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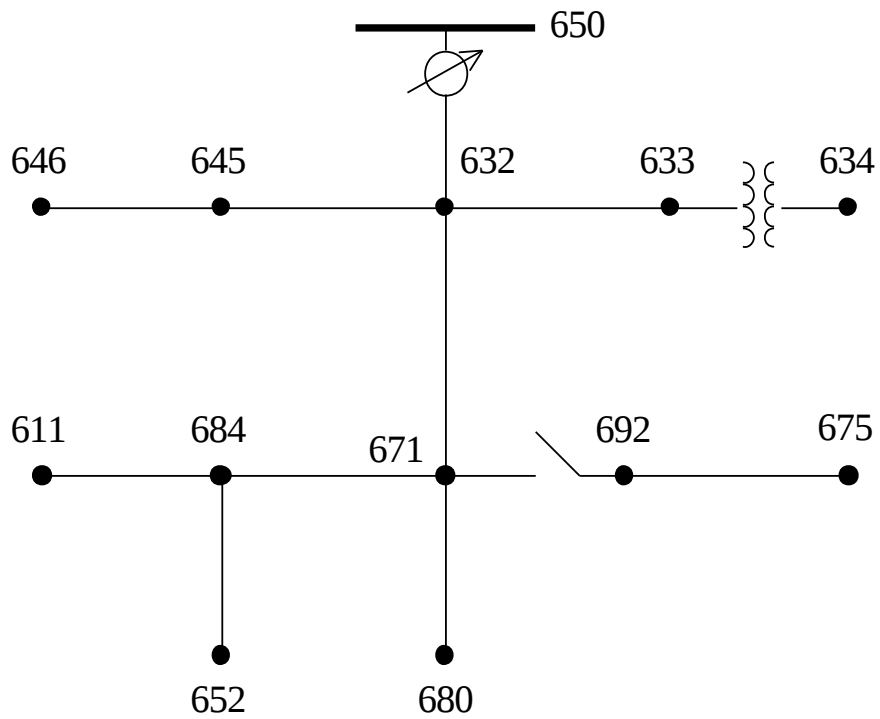
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**Distribution System Analysis Subcommittee**

# IEEE 13 Node Test Feeder



## IEEE 13 Node Test Feeder



### 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     |

### 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    |
| Voltage 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 |
| 634  | Y-PQ  | 160  | 110  | 120  | 90   | 120  | 90   |
| 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   |



## IEEE 13 NODE TEST FEEDER

### *Impedances*

#### Configuration 601:

Z (R +jX) in ohms per mile  
0.3465 1.0179 0.1560 0.5017 0.1580 0.4236  
0.3375 1.0478 0.1535 0.3849  
0.3414 1.0348  
B in micro Siemens per mile  
6.2998 -1.9958 -1.2595  
5.9597 -0.7417  
5.6386

#### Configuration 602:

Z (R +jX) in ohms per mile  
0.7526 1.1814 0.1580 0.4236 0.1560 0.5017  
0.7475 1.1983 0.1535 0.3849  
0.7436 1.2112  
B in micro Siemens per mile  
5.6990 -1.0817 -1.6905  
5.1795 -0.6588  
5.4246

#### Configuration 603:

Z (R +jX) in ohms per mile  
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000  
1.3294 1.3471 0.2066 0.4591  
1.3238 1.3569  
B in micro Siemens per mile  
0.0000 0.0000 0.0000  
4.7097 -0.8999  
4.6658

#### Configuration 604:

Z (R +jX) in ohms per mile  
1.3238 1.3569 0.0000 0.0000 0.2066 0.4591  
0.0000 0.0000 0.0000 0.0000  
1.3294 1.3471  
B in micro Siemens per mile  
4.6658 0.0000 -0.8999  
0.0000 0.0000  
4.7097



**Configuration 605:**

Z (R +jX) in ohms per mile  
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000  
0.0000 0.0000 0.0000 0.0000  
1.3292 1.3475  
B in micro Siemens per mile  
0.0000 0.0000 0.0000  
0.0000 0.0000  
4.5193

