# Test Systems

The following is an IEEE 13 Node Test System that has been modified by replacing the load at node 634 with a 500 Hp motor and adding a three-phase PV system added onto node 675 which is supplied by a 4.16/.48 inline transformer, and a single phase PV system added onto node 611 which is supplied by a split phase transformer.

Diagram, schematic

Description automatically generated

Overhead Line Configuration Data:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Config. | Phasing | Phase | Neutral | Spacing |
|  |  | ACSR | ACSR | ID |
| 601 | B A C N | 556,500 26/7 | 4/0 6/1 | 500 |
| 602 | C A B N | 4/0 6/1 | 4/0 6/1 | 500 |
| 603 | C B N | 1/0 | 1/0 | 505 |
| 604 | A C N | 1/0 | 1/0 | 505 |
| 605 | C N | 1/0 | 1/0 | 510 |

Underground Line Configuration Data:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Config. | Phasing | Cable | Neutral | Space ID |
| 606 | A B C N | 250,000 AA, CN | None | 515 |
| 607 | A N | 1/0 AA, TS | 1/0 Cu | 520 |

Line Segment Data:

|  |  |  |  |
| --- | --- | --- | --- |
| Node A | Node B | Length(ft.) | Config. |
| 632 | 645 | 500 | 603 |
| 632 | 633 | 500 | 602 |
| 633 | 634 | 0 | XFM-1 |
| 645 | 646 | 300 | 603 |
| 650 | 632 | 2000 | 601 |
| 684 | 652 | 800 | 607 |
| 632 | 671 | 2000 | 601 |
| 671 | 684 | 300 | 604 |
| 671 | 680 | 1000 | 601 |
| 671 | 692 | 0 | Switch |
| 684 | 611 | 300 | 605 |
| 692 | 675 | 500 | 606 |

Transformer Data:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | kVA | kV-high | kV-low | R - % | X - % |
| Substation: | 5,000 | 115 - D | 4.16 Gr. Y | 1 | 8 |
| XFM -1 | 500 | 4.16 – Gr.W | 0.48 – Gr.W | 1.1 | 2 |
| XFM-2 | 500 | 4.16 – Gr.W | 0.48 – Gr.W | 1.1 | 2 |
| XFM-3 | 100 | 2.4 – Gr.W | 0.12/0.24 | 0.75 | 1 |

Capacitor Data:

|  |  |  |  |
| --- | --- | --- | --- |
| Node | Ph-A | Ph-B | Ph-C |
|  | kVAr | kVAr | kVAr |
| 675 | 200 | 200 | 200 |
| 611 |  |  | 100 |
| Total | 200 | 200 | 300 |

Regulator Data:

|  |  |  |  |
| --- | --- | --- | --- |
| Regulator ID: | 1 |  |  |
| Line Segment: | 650 - 632 |  |  |
| Location: | 50 |  |  |
| Phases: | A - B -C |  |  |
| Connection: | 3-Ph,LG |  |  |
| Monitoring Phase: | A-B-C |  |  |
| Bandwidth: | 2.0 volts |  |  |
| PT Ratio: | 20 |  |  |
| Primary CT Rating: | 700 |  |  |
| Compensator Settings: | Ph-A | Ph-B | Ph-C |
| R - Setting: | 3 | 3 | 3 |
| X - Setting: | 9 | 9 | 9 |
| Volltage Level: | 122 | 122 | 122 |

Spot Load Data:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Node | Load | Ph-1 | Ph-1 | Ph-2 | Ph-2 | Ph-3 | Ph-3 |
|  | Model | kW | kVAr | kW | kVAr | kW | kVAr |
| 645 | Y-PQ | 0 | 0 | 170 | 125 | 0 | 0 |
| 646 | D-Z | 0 | 0 | 230 | 132 | 0 | 0 |
| 652 | Y-Z | 128 | 86 | 0 | 0 | 0 | 0 |
| 671 | D-PQ | 385 | 220 | 385 | 220 | 385 | 220 |
| 675 | Y-PQ | 485 | 190 | 68 | 60 | 290 | 212 |
| 692 | D-I | 0 | 0 | 0 | 0 | 170 | 151 |
| 611 | Y-I | 0 | 0 | 0 | 0 | 170 | 80 |
|  | TOTAL | 1158 | 606 | 973 | 627 | 1135 | 753 |

Distributed Load Data:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node A | Node B | Load | Ph-1 | Ph-1 | Ph-2 | Ph-2 | Ph-3 | Ph-3 |
|  |  | Model | kW | kVAr | kW | kVAr | kW | kVAr |
| 632 | 671 | Y-PQ | 17 | 10 | 66 | 38 | 117 | 68 |

Motor Data:

*Ratings:*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Node | Conn | Conn | kV | kW | kVA | Pole | rpm |
| 610 | IM | D | 0.48 | 372 | 478 | 4 | 1791 |

*Dynamic Parameters:*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node | H | D | Rs | Rr | Xs | Xr | Xm | m |
| 610 | 1.6 | 1 | 0.007 | 0.0062 | 0.0409 | 0.0267 | 3.62 | 2.0 |

PV Data:

*Ratings:*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Node | Conn | Ph-1 | Ph-1 | Ph-2 | Ph-2 | Ph-3 | Ph-3 |
|  |  | kVA | pf | kVA | pf | kVA | pf |
| 610 | D | 0 | - | 0 | - | 100 | 0.95 |
| 676 | D | 120 | 0.95 | 120 | 0.95 | 120 | 0.95 |

*Dynamic Parameters:*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Node | R | X | Kp | kVDC | KP Tol | Safe Voltage |
| 610 | 0.5 | 0.5 | 0.01 | 0.7 | 0.1 | 0 |
| 676 | 0.5 | 0.5 | 0.01 | 0.03 | 0.1 | 0 |