## Electrical Transient Analyzer Program

## Load Flow Analysis

Loading Category (1): Design

Generation Category (1): Design

Load Diversity Factor: None

| | Swing | V-Control | Load | Total |
|---|---|---|---|---|
| Number of Buses: | 1 | 2 | 6 | 9 |

| | XFMR2 | XFMR3 | Reactor | Line/Cable/ Busway | Impedance | Tie PD | Total |
|---|---|---|---|---|---|---|---|
| Number of Branches: | 3 | 0 | 0 | 6 | 0 | 0 | 9 |

| | |
|---|---|
| Method of Solution: | Adaptive Newton-Raphson Method |
| Maximum No. of Iteration: | 99 |
| Precision of Solution: | 0.0001000 |
| System Frequency: | 60.00 Hz |
| Unit System: | English |
| Project Filename: | grid2 |
| Output Filename: | C:\Users\owner's\Desktop\PSA PBL\grid2\grid2\Untitled.lfr |

## Adjustments

| Tolerance | Apply Adjustments | Individual /Global | Percent |
|---|---|---|---|
| Transformer Impedance: | Yes | Individual | |
| Reactor Impedance: | Yes | Individual | |
| Overload Heater Resistance: | No | | |
| Transmission Line Length: | No | | |
| Cable / Busway Length: | No | | |

| Temperature Correction | Apply Adjustments | Individual /Global | Degree C |
|---|---|---|---|
| Transmission Line Resistance: | Yes | Individual | |
| Cable / Busway Resistance: | Yes | Individual | |

## Bus Input Data

| Bus | | | Initial Voltage | | Load | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Constant kVA | | Constant Z | | Constant I | | Generic | |
| ID | kV | Sub-sys | % Mag. | Ang. | MW | Mvar | MW | Mvar | MW | Mvar | MW | Mvar |
| Bus1 | 11.300 | 1 | 100.0 | 0.0 | | | | | | | | |
| Bus2 | 20.000 | 1 | 100.0 | 0.0 | | | | | | | | |
| Bus3 | 20.000 | 1 | 105.0 | 0.0 | 6.800 | 4.214 | 1.752 | 1.086 | | | | |
| Bus4 | 20.000 | 1 | 106.0 | 0.0 | 6.800 | 4.214 | 1.735 | 1.075 | | | | |
| Bus5 | 11.000 | 1 | 100.0 | 0.0 | | | | | | | | |
| Bus6 | 20.000 | 1 | 100.0 | 0.0 | 10.880 | 6.743 | 2.720 | 1.686 | | | | |
| Bus7 | 20.000 | 1 | 100.0 | 0.0 | 10.200 | 6.321 | 2.602 | 1.612 | | | | |
| Bus8 | 20.000 | 1 | 100.0 | 0.0 | 21.760 | 13.486 | 5.550 | 3.440 | | | | |
| Bus9 | 55.000 | 1 | 100.0 | 0.0 | | | | | | | | |
| Total Number of Buses: 9 | | | | | 56.440 | 34.978 | 14.359 | 8.899 | 0.000 | 0.000 | 0.000 | 0.000 |

| Generation Bus | | | | Voltage | | Generation | | | Mvar Limits | |
|---|---|---|---|---|---|---|---|---|---|---|
| ID | kV | Type | Sub-sys | % Mag. | Angle | MW | Mvar | % PF | Max | Min |
| Bus1 | 11.300 | Swing | 1 | 100.0 | 0.0 | | | | | |
| Bus5 | 11.000 | Voltage Control | 1 | 100.0 | 0.0 | 25.000 | | | 30.000 | 0.000 |
| Bus9 | 55.000 | Voltage Control | 1 | 100.0 | 0.0 | 20.000 | | | 40.000 | 0.000 |
| | | | | | | 45.000 | 0.000 | | | |

