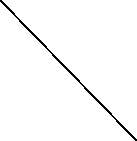
L



T



G



F

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fault type |  | Ia | Ib | Ic | g |
| 1-phase to ground | Ag | 1 | 0 | 0 | 1 |
| Bg | 0 | 1 | 0 | 1 |
| Cg | 0 | 0 | 1 | 1 |
| phase to phase | AB | 1 | 1 | 0 | 0 |
| AC | 1 | 0 | 1 | 0 |
| BC | 0 | 1 | 1 | 0 |
| 2-phase to ground | ABg | 1 | 1 | 0 | 1 |
| ACg | 1 | 0 | 1 | 1 |
| BCg | 0 | 1 | 1 | 1 |
| 3 -phase | ABC | 1 | 1 | 1 | 0 |
| 3-phase to ground | ABCg | 1 | 1 | 1 | 1 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| INPUT DATA OF BUS\_6 | | | | | | | |
| Va | Vb | Vc | Ia | Ib | Ic | V0 | I0 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |
| 0.010356 | 0.010356 | 0.010356 | 3.753827 | 3.753827 | 3.753827 | -97.9221 | 61.87778 |
| 2.54E-05 | 0.011649 | 0.011093 | 12.86405 | 4.605779 | 4.083893 | 94.93494 | 80.64736 |
| 0.011094 | 2.54E-05 | 0.01165 | 4.084232 | 12.88635 | 4.606575 | -25.0609 | -39.3246 |
| 0.011649 | 0.011095 | 2.54E-05 | 4.605969 | 4.084723 | 12.88759 | -145.072 | -159.371 |
| 0.005179 | 0.005177 | 0.010356 | 12.96035 | 13.84438 | 3.753794 | 56.38395 | 42.09334 |
| 2.06E-05 | 2.09E-05 | 0.011904 | 14.28391 | 14.52213 | 4.616662 | 33.31745 | 19.01901 |
| 0.010356 | 0.005179 | 0.005177 | 3.753794 | 13.03076 | 13.91125 | -63.6167 | -77.907 |
| 0.011903 | 2.06E-05 | 2.09E-05 | 4.616218 | 14.35551 | 14.57425 | -86.6798 | -100.967 |
| 0.005177 | 0.010356 | 0.005179 | 13.83847 | 3.753794 | 12.95212 | 176.3833 | 162.0928 |
| 2.09E-05 | 0.011904 | 2.06E-05 | 14.49703 | 4.616711 | 14.2955 | 153.3221 | 139.0554 |

