

## CHAPTER 5

### CONCLUSION

#### 5.1 Introduction

Chapter one introduces low impedance restricted earth fault protection and the difference between low impedance and high impedance restricted earth fault protection. As mentioned, this dissertation focuses on the restricted earth fault protection in the power transformer. Chapter two discusses on restricted earth fault protection and its details. Also in chapter two the important grounding in the star point for restricted earth fault protection is described. Chapter 2 furthermore investigates five algorithms of restricted earth fault protection in numerical relays.

Inrush current and over excitation is investigated in chapter three. These two phenomena influence the restricted earth fault relay operation. Also how to distinguish fault current and these phenomena is investigated. Moreover, five low impedance restricted earth fault algorithms are studied. Advantage and disadvantage of each algorithm is scrutinized. Finally, two better algorithms are chosen for simulation.

Siemens and GE algorithm are chosen for simulation by using MATLAB Simulink software in chapter four. Three conditions including normal condition, in zone fault and out of zone fault for each algorithm are studied. Simulations prove that each algorithm in these three conditions work perfectly.

#### 5.2 Conclusion

For the comparing the two best algorithms, GE and Siemens, the following conclusion can be drawn:

GE algorithm is based on sequence components and with summation of these components GE calculates differential current and restraint current. Siemens algorithm is established on vectorial summation for calculating differential and restraint current.

GE algorithm makes restraint current using sequence components. Also the restraint current decays exponentially. This makes relay stable at out of zone conditions. This algorithm has a good security at second and fifth harmonic current components. But, GE relay algorithm needs detail mathematical calculations and advising to make a relay operation command takes more time. It means that to increase the calculative speed of this relay. More powerful processor is needed.

Siemens algorithm is based on the vector direction of the star point current and residual current. Also the phase displacement between the restraint current and star point current is important to determine the relay operating angle (ROA). This relay has a simple mathematical calculation, thus the time for calculation and process of operating command is less than the GE algorithm. But this diagram needs extra filters for second and fifth harmonic current components in the case of magnetizing inrush current and over excitation in power transformer.