Determining the Pattern of MV Overhead Line Failure Rate Using Poisson Regression

Amin Moradkhani
Ilam University
Ilam, Iran

Mohammad Rahimkhani
Ilam Electric Power distribution Company
Ilam, Iran

Abstract—**Improving reliability of the distribution system has necessitated the inclusion of considering precise assumptions in reliability study. Analytical methods of reliability assessment use constant reliability parameters which are not appropriate for real power distribution components and can give misleading guidance in designing and planning the distribution system. In this paper, Poisson process is used to analyze a failure history of overhead medium voltage feeders to determine their failure rate pattern. Through this method, some descriptive graphical techniques are used to evaluate the time varying failure rate. The functionality of this technique is tested on a four-year failure data of 38 overhead MV feeders of West Tehran Province Power Distribution Company. The results show that failure rate of overhead MV feeders are not constant, and an annual cyclic pattern with increasing linear trend exists in failure's data.**

Keywords-failure rate; distibution overhead line; Poisson regression;

Nomenclature

λ	the constant rate of failures' incidence
β	a vector of unknown regression
μ	Mean
$N(t)$	The cumulated number of failures from
Y_t	Number of failure in month t
Y_{t+h}	Number of failure with distance h from t
h	Distance or lag
K	the number of estimated parameters
L	Likelihood value of estimated model
$f(\cdot)$	Distribution density
$P(\cdot)$	Periodogram
$\Gamma(\cdot)$	Gamma
$\gamma(\cdot)$	Autocovariance
$\rho(\cdot)$	Autocorrelation

I. INTRODUCTION

Electric distribution systems are responsible for a large percentage of electricity costs and the vast majority of customer interruptions. Most failures of medium voltage distribution components results in the interruption of end customers because of the radial configuration of systems and typically, a large number of customers are influenced [1]. Furthermore, as an outcome of deregulation and restructuring of the power distribution utility pressure increased on electric utilities to maintain and enhance the reliability of their power distribution networks. So, reliability assessment is of primary importance for planning distribution systems.

Distribution system reliability assessment methods have been typically considered to fall into three categories: analytical [2], Monte Carlo Simulation [3-4] and combination of these two methods [5]. The failure and repair rate parameters used in analytical methods are generally supposed to be constant. The assumptions to constant failure and repair rate designate that the time to failure and the time to repair have exponential distributions. however, The exponential distribution is mainly tractable and facilitates the reliability calculations , but the assumption of a constant failure rate can result in poor system models [6]. The basic assumption for the constant failure rate is that component operates in its useful life period and under the normal operating condition. Reliability indices calculated based on the constant failure rate have been widely used in the long- and medium-term planning and have been proved feasible. The techniques and software for off-line reliability evaluation and planning have been well developed[7].

To evaluate the distribution system reliability, obtaining a proper model for failure rate of distribution components is an important aspect [8]. Most of the methods regarding the reliability problem until now, consider the constant failure rate which is in contrast with the realism distribution feeders particularly overhead ones. Overhead equipment is exposed to weather and in severe weather circumstances the failure rate of a component could be significantly larger than that in the normal weather circumstance [9-10]. Furthermore, failure occurrences in the distribution system depend upon a number of factors, containing component type, size, design, age, operational characteristics, preventive maintenance activities and geographical location. No guarantee would be devoted for a randomly component failure, if this takes part the times between failures are independent and identically distributed (iid), that will follow the exponential distribution, and the result would be a constant failure rate.

In [11], the impact of time-varying failure rates on distribution reliability has been assessed by Monte Carlo simulation method. They assumed failure cycle of component follows the bathtub curve pattern and the failure rate varying at the lowest level of resolution by estimating any long-term trend