NECESSITY OF STANDARDIZATION TO DETERMINE THE FAILURE RATES OF THE ELEMENTS OF THE NETWORK

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ABSTRACT
This paper describes the model used for taking network element failures into account in Power System Planning at Endesa and the necessary data. The second part describes the difficulties found when obtaining them, due to the data gathering process and due to the scope considered. It concludes with the necessity of standardization of the kind and scope of failures on the network, to be able to compare the results.

INTRODUCTION
The classic planning of Power Systems is based on the detection of problems in the network, given a scenario (generation/demand) and a set of deterministic criteria (basically the N-1 criterion). Subsequently, plans of action are proposed in order to solve these problems.

In situations of limited resources, when it is neither possible nor reasonable to initiate all the investment proposals, analysis more refined are carried out to quantify and rank the problems in severity order. These kinds of analysis require quite more data than the traditional methods.

PROBABILISTIC PLANNING
Probabilistic planning models are those which take into account the probability of the events that originate unavailability of the elements of the network. In this way, the effects of contingencies on the quality of service can be estimated, using a model to quantify the impact of each contingency, and the problems prioritized.

Non-Served Energy Model
The model we use at Endesa to rank contingencies takes into account the expected non served energy, as given by Eq. 1.

\[
Q^* = E(NSE) = \frac{TF \times DMF}{8760} \times \int_0^{hr} (D(t) - Pf) \, dt
\]

Where the expected Non Served Energy is given by
+ TF - rate of failure of the element considered
+ DMF - the mean failure duration of the element considered
+ Pf - the capacity available in contingency situation of the element considered
+ D(t) the demand (D(t))

The following figure represents the application of the model in a generic case:

Figure 1: Non-Served Energy Model

The higher line represents the normal capacity of the system. The lower line represents the maximum capacity in a contingency event. The area between the demand curve and the lower line, gives the maximum non served energy possible, which multiplied by the probability of occurrence, gives the expected non served energy.

Random Variables
The model complicates when we take into account the fact that failure rates and mean durations are random variables.

The probability density function of the failure rate can be approximated by a normal distribution. In this case, we have to determine the mean and the variance of the distribution.
Sources of Data
In conclusion of the two previous points, the use of probabilistic planning methods requires quite more data than the classic contingency analysis, and from different sources.

The demand (D(t)) is obtained from the metering department with the necessary detail.

The capacity in contingency situation is obtained from the classical load flow and contingency analysis.

The procedures to obtain the previous data, which are complicated per se, go beyond the scope of this paper.

The rate of failure and duration of events come from the asset management system of the company.

FAILURE RATE CHARACTERIZATION
As we have seen in the previous point, the analysis requires quite a lot of data that has to be obtained. Taking for instance the failure rate, it is obtained directly from the analysis of the incidents that happen on the network, classifying them according to the kind of network element and voltage level.

If we take the results directly, without any additional considerations, we find that the results are very disperse, with differences that amount up to 30:1, when we compare the values obtained in the different companies that form the Grupo Endesa.

This dispersion cannot be explained by the fact that the rate of failure is a random variable with a normal distribution, which motivated a further study of the reasons behind this dispersion.

The analysis of the data used provided two kinds of problems which led to the dispersion of the results:

+ The first kind was errors in the introduction of data in the systems due to the great number of people involved in the process (over 64,000 incidents analyzed for the year 2008). The principal errors detected were incorrect times of the events (beginning time, finishing time), and several data checks were proposed to avoid this kind of effects in the future. Nevertheless, this kind of errors accounted only for un 2.5% of the cases, and the high dispersion still stands, even after the filtering out of this events.

+ The second and most relevant kind of errors were the different scopes of the definition of the responsible element for a given incident. In order to avoid this kind of errors, we concluded with the necessity to standardize the procedures used to count and assign the failures to the elements, in order to be able to compare data obtained from different sources.

In the end, we conclude with the necessity to create a working group to address the definition of the kind and scope of all failures in the electric network.

REFERENCES