EFFECT OF VARIOUS LOAD ON POWER SYSTEM PROTECTION

SUN RUIHAO

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To my beloved mother and father

谨此献给含辛茹苦的，我所爱的父母

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ABSTRACT

This project established a reclosing simulation mode on 161kv line with bilateral power source of regional network based on PSCAD, and to do the simulation when the different types of fault occur on the various load condition. On this basis, analysis for the different types of fault occur is done, and effect of various loads of the protection devices in the power system is studied. The key point analysis focused on the effect of residue voltage produced from the induction motor load in case of the transient fault and permanent fault occurred on the transmission line separately.

This thesis has analyzed the changing rule of the residual voltage produced from the induction motor when the faults occurred. Hence, a proper reclosing time was identified, and a better control system, which able to improve the residual voltage on the power system protection, was proposed.

ABSTRAK

Projek ini bertujuan untuk mensimulasikan sumber kuasa elektrik rangkaian serantau dua hala 161kV dengan menggunakan PSCAD. Kajian ini adalah hasil simulasi mod “reclosing” pada sistem talian penghantaran 161kV ke atas jenis keadaan beban yang berlainan. Simulasi ini juga mengesahkan pelbagai kesilapan atau kegagalan yang mungkin boleh berlaku kepada sistem. Oleh itu, analisis ini dibuat berdasarkan pelbagai kesan beban peranti perlindungan dalam sistem kuasa. Analisis tertumpu kepada kesan voltan yang dihasilkan daripada beban yang berdasarkan motor induksi dalam kes kesalahan fana dan kerosakan tetap yang berlaku dalam talian penghantaran secara berasingan.

Tesis ini telah menganalisis perubahan peraturan voltan yang dihasilkan daripada motor induksi apabila kesalahan berlaku. Oleh itu, masa yang sesuai untuk “reclosing” telah dikenal pastikan. Selain itu, sistem kawalan yang lebih baik, di mana dapat meningkatkan voltan baki perlindungan sistem kuasa, telah dicadangkan.

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LIST OF ABBREVIATIONS

Ea	-	Voltage Source
Ia	-	Current phase a
UV	-	Under-Voltage
OV	-	Over-Voltage
TEF	-	Transient Energy Function
KV	-	Low Voltage Element
KY	-	Synchronous Element
AAR	-	Auto-Recloser
MATLAB	-	Math Lab
W	-	Motor Speed
CSMF	-	Continuous System Model Function
FFT	-	Fast Fourier Transform
MAG	-	Magnitude
PH	-	Phase
PSCAD	-	Power System CAD

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CHAPTER 1

INTRODUCTION

1.1 Background

Electrical energy is the most popular form of energy due to it can be transported easily at high efficiency and reasonable cost [1]. The modern power of engineering consists of three main subsystems, which are generation, transmission and distribution. In order to provide the electrical energy to consumer in usable form, the transmission and distribution system have to be satisfying some of the basic requirements, which are shown as below [2]:

i. Provide the power consumers needed for all the time.
ii. Maintain a stable and nominal voltage that does not vary by more than +10%.
iii. Maintain a stable frequency that does not vary by more than +0.1 Hz.
iv. Supply energy at an acceptable price.
v. Meet the standard of safety.
vi. Follow the environmental standards.

Transmission line in power system is an important component, where it is used to transmit the power. The operation experiences the power of system shows that the faults occurred on transmission lines are mostly transient; hence the automatic recloser is widely used in transmission line. It is a very important equipment to guarantee the security of operation power line and improve the reliability of power supply. Besides, it is an effective method to improve the stability and reliability of power systems. However, the present auto-recloser technique normally employs a prescribed reclosing time, which is the breaker will be re-closed after a fixed period following a tripping operation.

In the industrial production sectors, medium and large induction motors have been widely used, often used as an important auxiliary production. Its capacity can reach up to thousands of kilowatts, no matter the operations can reclose or cannot; all the consequence can affect the entire production process. Once the electrical outage for any reason, it will cause great loss of production [1-2].

In practice, when the transient fault occurred, the produce of the short-term depression on power supply, which led to the protection device tripped, and make the loss of motor power is a common phenomenon. Luckily, this failure is usually temporary, and let the motor rapidly recover the power supply after short-term outage; hence the production loss can be reduced. This requires a temporary reclose after troubleshooting operations to ensure the normal operation of the motor [3-5].