**Configuration 606:**

Z (R +jX) in ohms per mile  
0.7982 0.4463 0.3192 0.0328 0.2849 -0.0143  
0.7891 0.4041 0.3192 0.0328  
0.7982 0.4463  
B in micro Siemens per mile  
96.8897 0.0000 0.0000  
96.8897 0.0000  
96.8897

**Configuration 607:**

Z (R +jX) in ohms per mile  
1.3425 0.5124 0.0000 0.0000 0.0000 0.0000  
0.0000 0.0000 0.0000 0.0000  
0.0000 0.0000  
B in micro Siemens per mile  
88.9912 0.0000 0.0000  
0.0000 0.0000  
0.0000



## Power-Flow Results

- **R A D I A L F L O W S U M M A R Y** - DATE: 6-24-2004 AT 15:33: 2 HOURS ---  
 SUBSTATION: IEEE 13; FEEDER: IEEE 13

| SYSTEM | PHASE                 |       | PHASE                 |       | PHASE                 |       | TOTAL              |        |
|--------|-----------------------|-------|-----------------------|-------|-----------------------|-------|--------------------|--------|
| INPUT  | ----- (A) -----       |       | ----- (B) -----       |       | ----- (C) -----       |       | -----              |        |
| kW :   | 1251.398              |       | 977.332               |       | 1348.461              |       | 3577.191           |        |
| kVAr : | 681.570               |       | 373.418               |       | 669.784               |       | 1724.772           |        |
| kVA :  | 1424.968              |       | 1046.241              |       | 1505.642              |       | 3971.289           |        |
| PF :   | .8782                 |       | .9341                 |       | .8956                 |       | .9008              |        |
| LOAD   | -- (A-N) ---- (A-B) - |       | -- (B-N) ---- (B-C) - |       | -- (C-N) ---- (C-A) - |       | ---WYE-----DELTA-- |        |
| kW :   | 785.6                 | 385.0 | 424.0                 | 625.7 | 692.5                 | 553.4 | 1902.1             | 1564.0 |
| TOT :  | 1170.563              |       | 1049.658              |       | 1245.907              |       | 3466.128           |        |
| kVAr : | 393.0                 | 220.0 | 313.0                 | 358.1 | 447.9                 | 369.5 | 1153.9             | 947.7  |
| TOT :  | 613.019               |       | 671.117               |       | 817.450               |       | 2101.586           |        |
| kVA :  | 878.4                 | 443.4 | 527.0                 | 720.9 | 824.8                 | 665.4 | 2224.8             | 1828.7 |
| TOT :  | 1321.367              |       | 1245.865              |       | 1490.137              |       | 4053.481           |        |
| PF :   | .8943                 | .8682 | .8045                 | .8679 | .8397                 | .8316 | .8550              | .8553  |
| TOT :  | .8859                 |       | .8425                 |       | .8361                 |       | .8551              |        |
| LOSSES | ----- (A) -----       |       | ----- (B) -----       |       | ----- (C) -----       |       | -----              |        |
| kW :   | 39.107                |       | -4.697                |       | 76.653                |       | 111.063            |        |
| kVAr : | 152.585               |       | 42.217                |       | 129.850               |       | 324.653            |        |
| kVA :  | 157.517               |       | 42.478                |       | 150.787               |       | 343.124            |        |
| CAPAC  | -- (A-N) ---- (A-B) - |       | -- (B-N) ---- (B-C) - |       | -- (C-N) ---- (C-A) - |       | ---WYE-----DELTA-- |        |
| R-kVA: | 200.0                 | .0    | 200.0                 | .0    | 300.0                 | .0    | 700.0              | .0     |
| TOT :  | 200.000               |       | 200.000               |       | 300.000               |       | 700.000            |        |
| A-kVA: | 193.4                 | .0    | 222.7                 | .0    | 285.3                 | .0    | 701.5              | .0     |
| TOT :  | 193.443               |       | 222.747               |       | 285.276               |       | 701.466            |        |



