# Appendix IV

Relay Settings
All impedances are in ohms (secondary ), all angles in radians, all currents in amps (secondary), and all time in seconds.

## Line 301

**Table 30: Phase Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 0.8166+4.7335i | 0.8166+4.7335i | 0.8166+4.7335i |
| Zero Sequence Impedance | 4.9449+14.5428i | 4.9449+14.5428i | 4.9449+14.5428i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 4.3231 | 7.2052 | 13.8752 |
| Timer | Inst | 0.3 | 0.6 |

**Table 31: Ground Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 0.8166+4.7335i | 0.8166+4.7335i | 0.8166+4.7335i |
| Zero Sequence Impedance | 4.9449+14.5428i | 4.9449+14.5428i | 4.9449+14.5428i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 13.8245 | 23.0408 | 38.4013 |
| Timer | Inst | 0.3 | 0.6 |

**Table 32: Zone 1 Extension Settings**

| | DCB | PCB ($\phi$) | PCB (Gnd) |
|---|---|---|---|
| Positive Sequence Impedance | 0.8166+4.7335i | 0.8166+4.7335i | 0.8166+4.7335i |
| Zero Sequence Impedance | 4.9449+14.5428i | 4.9449+14.5428i | 4.9449+14.5428i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone 1 Reach | 4.3231 | 4.3231 | 13.8245 |
| Zone 2 Reach | 7.2052 | 7.2052 | 23.0408 |
| Delay Timer | 0.3 | 0.3 | 0.3 |

## Line 302

**Table 33: Phase Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 0.8166+4.7335i | 0.8166+4.7335i | 0.8166+4.7335i |
| Zero Sequence Impedance | 4.9449+14.5428i | 4.9449+14.5428i | 4.9449+14.5428i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 4.3231 | 7.2052 | 13.8752 |
| Timer | Inst | 0.3 | 0.6 |

**Table 34: Ground Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 0.8166+4.7335i | 0.8166+4.7335i | 0.8166+4.7335i |
| Zero Sequence Impedance | 4.9449+14.5428i | 4.9449+14.5428i | 4.9449+14.5428i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 13.8245 | 23.0408 | 38.4013 |
| Timer | Inst | 0.3 | 0.6 |

**Table 35: Zone 1 Extension Settings**

| | DCB | PCB (ϕ) | PCB (Gnd) |
|---|---|---|---|
| Positive Sequence Impedance | 0.8166+4.7335i | 0.8166+4.7335i | 0.8166+4.7335i |
| Zero Sequence Impedance | 4.9449+14.5428i | 4.9449+14.5428i | 4.9449+14.5428i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone 1 Reach | 4.3231 | 4.3231 | 13.8245 |
| Zone 2 Reach | 7.2052 | 7.2052 | 23.0408 |
| Delay Timer | 0.3 | 0.3 | 0.3 |

## Line 501

**Table 36: Phase Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 0.8599+4.2835i | 0.8599+4.2835i | 0.8599+4.2835i |
| Zero Sequence Impedance | 1.0920+10.8038i | 1.0920+10.8038i | 1.0920+10.8038i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 3.9321 | 6.5534 | 14.8546 |
| Timer | Inst | 0.3 | 0.6 |

**Table 37: Ground Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 0.8599+4.2835i | 0.8599+4.2835i | 0.8599+4.2835i |
| Zero Sequence Impedance | 1.0920+10.8038i | 1.0920+10.8038i | 1.0920+10.8038i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 9.7730 | 16.2883 | 36.9201 |
| Timer | Inst | 0.3 | 0.6 |

**Table 38: Zone 1 Extension Settings**

| | DCB | PCB (ϕ) | PCB (Gnd) |
|---|---|---|---|
| Positive Sequence Impedance | 0.8599+4.2835i | 0.8599+4.2835i | 0.8599+4.2835i |
| Zero Sequence Impedance | 1.0920+10.8038i | 1.0920+10.8038i | 1.0920+10.8038i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone 1 Reach | 3.9321 | 3.9321 | 9.7730 |
| Zone 2 Reach | 6.5534 | 6.5534 | 16.2883 |
| Delay Timer | 0.3 | 0.3 | 0.3 |

## Line 502

**Table 39: Phase Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 0.8599+4.2835i | 0.8599+4.2835i | 0.8599+4.2835i |
| Zero Sequence Impedance | 1.0920+10.8038i | 1.0920+10.8038i | 1.0920+10.8038i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 3.9321 | 6.5534 | 14.8546 |
| Timer | Inst | 0.3 | 0.6 |

