**Assignment 1\_13, EE 330, 2014**

**Students:**

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Use the following data to solve the power flow problem using Newton-Raphson method. Take bus 1 as the slack bus and base MVA as 100.

Build the system with the following data in PowerWorld software. Present the power flow result from PowerWorld software, using Newton-Raphson method. How does it compare with the computed power flow solution?

How much is the value of shunt capacitor that you should add at bus 2 such that the voltage at bus 2 becomes at least 0.9 pu? Verify your solution with the software, and show the results.

**Data for the 5 bus system**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bus data |  |  |  |  |  |  |  |  |
| Number | Nom kV | PU Volt | Angle (Deg) | Load MW | Load Mvar | Gen MW | Gen Mvar | B Shunt Mvar |
| 1 | 15 | 1 | 0 | 0 | 0 | 394.8 | 114.18 | 0 |
| 2 | 345 | 1 | 0 | 800 | 280 | 0 | 0 | 0 |
| 3 | 345 | 1.05 | 0 | 80 | 40 | 520 | 337.35 | 0 |
| 4 | 345 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 345 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

Line data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| From Number | To Number | Branch Device Type | R | X | B |
| 5 | 1 | Transformer | 0.0015 | 0.02 | 0 |
| 4 | 2 | Line | 0.009 | 0.1 | 1.72 |
| 5 | 2 | Line | 0.0045 | 0.05 | 0.88 |
| 3 | 4 | Transformer | 0.00075 | 0.01 | 0 |
| 5 | 4 | Line | 0.00225 | 0.025 | 0.44 |

For the first part

1

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Newton Raphson Loadflow Analysis

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| Bus | V | Angle | Injection | Generation | Load |

| No | pu | Degree | MW | MVar | MW | Mvar | MW | MVar |

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1 1.0000 0.0000 363.609 -71.904 363.609 -71.904 0.000 0.000

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2 0.9429 -18.5114 -753.524 -172.093 46.476 107.907 800.000 280.000

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3 1.0500 0.2009 458.925 56.037 538.925 96.037 80.000 40.000

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4 1.0423 -2.1804 -12.677 79.654 -12.677 79.654 0.000 0.000

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5 1.0116 -4.1836 -32.623 79.125 -32.623 79.125 0.000 0.000

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Total 23.711 -29.180 903.711 290.820 880.000 320.000

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Newton Raphson Loadflow Analysis

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| Bus | V | Angle | Injection | Generation | Load |

| No | pu | Degree | MW | MVar | MW | Mvar | MW | MVar |

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1 1.0000 0.0000 389.585 88.944 389.585 88.944 0.000 0.000

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2 0.8518 -21.5135 -784.421 -266.632 15.579 13.368 800.000 280.000

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3 1.0500 -0.4875 440.503 267.770 520.503 307.770 80.000 40.000

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4 1.0221 -2.7325 -3.715 1.553 -3.715 1.553 0.000 0.000

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5 0.9794 -4.4849 -9.926 3.070 -9.926 3.070 0.000 0.000

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Total 32.024 94.705 912.024 414.705 880.000 320.000

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Newton Raphson Loadflow Analysis

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| Bus | V | Angle | Injection | Generation | Load |

| No | pu | Degree | MW | MVar | MW | Mvar | MW | MVar |

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1 1.0000 0.0000 394.612 113.131 394.612 113.131 0.000 0.000

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2 0.8346 -22.3611 -799.148 -279.468 0.852 0.532 800.000 280.000

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3 1.0500 -0.5930 440.004 296.138 520.004 336.138 80.000 40.000

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4 1.0194 -2.8299 -0.237 0.021 -0.237 0.021 0.000 0.000

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5 0.9745 -4.5451 -0.536 0.074 -0.536 0.074 0.000 0.000

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Total 34.695 129.897 914.695 449.897 880.000 320.000

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Newton Raphson Loadflow Analysis

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| Bus | V | Angle | Injection | Generation | Load |

| No | pu | Degree | MW | MVar | MW | Mvar | MW | MVar |

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1 1.0000 0.0000 394.838 114.280 394.838 114.280 0.000 0.000

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2 0.8338 -22.4063 -799.998 -279.999 0.002 0.001 800.000 280.000

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3 1.0500 -0.5973 440.000 297.476 520.000 337.476 80.000 40.000

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4 1.0193 -2.8340 -0.001 0.000 -0.001 0.000 0.000 0.000

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5 0.9743 -4.5479 -0.001 0.000 -0.001 0.000 0.000 0.000

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Total 34.838 131.758 914.838 451.758 880.000 320.000

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Newton Raphson Loadflow Analysis

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| Bus | V | Angle | Injection | Generation | Load |

| No | pu | Degree | MW | MVar | MW | Mvar | MW | MVar |

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1 1.0000 0.0000 394.839 114.283 394.839 114.283 0.000 0.000

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2 0.8338 -22.4064 -800.000 -280.000 0.000 0.000 800.000 280.000

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3 1.0500 -0.5973 440.000 297.480 520.000 337.480 80.000 40.000

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4 1.0193 -2.8340 -0.000 0.000 -0.000 0.000 0.000 0.000

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5 0.9743 -4.5479 -0.000 0.000 -0.000 0.000 0.000 0.000

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Total 34.839 131.763 914.839 451.763 880.000 320.000

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Newton Raphson Loadflow Analysis

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| Bus | V | Angle | Injection | Generation | Load |

| No | pu | Degree | MW | MVar | MW | Mvar | MW | MVar |

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1 1.0000 0.0000 394.839 114.283 394.839 114.283 0.000 0.000

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2 0.8338 -22.4064 -800.000 -280.000 -0.000 -0.000 800.000 280.000

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3 1.0500 -0.5973 440.000 297.480 520.000 337.480 80.000 40.000

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4 1.0193 -2.8340 -0.000 -0.000 -0.000 -0.000 0.000 0.000

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5 0.9743 -4.5479 0.000 -0.000 0.000 -0.000 0.000 0.000

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Total 34.839 131.763 914.839 451.763 880.000 320.000

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