

While an electrical power system is one of the more complex and important systems ever built by human civilization; the protection system is not less complexity. The situation is aggravated by the increasing complexity of protection schemes and the use of digital relays containing software for the management of the different operating conditions of power systems. Digital relays are a result of the application of microprocessor technology in the protection industry. These relays are in an extensive use in modern protection schemes and are also a very active area of research. A particular emphasis has been given to the development of algorithms that allow obtaining the most accurate decision in the fastest way. Besides, the low reliability level of digital relays is regarded as a dark point that hovers about them and considered as major worry stated by many specialists in the field of power system. The work reported in this thesis has made the following contributions : -An exhausting review which resumes the main highlights in protective relay's developments and trends. -An enhanced algorithm based on the theory of harmonic analysis to discriminate between the internal fault and the inrush current created during the switching of the power transformer. The simulation results of the proposed differential relay gave very satisfactory results in term of discrimination as well as in term of rapidity (operating time). - A new algorithm for numerical overcurrent protection of induction motors. The effectiveness of our developed model was proven by comparing its behaviors versus different abnormal situations with various inverse time characteristics normalized by the IEC standard. - A comprehensive analytical approach for assessing and improving the reliability of digital protective relay has been presented. After identifying the common cause failures; the fault Tree method has been used to analyze and quantify the failure rate, the reliability as well as the lifetime of DR. The results of the proposed methodology reveal that the failure rate is reduced by 25 %, the reliability is significantly improved and the lifetime is extended by more than 30 %