IEEE 14 Bus System Simulation Results

Voltage Profile Variations

Fig. 1. Bus voltage angle variations during single and three slack bus selections

Table 1. Bus voltage magnitude variations during single and three slack bus selections

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bus No.** | **Voltage Magnitude (p.u)** | | **Bus No.** | **Voltage Magnitude (p.u)** | |
| **Single Bus** | **Three Bus** | **Single Bus** | **Three Bus** |
| 1 | 1.06 | 1.06 | 16 | 1.0444 | 1.0481 |
| 2 | 1.0431 | 1.045 | 17 | 1.0399 | 1.0431 |
| 3 | 1.0207 | 1.0307 | 18 | 1.0282 | 1.0322 |
| 4 | 1.0118 | 1.0232 | 19 | 1.0257 | 1.0291 |
| 5 | 1.01 | 1.01 | 20 | 1.0297 | 1.0329 |
| 6 | 1.0103 | 1.0175 | 21 | 1.0327 | 1.0352 |
| 7 | 1.0024 | 1.0067 | 22 | 1.0333 | 1.0357 |
| 8 | 1.01 | 1.01 | 23 | 1.0272 | 1.0308 |
| 9 | 1.0509 | 1.0533 | 24 | 1.0216 | 1.0237 |
| 10 | 1.0451 | 1.0475 | 25 | 1.0173 | 1.0163 |
| 11 | 1.082 | 1.082 | 26 | 0.9997 | 0.9986 |
| 12 | 1.0571 | 1.0641 | 27 | 1.0233 | 1.0209 |
| 13 | 1.071 | 1.071 | 28 | 1.0068 | 1.0124 |
| 14 | 1.0423 | 1.0492 | 29 | 1.0034 | 1.001 |
| 15 | 1.0377 | 1.0428 | 30 | 0.9919 | 0.9895 |

Table 2. Real power injected variations during single and three slack bus selections

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bus No.** | **Real Power (MW)** | | **Bus No.** | **Real Power (MW)** | |
| **Single Bus** | **Three Bus** | **Single Bus** | **Three Bus** |
| 1 | 260.9 | 147.4 | 16 | -3.5 | -3.5 |
| 2 | 18.3 | 18.3 | 17 | -9 | -9 |
| 3 | -2.4 | -2.4 | 18 | -3.2 | -3.2 |
| 4 | -7.6 | -7.6 | 19 | -9.5 | -9.5 |
| 5 | -94.2 | -94.2 | 20 | -2.2 | -2.2 |
| 6 | 0 | 0 | 21 | -17.5 | -17.5 |
| 7 | -22.8 | -22.8 | 22 | 7.6 | 0 |
| 8 | -30 | -30 | 23 | -3.2 | -3.2 |
| 9 | 0 | 0 | 24 | -8.7 | -8.7 |
| 10 | -5.8 | -5.8 | 25 | 0 | 0 |
| 11 | 0 | 44.5 | 26 | -3.5 | -3.5 |
| 12 | -11.2 | -11.2 | 27 | 0 | 0 |
| 13 | 0 | 60.4 | 28 | 0 | 0 |
| 14 | -6.2 | -6.2 | 29 | -2.4 | -2.4 |
| 15 | -8.2 | -8.2 | 30 | -10.6 | -10.6 |

Table 3 Bus complex power variations during single and three slack bus selections

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bus No.** | **Complex Power (Mvar)** | | **Bus No.** | **Complex Power (Mvar)** | |
| **Single Bus** | **Three Bus** | **Single Bus** | **Three Bus** |
| 1 | -16.8 | -1.1 | 16 | -1.8 | -1.8 |
| 2 | 37.3 | 20.1 | 17 | -5.8 | -5.8 |
| 3 | -1.2 | -1.2 | 18 | -0.9 | -0.9 |
| 4 | -1.6 | -1.6 | 19 | -3.4 | -3.4 |
| 5 | 17.8 | 13.5 | 20 | -0.7 | -0.7 |
| 6 | 0 | 0 | 21 | -11.2 | -11.2 |
| 7 | -10.9 | -10.9 | 22 | 0 | 0 |
| 8 | 7.1 | -13.2 | 23 | -1.6 | -1.6 |
| 9 | 0 | 0 | 24 | -2.2 | -2.2 |
| 10 | 18.8 | 18.8 | 25 | 0 | 0 |
| 11 | 16.2 | 16.7 | 26 | -2.3 | -2.3 |
| 12 | -7.5 | -7.5 | 27 | 0 | 0 |
| 13 | 10.6 | 7.5 | 28 | 0 | 0 |
| 14 | -1.6 | -1.6 | 29 | -0.9 | -0.9 |
| 15 | -2.5 | -2.5 | 30 | -1.9 | -1.9 |

Table 5. Current flow variations during single and three slack bus selections

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Line No.** | **Current Flow (p.u.)** | | **Line No.** | **Current Flow (p.u.)** | |
| **Single Bus** | **Three Bus** | **Single Bus** | **Three Bus** |
| 01 – 02 | 720 | 422 | 12 – 13 | 43 | 248 |
| 01 – 03 | 362 | 188 | 12 – 14 | 34 | 40 |
| 02 – 04 | 184 | 80 | 12 – 15 | 79 | 101 |
| 02 – 05 | 346 | 289 | 12 – 16 | 33 | 55 |
| 02 – 06 | 253 | 132 | 14 – 15 | 08 | 13 |
| 03 – 04 | 353 | 180 | 15 – 18 | 26 | 37 |
| 04 – 06 | 320 | 235 | 15 – 23 | 24 | 41 |
| 04 – 12 | 201 | 63 | 16 – 17 | 17 | 40 |
| 05 – 07 | 82 | 131 | 18 – 19 | 12 | 24 |
| 06 – 07 | 166 | 220 | 19 – 20 | 31 | 23 |
| 06 – 08 | 133 | 129 | 21 – 22 | 10 | 09 |
| 06 – 09 | 125 | 54 | 22 – 24 | 27 | 32 |
| 06 – 10 | 69 | 11 | 23 – 24 | 09 | 27 |
| 06 – 28 | 81 | 62 | 24 – 25 | 10 | 20 |
| 08 – 28 | 03 | 14 | 25 – 26 | 18 | 18 |
| 09 – 10 | 118 | 142 | 25 – 27 | 20 | 13 |
| 09 – 11 | 66 | 192 | 27 – 28 | 78 | 58 |
| 10 – 17 | 29 | 24 | 27 – 29 | 27 | 27 |
| 10 – 20 | 41 | 32 | 27 – 30 | 31 | 31 |
| 10 – 21 | 78 | 80 | 29 - 30 | 7 | 16 |
| 10 – 22 | 37 | 39 |  |  |  |

***Report on Slack Bus Analysis of IEEE30 Bus systems:***