

Advanced Course to Transformer Differential Protection (Schemes, Relay Settings, Testing)

1. Introduction

1. Explain the Course contents

2. Differential Protection Basics and Current Transformer (Briefly)

1. What is differential protection?
2. Explained KCL
3. How KCL applies to differential protection
4. Explained current transformer
5. Current transformer Polarity
6. What will happen if Polarity is wrong
7. Dot Notation that is used in books Vs S1,P1 notation that is used in the field
8. What is star point of CT
9. What mean by CT star point towards object (Line / Transformer etc) or towards bus
10. What happen to CT current flowing to relay is star point is changed
11. Relay can operate falsely, if star point is feed wrong, explained in detail
12. Single point earthing

3. Simple Transformer Differential Scheme

1. How to draw simple differential scheme
2. Draw primary and secondary current refer to dot notation
3. explained dot notation and S1,P1 notation
4. Differential Zone
5. In Zone and out of zone fault
6. What is through the fault
7. Through fault stability of differential relay
8. CT error, CT saturation
9. Draw current for in zone & out of zone faults
10. Phase and Ratio Compensation in Differential Protection

4. Phase and Ratio Compensation in Differential Protection

1. Ratio error & Phase Errors
2. Matching CT
3. Ration and Phase error compensation
4. Use of matching CTs
5. Use of numerical relay filters for phase & ratio compensation
6. Magnitude Vs Phase angle compensation
7. Ratio Compensation

5. **CT Errors**
 1. What are CT errors and how to compensate
6. **Error due to tap changer in transformer**
 1. Ratio variation due to tap changer
 2. How to compensate tap changer error
7. **Transformer Protection Vs Busbar Protection**
 1. Comparison between busbar & transformer differential protection
 2. Errors in transformer Vs Busbar Protection
8. **Biased Differential Protection of Transformer**
 1. What is operating and restraining current
 2. What is biased differential protection
 3. Why biased differential protection is designed
 4. How biased differential protection works
 5. Tripping and restraining
9. **Development of transformer winding connections from vector diagram**
 1. How to draw a vector diagram
 2. What is the clock Method for the vector diagram
 3. Drawing DY1 Vector group connection
 4. Why it is important to understand vector group winding connections for differential relay testing
 5. Drawing current direction for delta star transformer
10. **Zero Sequence Filtering in Differential Relay**
 1. What is zero sequence current
 2. Star and delta winding and its relationship with zero-sequence current
 3. Why zero-sequence filtering is required
11. **Transformer Differential Protection Setting Calculations (Siemens 6UT Relay)**
 1. Detail transformer calculations will be explained
 2. Calculate differential pickup
 3. Differential high set element
 4. harmonics settings
 5. slope1 and slope 2 settings
12. **Manual Test Results for Differential Protection Relay**
 1. Sharing test results and calculations of doing testing of differential protection
 2. Calculate injected current & pickup settings of differential current
 3. PickUp and Trip time, slope testing, harmonic testing
13. **Relay Excel calculation sheet & plotting of slope**
 1. Excel sheet to feed data and doing calculations
 2. Plot relay characteristic curves
14. **Relay Characteristics and Trip Characteristics Testing**
 1. Explained Relay characteristic curve in detail
 2. Draw pickup, slope 1 & slope 2, differential 2nd stage
 3. Shot test Vs Search test
 4. Time test, pickup
15. **Draw Relay settings calculations curve**
 1. Draw & understand relay settings and curve

16. Finding a point of intersection & draw characteristics

1. Using relay settings we will find a point of intersection of two slopes
2. point of intersection will be required to draw slopes line in the test set

17. Create Relay Characteristic Curve in Omicron Differential Module

1. Use to the calculated value of points on the intersection to draw a curve in omicron software
2. Differential relay testing

18. Defining the Hardware Configuration and setting up test set connections

1. Define analogue current modules in CMC
2. Define Binary input in CMC
3. Connection of CTs to CMC

19. Differential Relay Shot test

20. Differential Relay Search test

21. Harmonics Test

22. Advance Differential Relay Testing Using Omicron PTL Library