**Slack Bus Analysis on IEEE 30/14 Bus System**



***Fig0: Single line diagram of IEEE 14 BUS power system***

**Analysis on 14 Bus System**

* System Data of 14 Bus system

**Bus Data**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bus**  **Number** | **Base KV** | **Code** | **Voltage**  **(p.u.)** | **Angle**  **(p.u.)** | **Vmax**  **(p.u.)** | **Vmin**  **(p.u.)** |
| 1 | 138.0 | 3 | 1.0600 | 0.00 | 1.100 | 0.900 |
| 2 | 138.0 | 2 | 1.0450 | -4.98 | 1.100 | 0.900 |
| 3 | 138.0 | 2 | 1.0100 | -12.73 | 1.100 | 0.900 |
| 4 | 138.0 | 1 | 1.0177 | -10.31 | 1.100 | 0.900 |
| 5 | 138.0 | 1 | 1.0195 | -8.77 | 1.100 | 0.900 |
| 6 | 138.0 | 2 | 1.0700 | -14.22 | 1.100 | 0.900 |
| 7 | 138.0 | 1 | 1.0615 | -13.36 | 1.100 | 0.900 |
| 8 | 138.0 | 2 | 1.0900 | -13.36 | 1.100 | 0.900 |
| 9 | 138.0 | 1 | 1.0559 | -14.94 | 1.100 | 0.900 |
| 10 | 138.0 | 1 | 1.0510 | -15.10 | 1.100 | 0.900 |
| 11 | 138.0 | 1 | 1.0569 | -14.79 | 1.100 | 0.900 |
| 12 | 138.0 | 1 | 1.0552 | -15.08 | 1.100 | 0.900 |
| 13 | 138.0 | 1 | 1.0504 | -15.16 | 1.100 | 0.900 |
| 14 | 138.0 | 1 | 1.0355 | -16.03 | 1.100 | 0.900 |

**Machine data**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bus Number** | **Base KV** | **Code** | **Pgen (MW)** | **Pmax (MW)** | **Pmin (MW)** | **Qgen**  **(Mvar)** | **Qmax**  **(Mvar)** | **Qmin**  **(Mvar)** | **X (p.u.)** |
| 1 | 138.0 | 3 | 232.39 | 10000.0 | -10000 | -16.54 | 0 | 0 | 1.0 |
| 2 | 138.0 | 2 | 40.000 | 10000.0 | -10000 | 43.55 | 50 | -40.0 | 1.0 |
| 3 | 138.0 | 2 | 00.000 | 10000.0 | -10000 | 25.05 | 40 | 0 | 1.0 |
| 6 | 138.0 | 2 | 00.000 | 10000.0 | -10000 | 12.73 | 24 | -6.0 | 1.0 |
| 8 | 138.0 | 2 | 00.000 | 10000.0 | -10000 | 17.62 | 24 | -6.0 | 1.0 |

**Shunt Capacitor Data**

|  |  |
| --- | --- |
| **Bus Number** | **Susceptance (p.u.)** |
| 9 | 0.190 |

**Transformer Data**

|  |  |  |
| --- | --- | --- |
| **Transformer** | **Between**  **Buses** | **Tap**  **setting** |
| 1 | 4-7 | 0.978 |
| 2 | 4-9 | 0.969 |
| 3 | 5-6 | 0.932 |

**Regulated Bus Data (P-V Buses)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bus**  **Number** | **Voltage**  **(p.u.)** | **Min**  **Mvar** | **Max**  **Mvar** |
| 2 | 1.045 | -40 | 50 |
| 3 | 1.010 | 0 | 40 |
| 6 | 1.070 | -6 | 24 |
| 8 | 1.090 | -6 | 24 |