## Line/Cable/Busway Input Data

ohms or siemens/1000 ft per Conductor (Cable) or per Phase (Line/Busway)

| Line/Cable/Busway ID | Library | Size | Length Adj. (ft) | % Tol. | #/Phase | T (°C) | R | X | Y |
|---|---|---|---|---|---|---|---|---|---|
| Cable2-6 | 25MCUS1 | 750 | 8000.0 | 0.0 | 12 | 75 | 0.024798 | 0.093000 | |
| Cable4-7 | 15MALS1 | 750 | 8000.0 | 0.0 | 12 | 75 | 0.036570 | 0.049700 | |
| Cable_7-8 | 25MCUS1 | 750 | 8000.0 | 0.0 | 12 | 75 | 0.024798 | 0.093000 | |
| Line2-3 | | 203. | 5280.0 | 0.0 | 1 | 75 | 0.130873 | 0.166755 | 0.0000010 |
| Line_3-4 | | 203. | 5280.0 | 0.0 | 1 | 75 | 0.130873 | 0.166755 | 0.0000010 |
| Line6-8 | | 203. | 5280.0 | 0.0 | 1 | 75 | 0.130873 | 0.166755 | 0.0000010 |

Line / Cable / Busway resistances are listed at the specified temperatures.

## 2-Winding Transformer Input Data

| Transformer | | Rating | | | | | Z Variation | | | % Tap Setting | | Adjusted | Phase Shift | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Phase | MVA | Prim. kV | Sec. kV | % Z1 | X1/R1 | + 5% | - 5% | % Tol. | Prim. | Sec. | % Z | Type | Angle |
| TR_1 | 3-Phase | 100.000 | 11.300 | 20.000 | 6.50 | 34.10 | 0 | 0 | 0 | 0 | 0 | 6.5000 | YNd | 0.000 |
| TR_2 | 3-Phase | 100.000 | 20.000 | 11.000 | 6.50 | 34.10 | 0 | 0 | 0 | 0 | 0 | 6.5000 | Dyn | 0.000 |
| TR_3 | 3-Phase | 100.000 | 20.000 | 55.000 | 8.00 | 34.10 | 0 | 0 | 0 | 0 | 0 | 8.0000 | YNd | 0.000 |

## Branch Connections

| CKT/Branch | | Connected Bus ID | | % Impedance, Pos. Seq., 100 MVA Base | | | |
|---|---|---|---|---|---|---|---|
| ID | Type | From Bus | To Bus | R | X | Z | Y |
| TR_1 | 2W XFMR | Bus1 | Bus2 | 0.19 | 6.50 | 6.50 | |
| TR_2 | 2W XFMR | Bus4 | Bus5 | 0.19 | 6.50 | 6.50 | |
| TR_3 | 2W XFMR | Bus8 | Bus9 | 0.23 | 8.00 | 8.00 | |
| Cable2-6 | Cable | Bus2 | Bus6 | 0.41 | 1.55 | 1.60 | |
| Cable4-7 | Cable | Bus4 | Bus7 | 0.61 | 0.83 | 1.03 | |
| Cable_7-8 | Cable | Bus7 | Bus8 | 0.41 | 1.55 | 1.60 | |
| Line2-3 | Line | Bus2 | Bus3 | 17.28 | 22.01 | 27.98 | 0.0020147 |
| Line_3-4 | Line | Bus3 | Bus4 | 17.28 | 22.01 | 27.98 | 0.0020147 |
| Line6-8 | Line | Bus8 | Bus6 | 17.28 | 22.01 | 27.98 | 0.0020147 |