The various components constitute in the power system, the transmission lines have a wide working area and can support a variety of natural conditions and the rate of failure is the highest in all electrical equipment. Therefore, the protection of normal transmission line operation is an important task in the power system. The installation of auto-recloser is to ensure the rapid restoration if necessary, and to protect the circuit during normal operation.

1.2 Problem Statement

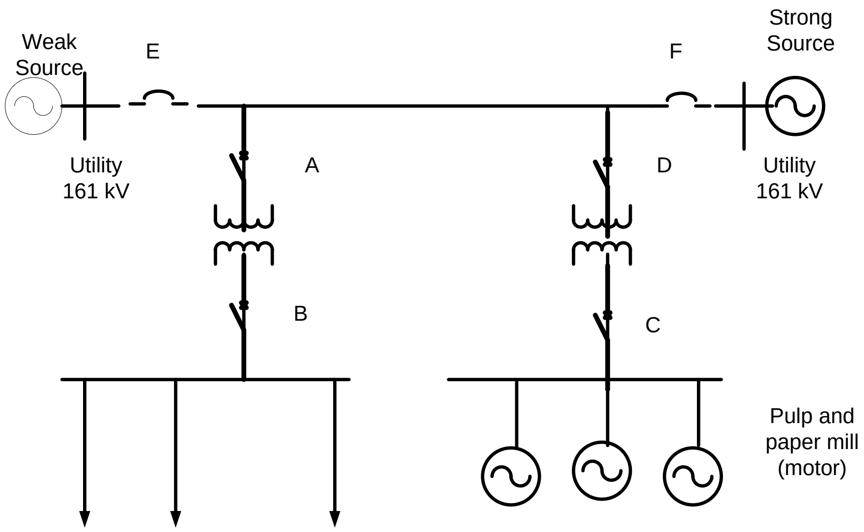

Figure 1.1: The typical load on transmission line network

With reference to Figure 1.1, points E and F are circuit breakers which are installed with protective device, first to assume there without motor load, when faults occur on the transmission line the utility protective relays at each end detect the fault and initiate tripping of their respective breaker. Breakers E and F will trip. Protection device at E will operate in the dead line live bus condition, followed by F. After the protective device E operates, the transmission line become live, the protective device F will be reclose during this condition.

In reality, there are large motor loads connected to transmission line. When the faults occur in the transmission line, the supply is removed from an induction machine, flux is trapped in its rotor. This flux decays with time and produces a residual voltage in the machine windings until its rotation ceases. Residual voltage can decay in a few cycles in small machines but may require up to five seconds in larger machines. Higher inertia machines will tend to act as generators feeding the lower inertia machines on the bus such that the entire group decays together. Means that the motor load will become generator which supply power to grid. The power will be supplied from strong source to weak source, so the problem is to optimize the protective device setting in the system, which can work normal conduction in live line live bus condition.

1.3 Objective

The objectives of this study are:

(i) To study the performances of protective device operate safely and successfully during various load condition.

(ii) To study the residual voltage generated by induction motor.

(iii) To propose some protection elements to decrease the effect of residual voltage on power system.

1.4 Scope

The two main goals of a transmission line protection scheme are to successfully clear faults and to successfully reclose the circuit once when fault has been cleared. The chances of success are greatly reduced in the presence of significant induction motor load. The presence of motor load, can affect the system protection, so must proper scheme adjustments could be made.

The scopes of the project are as below:

(i) The various load condition effect on the transmission line reclosing will be studied.

(ii) In this project, the protection elements setting will be considered.

(iii) The modeling and simulation using power system CAD software.

1.5 Thesis Outline

First chapter is briefly introducing protective devices which are used in transmission line and a general idea about the project. This chapter discusses about the main objectives, scope, problem statement and describes the project methodology that will be used.

Second chapter is written based on the finding from literature review. This chapter elaborates about protective device used related with induction motor of transmission line, and the residue voltage generated by induction motor. It is about the basic theory or general topic related this project.

Third chapter is mainly discussed the methodology and the background of the project.

Fourth chapter is to describe the simulation and results of the design using PSCAD consist of the components.

Fifth chapter is the conclusion and also the last chapter concludes the project and highlights some of the recommendation to improve the project.

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