**Line Data**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Line No.** | **Between**  **Buses** | **R(p.u.)** | **X(p.u.)** | **Charging**  **B (p.u.)** |
| 1 | 1-2 | 0.01938 | 0.05917 | 0.02640 |
| 2 | 2-3 | 0.04699 | 0.19797 | 0.02190 |
| 3 | 2-4 | 0.05811 | 0.17632 | 0.01870 |
| 4 | 1-5 | 0.05403 | 0.22304 | 0.02460 |
| 5 | 2-5 | 0.05695 | 0.17388 | 0.01700 |
| 6 | 3-4 | 0.06701 | 0.17103 | 0.01730 |
| 7 | 4-5 | 0.01335 | 0.04211 | 0.0064 |
| 8 | 5-6 | 0 | 0.25202 | 0 |
| 9 | 4-7 | 0 | 0.20912 | 0 |
| 10 | 7-8 | 0 | 0.17615 | 0 |
| 11 | 4-9 | 0 | 0.55618 | 0 |
| 12 | 7-9 | 0 | 0.11001 | 0 |
| 13 | 9-10 | 0.03181 | 0.08450 | 0 |
| 14 | 6-11 | 0.09498 | 0.19890 | 0 |
| 15 | 6-12 | 0.12291 | 0.25581 | 0 |
| 16 | 6-13 | 0.06615 | 0.13027 | 0 |
| 17 | 9-14 | 0.12711 | 0.27038 | 0 |
| 18 | 10-11 | 0.08205 | 0.19207 | 0 |
| 19 | 12-13 | 0.22092 | 0.19988 | 0 |
| 20 | 13-14 | 0.17093 | 0.34802 | 0 |

**Base Case Load Flow Results:**

**Single Slack Bus And Three Slack Bus Analytical Results:**

**VOLTAGES IN PER UNIT AT BUSES**

|  |  |  |
| --- | --- | --- |
| **Bus Number** | **Voltage(p.u.)**  **(***singl*e) | **Voltage (pu)**  **(**t*hree***)** |
| 1 | 1.0600 | 1.0600 |
| 2 | 1.0450 | 1.0450 |
| 3 | 1.0100 | 1.0100 |
| 4 | 1.0177 | 1.0172 |
| 5 | 1.0195 | 1.0202 |
| 6 | 1.0700 | 1.0700 |
| 7 | 1.0615 | 1.0617 |
| 8 | 1.0900 | 1.0900 |
| 9 | 1.0559 | 1.0567 |
| 10 | 1.0510 | 1.0517 |
| 11 | 1.0569 | 1.0574 |
| 12 | 1.0552 | 1.0552 |
| 13 | 1.0504 | 1.0506 |
| 14 | 1.0355 | 1.0361 |

**VOLTAGE ANGLES AT BUSES**

|  |  |  |
| --- | --- | --- |
| **Bus Number** | **angle(deg)**  **(*single*)** | **angle(deg)**  **(*three*)** |
| 1 | 0 | 0 |
| 2 | -4.98 | 0 |
| 3 | -12.73 | 0 |
| 4 | -10.31 | -3.9 |
| 5 | -8.77 | -3.45 |
| 6 | -14.22 | -8.55 |
| 7 | -13.36 | -7.14 |
| 8 | -13.36 | -7.14 |
| 9 | -14.94 | -8.81 |
| 10 | -15.1 | -9.05 |
| 11 | -14.79 | -8.93 |
| 12 | -15.08 | -9.38 |
| 13 | -15.16 | -9.42 |
| 14 | -16.03 | -10.08 |

**REAL POWER INJECTED AT BUSES**

|  |  |  |
| --- | --- | --- |
| **Bus**  **Number** | **Real Power injected**  **(*single*)** | **Real Power injected**  ***(three*)** |
| 1 | 232.4 | 40 |
| 2 | 18.3 | 76.7 |
| 3 | -94.2 | 30.5 |
| 4 | -47.8 | -47.8 |
| 5 | -7.6 | -7.6 |
| 6 | -7.2 | -11.2 |
| 7 | 0 | 0 |
| 8 | 0 | 0 |
| 9 | -29.5 | -29.5 |
| 10 | -9 | -9 |
| 11 | -3.5 | -3.5 |
| 12 | -6.1 | -6.1 |
| 13 | -13.5 | -13.5 |
| 14 | -14.9 | -14.9 |