## LOAD FLOW REPORT

| Bus | | Voltage | | Generation | | Load | | Load Flow | | | | | XFMR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | kV | % Mag. | Ang. | MW | Mvar | MW | Mvar | ID | MW | Mvar | Amp | %PF | %Tap |
| * Bus1 | 11.300 | 100.000 | 0.0 | 25.652 | 9.579 | 0.000 | 0.000 | Bus2 | 25.652 | 9.579 | 1399.0 | 93.7 | |
| Bus2 | 20.000 | 99.342 | -1.0 | 0.000 | 0.000 | 0.000 | 0.000 | Bus6 | 18.614 | 7.193 | 579.9 | 93.3 | |
| | | | | | | | | Bus3 | 7.023 | 1.899 | 211.4 | 96.5 | |
| | | | | | | | | Bus1 | -25.637 | -9.092 | 790.4 | 94.2 | |
| Bus3 | 20.000 | 97.708 | -1.7 | 0.000 | 0.000 | 8.473 | 5.251 | Bus2 | -6.931 | -1.783 | 211.4 | 96.8 | |
| | | | | | | | | Bus4 | -1.542 | -3.468 | 112.1 | 40.6 | |
| Bus4 | 20.000 | 98.762 | -1.8 | 0.000 | 0.000 | 8.492 | 5.263 | Bus7 | 14.922 | 9.127 | 511.3 | 85.3 | |
| | | | | | | | | Bus3 | 1.568 | 3.500 | 112.1 | 40.9 | |
| | | | | | | | | Bus5 | -24.982 | -17.889 | 898.1 | 81.3 | |
| * Bus5 | 11.000 | 100.000 | -0.9 | 25.000 | 18.518 | 0.000 | 0.000 | Bus4 | 25.000 | 18.518 | 1632.9 | 80.4 | |
| Bus6 | 20.000 | 99.153 | -1.1 | 0.000 | 0.000 | 13.554 | 8.400 | Bus2 | -18.597 | -7.130 | 579.9 | 93.4 | |
| | | | | | | | | Bus8 | 5.043 | -1.270 | 151.4 | -97.0 | |
| Bus7 | 20.000 | 98.593 | -1.9 | 0.000 | 0.000 | 12.729 | 7.889 | Bus4 | -14.903 | -9.101 | 511.3 | 85.3 | |
| | | | | | | | | Bus8 | 2.173 | 1.212 | 72.9 | 87.3 | |
| Bus8 | 20.000 | 98.565 | -1.9 | 0.000 | 0.000 | 27.152 | 16.828 | Bus7 | -2.173 | -1.211 | 72.9 | 87.4 | |
| | | | | | | | | Bus6 | -4.996 | 1.328 | 151.4 | -96.6 | |
| | | | | | | | | Bus9 | -19.983 | -16.945 | 767.4 | 76.3 | |
| * Bus9 | 55.000 | 100.000 | -1.0 | 20.000 | 17.510 | 0.000 | 0.000 | Bus8 | 20.000 | 17.510 | 279.0 | 75.2 | |

* Indicates a voltage regulated bus ( voltage controlled or swing type machine connected to it)

# Indicates a bus with a load mismatch of more than 0.1 MVA

## Bus Loading Summary Report

| Bus | | | Directly Connected Load | | | | | | | | Total Bus Load | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Constant kVA | | Constant Z | | Constant I | | Generic | | | | | Percent |
| ID | kV | Rated Amp | MW | Mvar | MW | Mvar | MW | Mvar | MW | Mvar | MVA | % PF | Amp | Loading |
| Bus1 | 11.300 | | | | | | | | | | 27.382 | 93.7 | 1399.0 | |
| Bus2 | 20.000 | | | | | | | | | | 27.202 | 94.2 | 790.4 | |
| Bus3 | 20.000 | | 6.800 | 4.214 | 1.673 | 1.037 | | | | | 9.968 | 85.0 | 294.5 | |
| Bus4 | 20.000 | | 6.800 | 4.214 | 1.692 | 1.049 | | | | | 30.726 | 81.3 | 898.1 | |
| Bus5 | 11.000 | | | | | | | | | | 31.111 | 80.4 | 1632.9 | |
| Bus6 | 20.000 | | 10.880 | 6.743 | 2.674 | 1.657 | | | | | 20.406 | 91.1 | 594.1 | |
| Bus7 | 20.000 | | 10.200 | 6.321 | 2.529 | 1.567 | | | | | 17.462 | 85.3 | 511.3 | |
| Bus8 | 20.000 | | 21.760 | 13.486 | 5.392 | 3.342 | | | | | 32.663 | 83.1 | 956.6 | |
| Bus9 | 55.000 | | | | | | | | | | 26.582 | 75.2 | 279.0 | |

* Indicates operating load of a bus exceeds the bus critical limit ( 100.0% of the Continuous Ampere rating).
# Indicates operating load of a bus exceeds the bus marginal limit (95.0% of the Continuous Ampere rating).

## Branch Loading Summary Report

| CKT / Branch | | Busway / Cable & Reactor | | | Transformer | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Ampacity (Amp) | Loading Amp | | Capability (MVA) | Loading (input) | | Loading (output) | |
| ID | Type | | | % | | MVA | % | MVA | % |
| Cable2-6 | Cable | 7697.38 | 579.88 | 7.53 | | | | | |
| Cable4-7 | Cable | 6144.38 | 511.27 | 8.32 | | | | | |
| Cable_7-8 | Cable | 7697.38 | 72.86 | 0.95 | | | | | |
| TR_1 | Transformer | | | | 100.000 | 27.382 | 27.4 | 27.202 | 27.2 |
| TR_2 | Transformer | | | | 100.000 | 31.111 | 31.1 | 30.726 | 30.7 |
| TR_3 | Transformer | | | | 100.000 | 26.582 | 26.6 | 26.200 | 26.2 |

* Indicates a branch with operating load exceeding the branch capability.