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--- **V O L T A G E   P R O F I L E** ---- DATE: 6-24-2004 AT 15:33:12 HOURS ----  
 SUBSTATION: IEEE 13; FEEDER: IEEE 13

| NODE   | MAG       | ANGLE | MAG       | ANGLE   | MAG       | ANGLE  | mi.to SR |
|--------|-----------|-------|-----------|---------|-----------|--------|----------|
|        | A-N       |       | B-N       |         | C-N       |        |          |
| 650    | 1.0000 at | .00   | 1.0000 at | -120.00 | 1.0000 at | 120.00 | .000     |
| RG60   | 1.0625 at | .00   | 1.0500 at | -120.00 | 1.0687 at | 120.00 | .000     |
| 632    | 1.0210 at | -2.49 | 1.0420 at | -121.72 | 1.0174 at | 117.83 | .379     |
| 633    | 1.0180 at | -2.56 | 1.0401 at | -121.77 | 1.0148 at | 117.82 | .474     |
| XFXFM1 | .9941 at  | -3.23 | 1.0218 at | -122.22 | .9960 at  | 117.35 | .474     |
| 634    | .9940 at  | -3.23 | 1.0218 at | -122.22 | .9960 at  | 117.34 | .474     |
| 645    |           |       | 1.0329 at | -121.90 | 1.0155 at | 117.86 | .474     |
| 646    |           |       | 1.0311 at | -121.98 | 1.0134 at | 117.90 | .530     |
| 671    | .9900 at  | -5.30 | 1.0529 at | -122.34 | .9778 at  | 116.02 | .758     |
| 680    | .9900 at  | -5.30 | 1.0529 at | -122.34 | .9778 at  | 116.02 | .947     |
| 684    | .9881 at  | -5.32 |           |         | .9758 at  | 115.92 | .815     |
| 611    |           |       |           |         | .9738 at  | 115.78 | .871     |
| 652    | .9825 at  | -5.25 |           |         |           |        | .966     |
| 692    | .9900 at  | -5.31 | 1.0529 at | -122.34 | .9777 at  | 116.02 | .852     |
| 675    | .9835 at  | -5.56 | 1.0553 at | -122.52 | .9758 at  | 116.03 | .947     |

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----- **V O L T A G E   R E G U L A T O R   D A T A** ---- DATE: 6-24-2004 AT 15:33:16 HOURS --  
 SUBSTATION: IEEE 13; FEEDER: IEEE 13

| [NODE] | [VREG] | [SEG] | [NODE]    | MODEL                | OPT    | BNDW                 |
|--------|--------|-------|-----------|----------------------|--------|----------------------|
| 650    | RG60   | 632   | 632       | Phase A & B & C, Wye | RX     | 2.00                 |
| .....  |        |       |           |                      |        |                      |
|        | PHASE  | LDCTR | VOLT HOLD | R-VOLT               | X-VOLT | PT RATIO CT RATE TAP |
|        | 1      |       | 122.000   | 3.000                | 9.000  | 20.00 700.00 10      |
|        | 2      |       | 122.000   | 3.000                | 9.000  | 20.00 700.00 8       |
|        | 3      |       | 122.000   | 3.000                | 9.000  | 20.00 700.00 11      |



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- **R A D I A L P O W E R F L O W** --- DATE: 6-24-2004 AT 15:33:27 HOURS ---  
 SUBSTATION: IEEE 13; FEEDER: IEEE 13

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-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
      NODE      VALUE      PHASE A      PHASE B      PHASE C      UNT O/L<
                          (LINE A)      (LINE B)      (LINE C)      60.%
-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
NODE: 650      VOLTS:      1.000      .00      1.000 -120.00      1.000 120.00 MAG/ANG
kV11  4.160      NO LOAD OR CAPACITOR REPRESENTED AT SOURCE NODE

TO NODE RG60 <VRG>... 593.30 -28.58 435.61 -140.91 626.92 93.59 AMP/DG <
<RG60 > LOSS= .000: ( .000) ( .000) ( .000) kW
-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
NODE: RG60      VOLTS:      1.062      .00      1.050 -120.00      1.069 120.00 MAG/ANG
kV11  4.160      -LD:      .00      .00      .00      .00      .00 kW/kVR
CAP:      .00      .00      .00      .00      .00 kVR