**COMPLEX POWER INJECTED AT BUSES**

|  |  |  |
| --- | --- | --- |
| **Bus**  **Number** | **complex power injected**  **(*single)*** | **complex power injected**  ***(three*)** |
| 1 | -16.5 | 30.6 |
| 2 | 30.9 | -8 |
| 3 | 6.1 | -36.1 |
| 4 | 3.9 | 3.9 |
| 5 | -1.6 | -1.6 |
| 6 | 5.2 | 5.5 |
| 7 | 0 | 0 |
| 8 | 17.6 | 17.5 |
| 9 | 5.6 | 4.6 |
| 10 | -5.8 | -5.8 |
| 11 | -1.8 | -1.8 |
| 12 | -1.6 | -1.6 |
| 13 | -5.8 | -5.8 |
| 14 | -5 | -5 |

***Fig3: Real power injected (MW) at 14 Buses for one and three slack bus system***

***Fig2: Voltage angle (P.U) at 14 Buses for one and three slack bus system***

***Fig1 (b): Voltage (P.U) at 14 Buses for 3 slack bus system***

***Fig1 (a): Voltage (P.U) at 14 Buses for one slack bus system***

***Fig4: Complex power injected (MW) at 14 Buses for one and three slack bus system***

**Observations:**

*Voltage Magnitude*

Voltage magnitude remains same with both single slack bus system and three slack bus system analyses.

*Voltage Angle*

Voltage angle will increase with increase in the number of slack buses of system.

*Real Power Injection*

With one slack bus the real power injected at bus-1 is 232.4MW while with three slack buses the real power injected at bus-1 is 40MW. So we can observe that with increase in number of slack buses the burden over a single bus is reduced, here in this case the generation is shared among the three slack buses

*Total System Loss*

With one slack bus the net loss is 24.4632MW but while with three slack buses the net loss is 8.03MW. We can observe that the net loss is also reduced with increase in number of slack buses.

**Analysis on 30 bus system**



***Fig1: Single line diagram of IEEE 30 BUS power system***

**System Data of 30 Bus system**

**Bus data**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bus**  **number** | **Voltage**  **(P.u)** | **Angle**  **(Deg)** | **Pgen**  **MW** | **Qgen**  **Mvar** | **Load P**  **MW** | **Load Q**  **Mvar** |
| 1 | 1.05 | 0.0 | 138.48 | -3.99 | 0.0 | 0.0 |
| 2 | 1.0338 | -2.7339 | 57.56 | -0.56 | 21.7 | 12.7 |
| 3 | 1.0334 | -4.7071 | 0.0 | 0.0 | 2.4 | 1.2 |
| 4 | 1.0263 | -5.6389 | 0.0 | 0.0 | 7.6 | 1.6 |
| 5 | 1.0058 | -8.993 | 24.56 | 21.2 | 94.2 | 19.0 |
| 6 | 1.0208 | -6.5078 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 1.0069 | -8.0509 | 0.0 | 0.0 | 22.8 | 10.9 |
| 8 | 1.0230 | -6.4811 | 35.0 | 26.78 | 30.0 | 30.0 |
| 9 | 1.0459 | -8.1658 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | 1.0432 | -10.048 | 0.0 | 0.0 | 5.8 | 2.0 |
| 11 | 1.0913 | -6.2935 | 17.93 | 24.1 | 0.0 | 0.0 |
| 12 | 1.0478 | -9.2514 | 0.0 | 0.0 | 11.1 | 7.5 |
| 13 | 1.0883 | -8.0618 | 16.91 | 31.69 | 0.0 | 0.0 |
| 14 | 1.0340 | -10.161 | 0.0 | 0.0 | 6.2 | 1.6 |
| 15 | 1.0306 | -10.284 | 0.0 | 0.0 | 8.2 | 2.5 |
| 16 | 1.0386 | -9.8714 | 0.0 | 0.0 | 3.5 | 1.8 |
| 17 | 1.0364 | -10.206 | 0.0 | 0.0 | 9.0 | 5.8 |
| 18 | 1.0228 | -10.903 | 0.0 | 0.0 | 3.2 | 0.9 |
| 19 | 1.0214 | -11.077 | 0.0 | 0.0 | 9.5 | 3.4 |
| 20 | 1.0260 | -10.878 | 0.0 | 0.0 | 2.2 | 0.7 |
| 21 | 1.0311 | -10.516 | 0.0 | 0.0 | 17.5 | 11.2 |
| 22 | 1.0317 | -10.509 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23 | 1.0230 | -10.735 | 0.0 | 0.0 | 3.2 | 1.6 |
| 24 | 1.0213 | -10.986 | 0.0 | 0.0 | 8.7 | 6.7 |
| 25 | 1.0254 | -10.896 | 0.0 | 0.0 | 0.0 | 0.0 |
| 26 | 1.0078 | -11.309 | 0.0 | 0.0 | 3.5 | 2.3 |
| 27 | 1.0364 | -10.576 | 0.0 | 0.0 | 0.0 | 0.0 |
| 28 | 1.0156 | -6.9160 | 0.0 | 0.0 | 0.0 | 0.0 |
| 29 | 1.0169 | -11.774 | 0.0 | 0.0 | 2.4 | 0.9 |
| 30 | 1.0056 | -12.634 | 0.0 | 0.0 | 10.6 | 1.9 |