**Table 40: Ground Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 0.8599+4.2835i | 0.8599+4.2835i | 0.8599+4.2835i |
| Zero Sequence Impedance | 1.0920+10.8038i | 1.0920+10.8038i | 1.0920+10.8038i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 9.7730 | 16.2883 | 36.9201 |
| Timer | Inst | 0.3 | 0.6 |

**Table 41: Zone 1 Extension Settings**

| | DCB | PCB (ϕ) | PCB (Gnd) |
|---|---|---|---|
| Positive Sequence Impedance | 0.8599+4.2835i | 0.8599+4.2835i | 0.8599+4.2835i |
| Zero Sequence Impedance | 1.0920+10.8038i | 1.0920+10.8038i | 1.0920+10.8038i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone 1 Reach | 3.9321 | 3.9321 | 9.7730 |
| Zone 2 Reach | 6.5534 | 6.5534 | 16.2883 |
| Delay Timer | 0.3 | 0.3 | 0.3 |

## Line 503

**Table 42: Phase Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 1.0319+5.1402i | 1.0319+5.1402i | 1.0319+5.1402i |
| Zero Sequence Impedance | 1.3104+12.9646i | 1.3104+12.9646i | 1.3104+12.9646i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 4.7185 | 7.8642 | 13.7618 |
| Timer | Inst | 0.3 | 0.6 |

**Table 43: Ground Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 1.0319+5.1402i | 1.0319+5.1402i | 1.0319+5.1402i |
| Zero Sequence Impedance | 1.3104+12.9646i | 1.3104+12.9646i | 1.3104+12.9646i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 11.7276 | 19.5460 | 34.2037 |
| Timer | Inst | 0.3 | 0.6 |

**Table 44: Zone 1 Extension Settings**

| | DCB | PCB ($\phi$) | PCB (Gnd) |
|---|---|---|---|
| Positive Sequence Impedance | 1.0319+5.1402i | 1.0319+5.1402i | 1.0319+5.1402i |
| Zero Sequence Impedance | 1.3104+12.9646i | 1.3104+12.9646i | 1.3104+12.9646i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone 1 Reach | 4.7185 | 4.7185 | 11.7276 |
| Zone 2 Reach | 7.8642 | 7.8642 | 19.5460 |
| Delay Timer | 0.3 | 0.3 | 0.3 |

## Line 504

**Table 45: Phase Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 1.0319+5.1402i | 1.0319+5.1402i | 1.0319+5.1402i |
| Zero Sequence Impedance | 1.3104+12.9646i | 1.3104+12.9646i | 1.3104+12.9646i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 4.7185 | 7.8642 | 13.7618 |
| Timer | Inst | 0.3 | 0.6 |

**Table 46: Ground Distance Relay Settings**

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| Positive Sequence Impedance | 1.0319+5.1402i | 1.0319+5.1402i | 1.0319+5.1402i |
| Zero Sequence Impedance | 1.3104+12.9646i | 1.3104+12.9646i | 1.3104+12.9646i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone Reach | 11.7276 | 19.5460 | 34.2037 |
| Timer | Inst | 0.3 | 0.6 |

**Table 47: Zone 1 Extension Settings**

| | DCB | PCB ($\phi$) | PCB (Gnd) |
|---|---|---|---|
| Positive Sequence Impedance | 1.0319+5.1402i | 1.0319+5.1402i | 1.0319+5.1402i |
| Zero Sequence Impedance | 1.3104+12.9646i | 1.3104+12.9646i | 1.3104+12.9646i |
| Maximum Torque Angle | 1.3963 | 1.3963 | 1.3963 |
| Zone 1 Reach | 4.7185 | 4.7185 | 11.7276 |
| Zone 2 Reach | 7.8642 | 7.8642 | 19.5460 |
| Delay Timer | 0.3 | 0.3 | 0.3 |

**Table 48: Transformer #1 Differential Settings**

| | Setting |
|---|---|
| High side voltage | 500 |
| Low side voltage | 345 |
| Tertiary voltage | 34.5 |
| High side CT ratio | 300 |
| Low side CT ratio | 400 |
| Tertiary CT ratio | 400 |
| $\alpha$ | 10 |
| $\beta$ | .133 |
| $\gamma$ | .3 |
| $\delta$ | .2 |

**Table 49: Transformer #2 Differential Settings**

| | Setting |
|---|---|
| High side voltage | 500 |
| Low side voltage | 345 |
| Tertiary voltage | 34.5 |
| High side CT ratio | 300 |
| Low side CT ratio | 400 |
| Tertiary CT ratio | 400 |
| $\alpha$ | 10 |
| $\beta$ | .133 |
| $\gamma$ | .3 |
| $\delta$ | .2 |