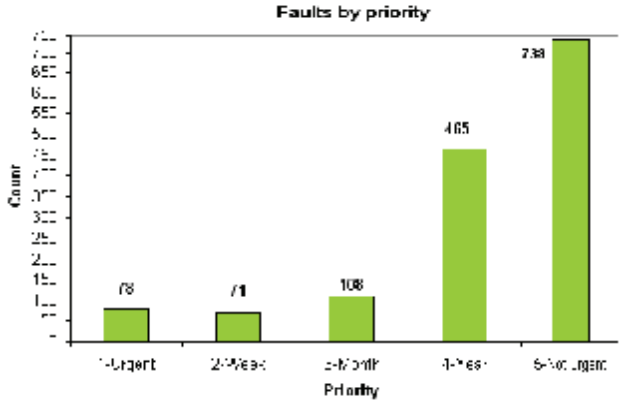


*Fig.2. Number of faults with priorities*

The graph (see Fig. 2.) shows that more than 80% of faults can be solved within a year and only a little over 5% must be solved promptly.

The following graphs represent a more detailed classification of faults in individual priorities. The classification respects the code (type) of failure – the codes are *MECH-FAULTS* for mechanical fault, *PROT-ZONE* for a fault in a protected line zone, *ELEMENT, PROT-EARTH* for protection – earthing, *MARK* and others form the group of 7 groups of codes. Furthermore, the element of the fault is specified [5] e.g. *Earth wire*, *Insulator*, *Wire, Support point*. Each fault code comprises exact enumeration of several possible faults. In simple terms, it is an IDF number of a fault.

For the illustration and purpose of this paper, only graphs with priorities 1, 2 and 3 were selected (see Fig. 3, 4 a 5). These are faults which must be solved as late as 30 days from their detection.

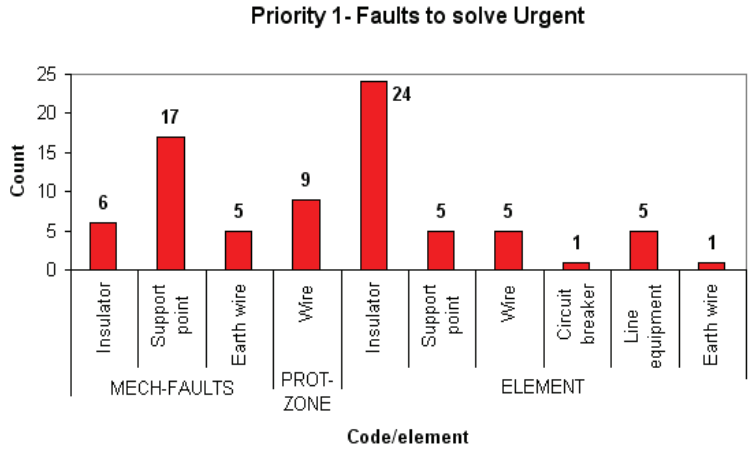


*Fig.3. Priority 1- Faults to solve promptly*

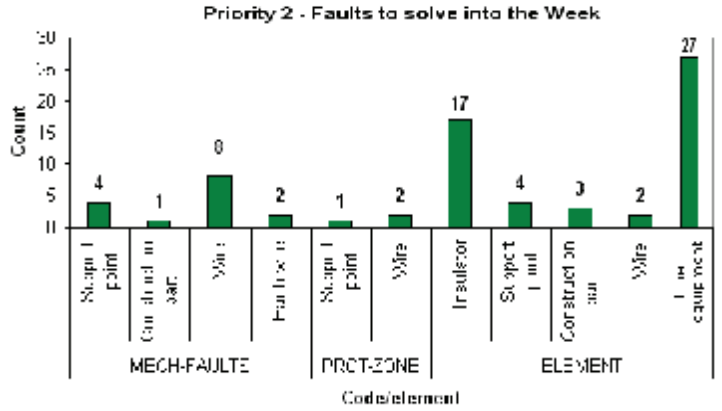


*Fig.4. Priority 2 - Faults to solve within a week*

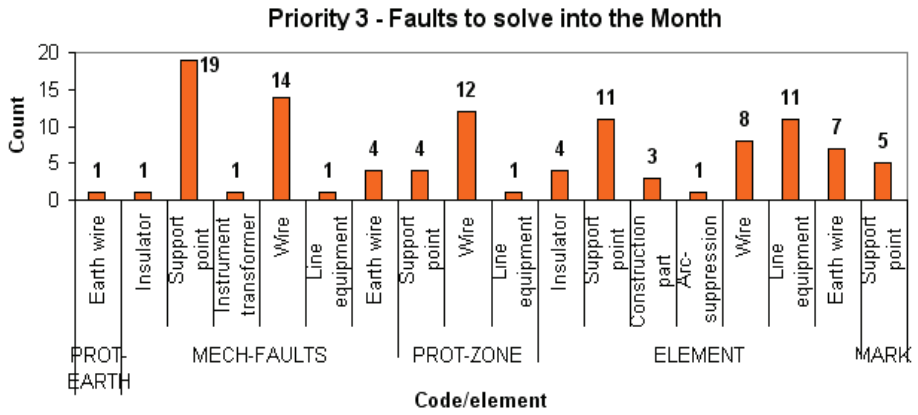


*Fig.5. Priority 3 - Faults to solve within a month*

As the graphs show, the codes (types) are in all priorities. Graph 6 shows total numbers of faults on particular elements which arose in all types of priorities.