**Line data**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Line No.** | **Between**  **Buses** | **R (p.u.)** | **X (p.u.)** | **Charging**  **B (p.u.)** |
| 1. | 1-2 | 0.00192 | 0.0575 | 0.0264 |
| 2. | 1-3 | 0.0452 | 0.1852 | 0.0204 |
| 3. | 2-4 | 0.0570 | 0.1737 | 0.0184 |
| 4. | 3-4 | 0.0132 | 0.0379 | 0.0042 |
| 5. | 2-5 | 0.0472 | 0.1983 | 0.0209 |
| 6. | 2-6 | 0.0581 | 0.1763 | 0.0187 |
| 7. | 4-6 | 0.0119 | 0.0414 | 0.0045 |
| 8. | 5-7 | 0.046 | 0.1160 | 0.0102 |
| 9. | 6-7 | 0.0267 | 0.0820 | 0.0085 |
| 10. | 6-8 | 0.0120 | 0.0420 | 0.0045 |
| 11. | 6-9 | 0.0 | 0.2080 | 0.0 |
| 12. | 6-10 | 0.0 | 0.5560 | 0.0 |
| 13. | 9-11 | 0.0 | 0.2080 | 0.0 |
| 14. | 9-10 | 0.0 | 0.1100 | 0.0 |
| 15. | 4-12 | 0.0 | 0.2560 | 0.0 |
| 16. | 12-13 | 0.0 | 0.1400 | 0.0 |
| 17. | 12-14 | 0.1231 | 0.2559 | 0.0 |
| 18. | 12-15 | 0.0662 | 0.1304 | 0.0 |
| 19. | 12-16 | 0.0945 | 0.1987 | 0.0 |
| 20. | 14-15 | 0.2210 | 0.1997 | 0.0 |
| 21. | 16-17 | 0.0824 | 0.1932 | 0.0 |
| 22. | 15-18 | 0.1070 | 0.2185 | 0.0 |
| 23. | 18-19 | 0.0639 | 0.1292 | 0.0 |
| 24. | 19-20 | 0.0340 | 0.682 | 0.0 |
| 25. | 10-20 | 0.0936 | 0.2090 | 0.0 |
| 26. | 10-17 | 0.0324 | 0.0845 | 0.0 |
| 27. | 10-21 | 0.0349 | 0.0749 | 0.0 |
| 28. | 10-22 | 0.0727 | 0.1499 | 0.0 |
| 29. | 21-22 | 0.0116 | 0.0236 | 0.0 |
| 30. | 15-23 | 0.1000 | 0.2020 | 0.0 |
| 31. | 22-24 | 0.1150 | 0.1790 | 0.0 |
| 32. | 23-24 | 0.1320 | 0.2700 | 0.0 |
| 33. | 24-25 | 0.1885 | 0.3292 | 0.0 |
| 34. | 25-26 | 0.2544 | 0.3800 | 0.0 |
| 35. | 25-27 | 0.1093 | 0.2087 | 0.0 |
| 36. | 27-28 | 0.0 | 0.3960 | 0.0 |
| 37. | 27-29 | 0.2198 | 0.4153 | 0.0 |
| 38. | 27-30 | 0.3202 | 0.6027 | 0.0 |
| 39. | 29-30 | 0.2399 | 0.4533 | 0.0 |
| 40. | 8-28 | 0.0636 | 0.2000 | 0.0214 |
| 41. | 6-28 | 0.0169 | 0.0599 | 0.0065 |