FROM NODE 650 <VRG>: 558.40 -28.58 414.87 -140.91 586.60 93.59 AMP/DG <
<RG60 > LOSS= .000: ( .000) ( .000) ( .000) kW
TO NODE 632 ..... 558.40 -28.58 414.87 -140.91 586.60 93.59 AMP/DG <
<632 > LOSS= 59.716: ( 21.517) ( -3.252) ( 41.451) kW
-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
NODE: 632      VOLTS:      1.021      -2.49      1.042 -121.72      1.017 117.83 MAG/ANG
kV11  4.160      -LD:      .00      .00      .00      .00      .00 kW/kVR
CAP:      .00      .00      .00      .00      .00 kVR

FROM NODE RG60 ..... 558.41 -28.58 414.87 -140.91 586.60 93.59 AMP/DG <
<632 > LOSS= 59.716: ( 21.517) ( -3.252) ( 41.451) kW
TO NODE 633 ..... 81.33 -37.74 61.12 -159.09 62.70 80.48 AMP/DG
<633 > LOSS= .808: ( .354) ( .148) ( .306) kW
TO NODE 645 ..... 143.02 -142.66 65.21 57.83 AMP/DG <
<645 > LOSS= 2.760: ( 2.540) ( .220) kW
TO NODE 671 ..... 478.29 -27.03 215.12 -134.66 475.50 99.90 AMP/DG <
<671 > LOSS= 35.897: ( 10.484) ( -6.169) ( 31.582) kW
-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
NODE: 633      VOLTS:      1.018      -2.56      1.040 -121.77      1.015 117.82 MAG/ANG
kV11  4.160      -LD:      .00      .00      .00      .00      .00 kW/kVR
CAP:      .00      .00      .00      .00      .00 kVR

FROM NODE 632 ..... 81.33 -37.74 61.12 -159.09 62.71 80.47 AMP/DG
<633 > LOSS= .808: ( .354) ( .148) ( .306) kW
TO NODE XFXFM1 ..... 81.33 -37.74 61.12 -159.09 62.71 80.47 AMP/DG <
<XFXFM1> LOSS= 5.427: ( 2.513) ( 1.420) ( 1.494) kW
-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*-----*
NODE: XFXFM1      VOLTS:      .994      -3.23      1.022 -122.22      .996 117.35 MAG/ANG
kV11 .480      -LD:      .00      .00      .00      .00      .00 kW/kVR
CAP:      .00      .00      .00      .00      .00 kVR