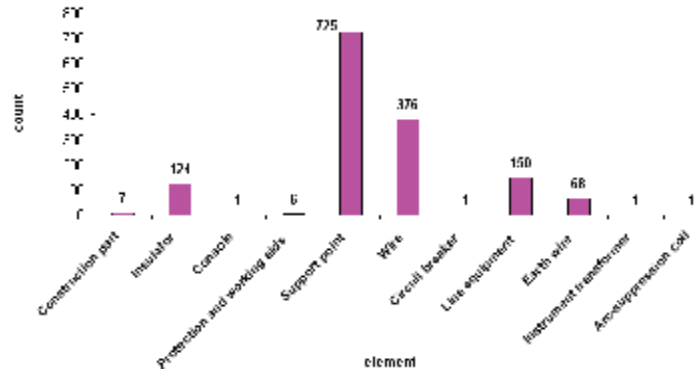


*Fig.6. The total number of faults on elements*

## 4. Assessment of faults with influence on HV twin line

The evaluation of the description will be necessary also at the detailed analysis of faults with respect to their effect on the line [4]. The faults affecting one line must be differentiated from those affecting both lines. The design of such classification which draws only upon the code of event is in tab. 3. Later on, a more detailed analysis of descriptions of individual faults will be necessary.

| Code fault | Problem | Total |
|---|---|---|
| PROT-EARTH | Damaged, insufficient earthing | 22 |
| total from PROT-EARTH | | 22 |
| MECH-FAULTS | Small mechanical fault | 92 |
| | Corrosion, poor paint | 141 |
| | Mechanical damage | 99 |
| | Unsecured transformer against moving | 2 |
| | Damaged base PB | 200 |
| | Rotten, cracked, damaged PB | 13 |
| | Bad mechanical protection | 3 |
| | Bad attachment cable, pipe, .. | 1 |
| | Leaning PB | 52 |
| total from MECH-FAULTS | | 603 |
| PROT-ZONE | Foreign object in the line | 13 |
| | Impaired protection zone | 7 |
| | Failure distance wires | 8 |
| | Slack wires | 27 |
| | Trees, branches in the line | 276 |
| total from PROT-ZONE | | 331 |
| MARKING | Missing warning marking | 46 |
| | Missing, wrong, unreadable marking | 80 |
| | Missing tables, barriers, covers, counters | 10 |
| total from MARKING | | 136 |
| ELEMENT | Irreparable element (exchange) | 61 |
| | Damaged bushing, insulator | 57 |
| | Damaged element | 210 |
| | Heated eye, clamps | 40 |
| total from ELEMENT | | 368 |
| total faults | | 1460 |

*Tab.2. Breakdown according to the influence of faults on single or twin lines*

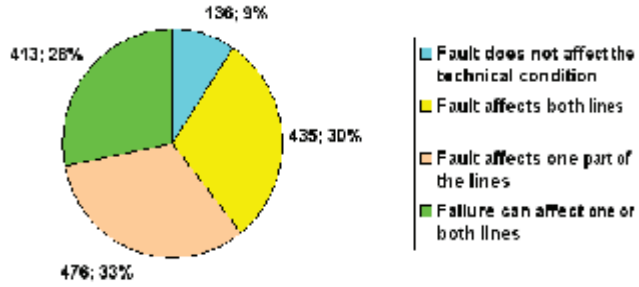


*Fig.7. Graph of faults by the ability to affect one or both lines*

## 5. Conclusion

The paper solves issues of assessing fault priorities on 110 kV lines. Types of priorities and their characteristics are given and explained, and then a fault database on 110 kV lines is analysed with respect to the fault priorities. The graph in fig. 2 shows that 32% of faults are not urgent, more than 51% of faults can be solved within a year, 7% within a month, 5% within a week, and something over 5% must be solved urgently. Finally, a classification of faults by the code (type) with respect to the possible effect of a fault on the lines of a 110 kV double line was designed. Graph 7 (Fig. 7) shows that 30% of faults affect both lines, 28% can affect one or both, 33% affects only one or the other, and 9% does not affect the technical condition of a 110 kV twin line at all.

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