**Transformer Data**

|  |  |  |
| --- | --- | --- |
| **Transformer** | **Between**  **Buses** | **Tap**  **setting** |
| 1 | 6-9 | 1.0155 |
| 2 | 6-10 | 0.9629 |
| 3 | 4-12 | 1.0129 |
| 4 | 28-27 | 0.9581 |

**Regulated Bus Data(P-V Buses)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bus**  **Number** | **Voltage**  **(p.u.)** | **Min**  **Mvar** | **Max**  **Mvar** |
| 2 | 1.0338 | -20 | 60 |
| 5 | 1.0058 | -15 | 62.5 |
| 8 | 1.0230 | -15 | 50 |
| 11 | 1.0913 | -10 | 40 |
| 13 | 1.0883 | -15 | 45 |

**Shunt Capacitor Data**

|  |  |
| --- | --- |
| **Bus Number** | **Susceptance (p.u.)** |
| 10 | 0.19 |
| 24 | 0.04 |

**Base Case Load Flow Results:**

**Single Slack Bus And Three Slack Bus Analytical Results:**

**VOLTAGES IN PER UNIT AT BUSES**

|  |  |  |
| --- | --- | --- |
| **Bus No.** | **Voltage (single slack Bus)** | **Voltage (3 Slack Bus)** |
| 1 | 1.06 | 1.06 |
| 2 | 1.0431 | 1.045 |
| 3 | 1.0207 | 1.0252 |
| 4 | 1.0118 | 1.0165 |
| 5 | 1.01 | 1.01 |
| 6 | 1.0103 | 1.0126 |
| 7 | 1.0024 | 1.0037 |
| 8 | 1.01 | 1.01 |
| 9 | 1.0509 | 1.0527 |
| 10 | 1.0451 | 1.0478 |
| 11 | 1.082 | 1.082 |
| 12 | 1.0571 | 1.0581 |
| 13 | 1.071 | 1.071 |
| 14 | 1.0423 | 1.0433 |
| 15 | 1.0377 | 1.0393 |
| 16 | 1.0444 | 1.0466 |
| 17 | 1.0399 | 1.0423 |
| 18 | 1.0282 | 1.0302 |
| 19 | 1.0257 | 1.0279 |
| 20 | 1.0297 | 1.0321 |
| 21 | 1.0327 | 1.0354 |
| 22 | 1.0333 | 1.0359 |
| 23 | 1.0272 | 1.0292 |
| 24 | 1.0216 | 1.0241 |
| 25 | 1.0173 | 1.0206 |
| 26 | 0.9997 | 1.003 |
| 27 | 1.0233 | 1.0269 |
| 28 | 1.0068 | 1.0082 |
| 29 | 1.0034 | 1.0072 |
| 30 | 0.9919 | 0.9957 |

**VOLTAGE ANGLES AT BUSES**

|  |  |  |
| --- | --- | --- |
| **Bus No.** | **Angle (Single slack Bus)** | **Angle (Three slack Bus)** |
| 1 | 0 | 0 |
| 2 | -5.35 | 0 |
| 3 | -7.53 | -1.76 |
| 4 | -9.28 | -2.1 |
| 5 | -14.17 | -7.02 |
| 6 | -11.06 | -2.05 |
| 7 | -12.87 | -4.61 |
| 8 | -11.81 | 0 |
| 9 | -14.11 | -5.35 |
| 10 | -15.7 | -7.07 |
| 11 | -14.11 | -5.35 |
| 12 | -14.94 | -7.01 |
| 13 | -14.94 | -7.01 |
| 14 | -15.84 | -7.8 |
| 15 | -15.93 | -7.8 |
| 16 | -15.53 | -7.3 |
| 17 | -15.86 | -7.36 |
| 18 | -16.54 | -8.24 |
| 19 | -16.72 | -8.3 |
| 20 | -16.52 | -8.05 |
| 21 | -16.14 | -7.51 |
| 22 | -16.13 | -7.5 |
| 23 | -16.32 | -7.97 |
| 24 | -16.49 | -7.86 |
| 25 | -16.07 | -7.05 |
| 26 | -16.49 | -7.46 |
| 27 | -15.54 | -6.29 |
| 28 | -11.69 | -2.08 |
| 29 | -16.77 | -7.51 |
| 30 | -17.66 | -8.38 |