FROM NODE 633 ..... 704.83 -37.74 529.73 -159.09 543.45 80.47 AMP/DG <
<XFXFM1> LOSS= 5.427: ( 2.513) ( 1.420) ( 1.494) kW
TO NODE 634 ..... 704.83 -37.74 529.73 -159.09 543.45 80.47 AMP/DG <
<634 > LOSS= .000: ( .000) ( .000) ( .000) kW
  
```



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- **R A D I A L P O W E R F L O W** --- DATE: 6-24-2004 AT 15:33:27 HOURS ---  
 SUBSTATION: IEEE 13; FEEDER: IEEE 13

| NODE                                                                     | VALUE        | PHASE A<br>(LINE A) | PHASE B<br>(LINE B) | PHASE C<br>(LINE C) | UNT O/L<<br>60.% |                      |
|--------------------------------------------------------------------------|--------------|---------------------|---------------------|---------------------|------------------|----------------------|
| -----*-----A-----*-----B-----*-----C-----*-----                          |              |                     |                     |                     |                  |                      |
| NODE: 634                                                                | VOLTS:       | .994                | -3.23               | 1.022               | -122.22          | .996 117.34 MAG/ANG  |
|                                                                          | Y-LD:        | 160.00              | 110.00              | 120.00              | 90.00            | 120.00 90.00 kW/kVR  |
| kV11                                                                     | .480 Y CAP:  |                     | .00                 |                     | .00              | .00 kVR              |
| FROM NODE XFXFM1..... 704.83 -37.74 529.73 -159.09 543.45 80.47 AMP/DG < |              |                     |                     |                     |                  |                      |
| <634 >                                                                   | LOSS=        | .000:               | ( .000)             | ( .000)             | ( .000)          | kW                   |
| -----*-----A-----*-----B-----*-----C-----*-----                          |              |                     |                     |                     |                  |                      |
| NODE: 645                                                                | VOLTS:       |                     | 1.033               | -121.90             | 1.015            | 117.86 MAG/ANG       |
|                                                                          | Y-LD:        |                     | 170.00              | 125.00              | .00              | .00 kW/kVR           |
| kV11                                                                     | 4.160 Y CAP: |                     |                     | .00                 |                  | .00 kVR              |
| FROM NODE 632 ..... 143.02 -142.66 65.21 57.83 AMP/DG <                  |              |                     |                     |                     |                  |                      |
| <645 >                                                                   | LOSS=        | 2.760:              | ( 2.540)            | ( .220)             |                  | kW                   |
| TO NODE 646                                                              | .....        |                     | 65.21               | -122.17             | 65.21            | 57.83 AMP/DG         |
| <646 >                                                                   | LOSS=        | .541:               | ( .271)             | ( .270)             |                  | kW                   |
| -----*-----A-----*-----B-----*-----C-----*-----                          |              |                     |                     |                     |                  |                      |
| NODE: 646                                                                | VOLTS:       |                     | 1.031               | -121.98             | 1.013            | 117.90 MAG/ANG       |
|                                                                          | D-LD:        |                     | 240.66              | 138.12              | .00              | .00 kW/kVR           |
| kV11                                                                     | 4.160 Y CAP: |                     |                     | .00                 |                  | .00 kVR              |
| FROM NODE 645 ..... 65.21 -122.18 65.21 57.82 AMP/DG                     |              |                     |                     |                     |                  |                      |
| <646 >                                                                   | LOSS=        | .541:               | ( .271)             | ( .270)             |                  | kW                   |
| -----*-----A-----*-----B-----*-----C-----*-----                          |              |                     |                     |                     |                  |                      |
| NODE: 671                                                                | VOLTS:       | .990                | -5.30               | 1.053               | -122.34          | .978 116.02 MAG/ANG  |
|                                                                          | D-LD:        | 385.00              | 220.00              | 385.00              | 220.00           | 220.00 kW/kVR        |
| kV11                                                                     | 4.160 Y CAP: |                     | .00                 |                     | .00              | .00 kVR              |
| FROM NODE 632 ..... 470.20 -26.90 186.41 -131.89 420.64 101.66 AMP/DG <  |              |                     |                     |                     |                  |                      |
| <671 >                                                                   | LOSS=        | 35.897:             | ( 10.484)           | ( -6.169)           | ( 31.582)        | kW                   |
| TO NODE 680                                                              | .....        | .00                 | .00                 | .00                 | .00              | .00 AMP/DG           |
| <680 >                                                                   | LOSS=        | .000:               | ( -.001)            | ( .001)             | ( .000)          | kW                   |
| TO NODE 684                                                              | .....        | 63.07               | -39.12              |                     | 71.15            | 121.62 AMP/DG        |
| <684 >                                                                   | LOSS=        | .580:               | ( .210)             |                     | ( .370)          | kW                   |
| TO NODE 692                                                              | .....        | 229.11              | -18.18              | 69.61               | -55.19           | 178.38 109.39 AMP/DG |
| <692 >                                                                   | LOSS=        | .008:               | ( .003)             | ( -.001)            | ( .006)          | kW                   |
| -----*-----A-----*-----B-----*-----C-----*-----                          |              |                     |                     |                     |                  |                      |
| NODE: 680                                                                | VOLTS:       | .990                | -5.30               | 1.053               | -122.34          | .978 116.02 MAG/ANG  |
