CHAPTER ONE:

INTRODUCTION

1.1. Background:

Electric power distribution systems are responsible for delivering the electrical energy from the bulk power systems to the end users. Issues such as radial operating status, aging infrastructures, poor design and operation practices and high exposure to environmental conditions have caused the electric power distribution systems to be addressed as the main contributor to the customer reliability problems. Generally, about 80 to 90 percents of the customer reliability problems are originated from the electric power distribution systems [1, 2]. Electric utilities have traditionally improved the distribution system reliability through simple measures such as tree trimming on a regular basis, construction design modification, installation of lightning arresters, use of animal guards, replacing overhead bare conductors by covered conductors or underground cables, protection scheme modification, and so on [3]. In addition to these conventional solutions, there is some other advanced reliability improvement measures that nowadays are categorized as smart grid technologies. Major smart grid technologies applicable for distribution system reliability improvements are fault passage indicators, fault locator schemes, substation automation, feeder automation, distribution automation, fault current limiters and dynamic voltage restorers.

Availability of the various reliability enhancement solutions is both an opportunity and a challenge for electric utilities. They have an opportunity to find the right solutions for their own reliability problems. But, each electric utility is different from another one and has its own set of failure causes for distribution system problems. In addition, the design history and the network

configuration have large impacts on the specific solutions to be selected. Therefore, the challenge for electric utilities, especially in the competitive electricity market, is to identify and evaluate potential reliability reinforcement schemes and then determine and prioritize those appropriate for implementation. This procedure is usually referred to as the value-based distribution system reliability planning. In order to perform the value-based distribution system reliability planning, it is necessary to use a suitable reliability assessment tool. This tool should quantitatively predict the various impacts that the targeted solutions may have on the reliability of electric power delivered to the customers. The simple conventional solutions are reliability enhancement measures that mainly affect the failure rates of the components of an electric power distribution system. As an example, consider an electric utility which aims to assess the reliability impacts of a tree trimming on a specific area of its distribution network. In this situation, the reliability impacts of the tree trimming can be evaluated by available reliability assessment approaches. The effects of the tree trimming is modeled by appropriate manipulations of the failure rates of the components located in the targeted areas for the tree trimming. However, the electric utilities face a challenge when the reliability enhancement solutions include sophisticated measures such as those of the smart grid technologies. As an example, an electric utility may aim at comparing the impacts of various available feeder automation schemes on the reliability performance of its distribution system. The reliability impacts of the automation solutions normally depend on their operational procedures. In addition, when an automation scheme encounters with an operational failure condition, its reliability impacts deteriorate compared to the situation when it is fully available. Therefore, it is necessary to model both the operational procedure of the targeted automation solutions and their possible operational failures when conducting the related reliability assessment studies. However,

the available reliability assessment approaches cannot be employed directly for such purposes. In a circumstance like this, it is necessary to develop a reliability evaluation approach for predicting the reliability performance of the electric power distribution systems when employing such sophisticated solutions [1].

1.2. Statement problem:

The primary function of modern electric power system is to supply the customers with electrical energy as economically as possible and with an acceptable degree of reliability. Modern society, because of its pattern of social and working habits, has come to expect the supply to be continuously available on demand. This degree of expectation requires electric power utilities to provide an uninterrupted power supply to their customers. Most of the interruption in distribution network has been caused due to tree contact, animals, equipments failure, wind storms, vehicle accidents & … etc. Hence it is necessary to improve the reliability of the system in order to improve the utility's performance and to keep our valued customers satisfied.

1.3. Objective:

The main objective of this thesis is to reduce the radial distribution feeders interruption in Khartoum North distribution area. Its main aim is to determine system reliability and customer satisfaction. The Assess, Evaluate and Compute reliability indices of the existing system 11 KV of Khartoum North City, using available reliability tools and suggests further improvements for the radial distribution feeders shall be discussed.

1.4. Methodology:

In these thesis reliability indices are used to assesses the reliability of Khartoum North distribution area in four steps which are:

STEP 1: Collecting operation reports of Khartoum North distribution area from distribution control center from the period 1/1/2014 to 31/10/2014.

STEP 2: Collecting the data of Khartoum North distribution area components from G.I.S department in SEDC.

STEP 3: Investigate the Khartoum North distribution area and making analysis of the causes of interruptions in the studied area by visiting the feeders routs and using G.I.S. software.

STEP 4: Improving the network of Khartoum North distribution area by using three scenarios of improvement which are : (installing sectionalizing devices in all 11KV over head line radial feeders, Removing the uninsulated conductor wires of the all radial feeders 11 kv & changing it with insulated wires 11kv,Changing the configuration of the overhead line radial feeders to underground cable system) , then estimate the customer reliability indices by using a computer program (G.I.S. & MATLAB soft wares) for calculations.

1.5. Thesis Layout:

The contents of this thesis are organized into six chapters. After this introductory chapter, Chapter two provides a brief description of distribution system reliability. Chapter three presents the operation of auto recloser & sectionalizer.
Chapter four described the distribution feeder automation. Chapter five described the improvement of radial distribution 11KV system of Khartoum North city. Chapter six draws the conclusions and recommendations for future research.