**REAL POWER INJECTED AT BUSES**

|  |  |  |
| --- | --- | --- |
| **Bus No.** | **Real Power injected**  **(Single slack Bus)** | **Real Power injected**  **(Three slack Bus)** |
| 1 | 260.9 | 32.9 |
| 2 | 18.3 | 109 |
| 3 | -2.4 | -2.4 |
| 4 | -7.6 | -7.6 |
| 5 | -94.2 | -94.2 |
| 6 | 0 | 0 |
| 7 | -22.8 | -22.8 |
| 8 | -30 | 96.5 |
| 9 | 0 | 0 |
| 10 | -5.8 | -5.8 |
| 11 | 0 | 0 |
| 12 | -11.2 | -11.2 |
| 13 | 0 | 0 |
| 14 | -6.2 | -6.2 |
| 15 | -8.2 | -8.2 |
| 16 | -3.5 | -3.5 |
| 17 | -9 | -9 |
| 18 | -3.2 | -3.2 |
| 19 | -9.5 | -9.5 |
| 20 | -2.2 | -2.2 |
| 21 | -17.5 | -17.5 |
| 22 | 7.6 | 7.6 |
| 23 | -3.2 | -3.2 |
| 24 | -8.7 | -8.7 |
| 25 | 0 | 0 |
| 26 | -3.5 | -3.5 |
| 27 | 0 | 0 |
| 28 | 0 | 0 |
| 29 | -2.4 | -2.4 |
| 30 | -10.6 | -10.6 |

**COMPLEX POWER INJECTED AT BUSES**

|  |  |  |
| --- | --- | --- |
| **Bus No.** | **Complex power input**  **(Single Slack Bus)** | **Complex power input**  **(Three Slack Bus)** |
| 1 | -16.8 | 35.5 |
| 2 | 37.3 | -6.6 |
| 3 | -1.2 | -1.2 |
| 4 | -1.6 | -1.6 |
| 5 | 17.8 | 16.2 |
| 6 | 0 | 0 |
| 7 | -10.9 | -10.9 |
| 8 | 7.1 | -34.1 |
| 9 | 0 | 0 |
| 10 | 18.8 | 18.8 |
| 11 | 16.2 | 15.2 |
| 12 | -7.5 | 9.9 |
| 13 | 10.6 | 10.5 |
| 14 | -1.6 | -1.6 |
| 15 | -2.5 | -2.5 |
| 16 | -1.8 | -1.8 |
| 17 | -5.8 | -5.8 |
| 18 | -0.9 | -0.9 |
| 19 | -3.4 | -3.4 |
| 20 | -0.7 | -0.7 |
| 21 | -11.2 | -11.2 |
| 22 | 0 | 0 |
| 23 | -1.6 | -1.6 |
| 24 | -2.2 | -2.2 |
| 25 | 0 | 0 |
| 26 | -2.3 | -2.3 |
| 27 | 0 | 0 |
| 28 | 0 | 0 |
| 29 | -0.9 | -0.9 |
| 30 | -1.9 | -1.9 |

***Fig2 (b): Voltage (P.U) at 30 Buses for 3 slack bus system***

***Fig2 (a): Voltage (P.U) at 30 Buses for one slack bus system***

***Fig3: Voltage angle (P.U) at 30 Buses for one and three slack bus system***

***Fig4: Real power injected (MW) at 30 Buses for one and three slack bus system***

***Fig5: Complex power injected (Mvar) at 30 Buses for one and three slack bus system***

**Observation:**

*Voltage Magnitude*

Voltage magnitude remains same with both single slack bus system and three slack bus system analyses.

*Voltage Angle*

Voltage angle will increase with increase in the number of slack buses of system.

*Real Power Injection*

With one slack bus the real power injected at bus-1 is 260.9MW while with three slack buses the real power injected at bus-1 is 32.9MW. So we can observe that with increase in number of slack buses the burden over a single bus is reduced, here in this case the generation is shared among the three slack buses

*Total System Loss*

With one slack bus the net loss is 35.462MW but while with three slack buses the net loss is 26.63MW. We can observe that the net loss is also reduced with increase in number of slack buses.