|                                                                          | -LD:         | .00                 | .00                 | .00                 | .00              | .00 kW/kVR           |
| kV11                                                                     | 4.160 CAP:   |                     | .00                 |                     | .00              | .00 kVR              |
| FROM NODE 671 ..... .00 .00 .00 .00 .00 .00 AMP/DG                       |              |                     |                     |                     |                  |                      |
| <680 >                                                                   | LOSS=        | .000:               | ( -.001)            | ( .001)             | ( .000)          | kW                   |



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- **R A D I A L   P O W E R   F L O W** --- DATE: 6-24-2004 AT 15:33:27 HOURS ---  
 SUBSTATION: IEEE 13; FEEDER: IEEE 13

| NODE                                       | VALUE  | PHASE A<br>(LINE A) | PHASE B<br>(LINE B) | PHASE C<br>(LINE C) | UNT O/L<<br>60.%              |
|--------------------------------------------|--------|---------------------|---------------------|---------------------|-------------------------------|
| -----*-----A-----*-----B-----*-----C-----* |        |                     |                     |                     |                               |
| NODE: 684                                  | VOLTS: | .988                | -5.32               | .976                | 115.92 MAG/ANG                |
|                                            | -LD:   | .00                 | .00                 | .00                 | .00 kW/kVR                    |
| kV11                                       | 4.160  | CAP:                | .00                 |                     | .00 kVR                       |
|                                            |        |                     |                     |                     |                               |
| FROM NODE 671                              | .....  | 63.07               | -39.12              | 71.15               | 121.61 AMP/DG                 |
| <684 > LOSS=                               | .580:  | ( .210)             |                     | ( .370)             | kW                            |
| TO NODE 611                                | .....  |                     |                     | 71.15               | 121.61 AMP/DG                 |
| <611 > LOSS=                               | .382:  |                     |                     | ( .382)             | kW                            |
| TO NODE 652                                | .....  | 63.07               | -39.12              |                     | AMP/DG                        |
| <652 > LOSS=                               | .808:  | ( .808)             |                     |                     | kW                            |
| -----*-----A-----*-----B-----*-----C-----* |        |                     |                     |                     |                               |
| NODE: 611                                  | VOLTS: |                     |                     | .974                | 115.78 MAG/ANG                |
|                                            | Y-LD:  |                     |                     | 165.54              | 77.90 kW/kVR                  |
| kVLL                                       | 4.160  | Y CAP:              |                     |                     | 94.82 kVR                     |
|                                            |        |                     |                     |                     |                               |
| FROM NODE 684                              | .....  |                     |                     | 71.15               | 121.61 AMP/DG                 |
| <611 > LOSS=                               | .382:  |                     |                     | ( .382)             | kW                            |
| -----*-----A-----*-----B-----*-----C-----* |        |                     |                     |                     |                               |
| NODE: 652                                  | VOLTS: | .983                | -5.25               |                     | MAG/ANG                       |
|                                            | Y-LD:  | 123.56              | 83.02               |                     | kW/kVR                        |
| kV11                                       | 4.160  | Y CAP:              | .00                 |                     | kVR                           |
|                                            |        |                     |                     |                     |                               |
| FROM NODE 684                              | .....  | 63.08               | -39.15              |                     | AMP/DG                        |
| <652 > LOSS=                               | .808:  | ( .808)             |                     |                     | kW                            |
| -----*-----A-----*-----B-----*-----C-----* |        |                     |                     |                     |                               |
| NODE: 692                                  | VOLTS: | .990                | -5.31               | 1.053               | -122.34 .978 116.02 MAG/ANG   |
|                                            | D-LD:  | .00                 | .00                 | .00                 | .00 168.37 149.55 kW/kVR      |
| kV11                                       | 4.160  | Y CAP:              | .00                 | .00                 | .00 kVR                       |
|                                            |        |                     |                     |                     |                               |
| FROM NODE 671                              | .....  | 229.11              | -18.18              | 69.61               | -55.19 178.38 109.39 AMP/DG   |
| <692 > LOSS=                               | .008:  | ( .003)             |                     | ( -.001)            | ( .006) kW                    |
| TO NODE 675                                | .....  | 205.33              | -5.15               | 69.61               | -55.19 124.07 111.79 AMP/DG < |
| <675 > LOSS=                               | 4.136: | ( 3.218)            |                     | ( .345)             | ( .573) kW                    |
| -----*-----A-----*-----B-----*-----C-----* |        |                     |                     |                     |                               |
| NODE: 675                                  | VOLTS: | .983                | -5.56               | 1.055               | -122.52 .976 116.03 MAG/ANG   |
|                                            | Y-LD:  | 485.00              | 190.00              | 68.00               | 60.00 290.00 212.00 kW/kVR    |
| kV11                                       | 4.160  | Y CAP:              | 193.44              | 222.75              | 190.45 kVR                    |
|                                            |        |                     |                     |                     |                               |
| FROM NODE 692                              | .....  | 205.33              | -5.15               | 69.59               | -55.20 124.07 111.78 AMP/DG < |
| <675 > LOSS=                               | 4.136: | ( 3.218)            |                     | ( .345)             | ( .573) kW                    |