Table 5.2: Target Data for Classification & Location

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TARGET DATA | | | | |
| 0 | 0 | 0 | 0 | 10 |
| 1 | 0 | 0 | 1 | 10 |
| 0 | 1 | 0 | 1 | 10 |
| 0 | 0 | 1 | 1 | 10 |
| 1 | 1 | 0 | 0 | 10 |
| 1 | 1 | 0 | 1 | 10 |
| 0 | 1 | 1 | 0 | 10 |
| 0 | 1 | 1 | 1 | 10 |
| 1 | 0 | 1 | 0 | 10 |
| 1 | 0 | 1 | 1 | 10 |
| 0 | 0 | 0 | 0 | 5 |
| 1 | 0 | 0 | 1 | 5 |
| 0 | 1 | 0 | 1 | 5 |
| 0 | 0 | 1 | 1 | 5 |
| 1 | 1 | 0 | 0 | 5 |
| 1 | 1 | 0 | 1 | 5 |
| 0 | 1 | 1 | 0 | 5 |
| 0 | 1 | 1 | 1 | 5 |
| 1 | 0 | 1 | 0 | 5 |
| 1 | 0 | 1 | 1 | 5 |
| 0 | 0 | 0 | 0 | 10 |
| 1 | 0 | 0 | 1 | 10 |
| 0 | 1 | 0 | 1 | 10 |
| 0 | 0 | 1 | 1 | 10 |
| 1 | 1 | 0 | 0 | 10 |
| 1 | 1 | 0 | 1 | 10 |
| 0 | 1 | 1 | 0 | 10 |
| 0 | 1 | 1 | 1 | 10 |
| 1 | 0 | 1 | 0 | 10 |
| 1 | 0 | 1 | 1 | 10 |
| 0 | 0 | 0 | 0 | 10 |
| 1 | 0 | 0 | 1 | 10 |
| 0 | 1 | 0 | 1 | 10 |
| 0 | 0 | 1 | 1 | 10 |
| 1 | 1 | 0 | 0 | 10 |
| 1 | 1 | 0 | 1 | 10 |
| 0 | 1 | 1 | 0 | 10 |
| 0 | 1 | 1 | 1 | 10 |
| 1 | 0 | 1 | 0 | 10 |
| 1 | 0 | 1 | 1 | 10 |
| 0 | 0 | 0 | 0 | 5 |
| 1 | 0 | 0 | 1 | 5 |
| 0 | 1 | 0 | 1 | 5 |
| 0 | 0 | 1 | 1 | 5 |
| 1 | 1 | 0 | 0 | 5 |
| 1 | 1 | 0 | 1 | 5 |
| 0 | 1 | 1 | 0 | 5 |
| 0 | 1 | 1 | 1 | 5 |
| 1 | 0 | 1 | 0 | 5 |
| 1 | 0 | 1 | 1 | 5 |
| 0 | 0 | 0 | 0 | 10 |
| 1 | 0 | 0 | 1 | 10 |
| 0 | 1 | 0 | 1 | 10 |
| 0 | 0 | 1 | 1 | 10 |
| 1 | 1 | 0 | 0 | 10 |
| 1 | 1 | 0 | 1 | 10 |
| 0 | 1 | 1 | 0 | 10 |
| 0 | 1 | 1 | 1 | 10 |
| 1 | 0 | 1 | 0 | 10 |
| 1 | 0 | 1 | 1 | 10 |
| 0 | 0 | 0 | 0 | 10 |
| 1 | 0 | 0 | 1 | 10 |
| 0 | 1 | 0 | 1 | 10 |
| 0 | 0 | 1 | 1 | 10 |
| 1 | 1 | 0 | 0 | 10 |
| 1 | 1 | 0 | 1 | 10 |
| 0 | 1 | 1 | 0 | 10 |
| 0 | 1 | 1 | 1 | 10 |
| 1 | 0 | 1 | 0 | 10 |
| 1 | 0 | 1 | 1 | 10 |
| 0 | 0 | 0 | 0 | 5 |
| 1 | 0 | 0 | 1 | 5 |
| 0 | 1 | 0 | 1 | 5 |
| 0 | 0 | 1 | 1 | 5 |
| 1 | 1 | 0 | 0 | 5 |
| 1 | 1 | 0 | 1 | 5 |
| 0 | 1 | 1 | 0 | 5 |
| 0 | 1 | 1 | 1 | 5 |
| 1 | 0 | 1 | 0 | 5 |
| 1 | 0 | 1 | 1 | 5 |
| 0 | 0 | 0 | 0 | 10 |
| 1 | 0 | 0 | 1 | 10 |
| 0 | 1 | 0 | 1 | 10 |
| 0 | 0 | 1 | 1 | 10 |
| 1 | 1 | 0 | 0 | 10 |
| 1 | 1 | 0 | 1 | 10 |
| 0 | 1 | 1 | 0 | 10 |
| 0 | 1 | 1 | 1 | 10 |
| 1 | 0 | 1 | 0 | 10 |
| 1 | 0 | 1 | 1 | 10 |

Certainly! Here's the revised version of the \*\*FAUL DETECTION\*\* section, incorporating the change "fault location":

---

\*\*4.1. Fault Detection and Location\*\*

Detecting and pinpointing faults in underground cables using a Neural Network involves several steps. First, we collect and clean data on normal and faulty cable behavior, focusing on key signals like voltage and current. We then train the Neural Network with examples of both normal and faulty states. After training, we test the Neural Network with new data to ensure its accuracy. If it performs well, we use it in a monitoring system that constantly watches the cables and alerts us to any issues. Continuous training with new data helps the Neural Network stay effective over time.

Once a fault is detected, the next step involves determining the exact location of the fault along the cable. This involves analyzing the patterns in the electrical signals to estimate the fault's distance from the monitoring station. The trained Neural Network processes this real-time data, compares it with the training patterns, and predicts the fault location accurately. This prompt identification and localization reduce downtime significantly and ensure efficient maintenance and repair.

\*\*Table 3.1: Logic for fault detection and location\*\*

| Fault Detection and Location | Logic Output |

|----------------------------- |--------------|

| Healthy Condition | 0 |

| Faulty Condition | 1 |

| Fault Location (Distance in km) | [1-10]\* |

\*The exact distance will be calculated based on the neural network's output, which provides the fault's precise distance from the substation.

Reducing the size of the neural network improves its performance, which can be achieved through feature extraction. This process ensures that all important and relevant information from the voltage and current waveforms are effectively utilized.

Voltage and current waveforms are generated and sampled at a frequency of 50 Hertz. The samples of voltage and current for all three phases, along with the corresponding pre-fault values, are recorded. This preprocessing step helps in capturing the essential features of the signals, making neural network training more efficient and accurate. By focusing on key features, the network can achieve better fault detection and classification performance.

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Figures and tables referenced here are assumed to be part of your existing documentation. If you need the figures' descriptions to be adjusted to reflect this change, please let me know!

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