## Branch Losses Summary Report

| Branch ID | From-To Bus Flow | | To-From Bus Flow | | Losses | | % Bus Voltage | | Vd % Drop |
|---|---|---|---|---|---|---|---|---|---|
| | MW | Mvar | MW | Mvar | kW | kvar | From | To | in Vmag |
| Cable_7-8 | 2.173 | 1.212 | -2.173 | -1.211 | 0.3 | 1.0 | 98.6 | 98.6 | 0.03 |
| Cable2-6 | 18.614 | 7.193 | -18.597 | -7.130 | 16.7 | 62.5 | 99.3 | 99.2 | 0.19 |
| Cable4-7 | 14.922 | 9.127 | -14.903 | -9.101 | 19.1 | 26.0 | 98.8 | 98.6 | 0.17 |
| Line_3-4 | -1.542 | -3.468 | 1.568 | 3.500 | 26.1 | 31.3 | 97.7 | 98.8 | 1.05 |
| Line2-3 | 7.023 | 1.899 | -6.931 | -1.783 | 92.7 | 116.1 | 99.3 | 97.7 | 1.63 |
| Line6-8 | 5.043 | -1.270 | -4.996 | 1.328 | 47.5 | 58.6 | 99.2 | 98.6 | 0.59 |
| TR_1 | 25.652 | 9.579 | -25.637 | -9.092 | 14.3 | 487.1 | 100.0 | 99.3 | 0.66 |
| TR_2 | -24.982 | -17.889 | 25.000 | 18.518 | 18.4 | 628.9 | 98.8 | 100.0 | 1.24 |
| TR_3 | -19.983 | -16.945 | 20.000 | 17.510 | 16.6 | 565.0 | 98.6 | 100.0 | 1.43 |
| | | | | | 251.6 | 1976.5 | | | |

* This Transmission Line includes Series Capacitor.

## Alert Summary Report

### % Alert Settings

| | Critical | Marginal |
|---|---|---|
| **Loading** | | |
| Bus | 100.0 | 95.0 |
| Cable / Busway | 100.0 | 95.0 |
| Reactor | 100.0 | 95.0 |
| Line | 100.0 | 95.0 |
| Transformer | 100.0 | 95.0 |
| Panel | 100.0 | 95.0 |
| Protective Device | 100.0 | 95.0 |
| Generator | 100.0 | 95.0 |
| Inverter/Charger | 100.0 | 95.0 |
| **Bus Voltage** | | |
| OverVoltage | 105.0 | 102.0 |
| UnderVoltage | 95.0 | 98.0 |
| **Generator Excitation** | | |
| OverExcited (Q Max.) | 100.0 | 95.0 |
| UnderExcited (Q Min.) | 100.0 | |

## Marginal Report

| Device ID | Type | Condition | Rating/Limit | Unit | Operating | % Operating | Phase Type |
|---|---|---|---|---|---|---|---|
| Bus3 | Bus | Under Voltage | 20.000 | kV | 19.542 | 97.7 | 3-Phase |

## SUMMARY OF TOTAL GENERATION , LOADING & DEMAND

| | MW | Mvar | MVA | % PF |
|---|---|---|---|---|
| Source (Swing Buses): | 25.652 | 9.579 | 27.382 | 93.68 Lagging |
| Source (Non-Swing Buses): | 45.000 | 36.028 | 57.646 | 78.06 Lagging |
| Total Demand: | 70.652 | 45.607 | 84.093 | 84.02 Lagging |
| Total Motor Load: | 56.440 | 34.978 | 66.400 | 85.00 Lagging |
| Total Static Load: | 13.960 | 8.652 | 16.424 | 85.00 Lagging |
| Total Constant I Load: | 0.000 | 0.000 | 0.000 | |
| Total Generic Load: | 0.000 | 0.000 | 0.000 | |
| Apparent Losses: | 0.252 | 1.977 | | |
| System Mismatch: | 0.000 | 0.000 | | |

Number of Iterations: 3