

CALCULATION OF LOADS FOR 220 KV D/C Monopole of type - 2P3

INPUT DATA:

| | | |
|--|--------------------------|-------------|
| 1. Wind pressure on Conductors in Kg/Sq.m . | [Pc] = | 106.5 |
| 2. Wind pressure on Ground wire in Kg/Sq.m | [Pgw] = | 133 |
| 3. Wind pressure on Insulator Kg/Sq.m | [Pi] = | 133.5 |
| 4. Wind span in mtrs for NC | [WSNC] = | 150 |
| 5. Wind span in mtrs for BWC | [WSBWC] = | 90 |
| 6. Weight Span in mtrs for NC (max). | [W1] = | 225 |
| 7. Weight Span in mtrs for NC (min). | [W2] = | -225 |
| 8. Weight Span in mtrs for BWC (max). | [W3] = | 135 |
| 9. Weight Span in mtrs for BWC (min) . | [W4] = | -135 |
| 10. Power Conductor Used. | <u>AAAC MOOSE</u> | |
| 11. Diameter of Conductor in mtrs. | [Dc] = | 0.03195 |
| 12. Weight of Conductor in Kg/m . | [Wc] = | 1.666 |
| 13. Number of Conductor. | [Nc] = | 1 |
| 14. Tension of Coductor at 32 deg.C & FW . | [CT1] = | 5213 |
| 15. Tension of Coductor at 32 deg.C & NW . | [CT2] = | 4074 |
| 16. Ground Wire Used. | <u>48F OPGW</u> | |
| 17. Diameter of Ground Wire in mtrs. | [Dgw] = | 0.0122 |
| 18. Weight of Ground wire in Kg/m. | [Wgw] = | 0.451 |
| 19. Tension of Ground Wirer at 32 deg.C & FW . | [GT1] = | 1263 |
| 20. Tension of Ground Wirer at 32 deg.C & NW . | [GT2] = | 456 |
| 21. No.of Insulator Strings. | [NI] = | 2 |
| 22. Length of Insulator String in Mtrs. | [LI] = | 3.35 |
| 22. Diameter of the Insulator in Mtrs. | [DI] = | 0.255 |
| 23. Weight of Insulator String in Kg. (Max). | [Wimax] = | 300 |
| 25. Weight of Insulator String in Kg. (Min). | [Wimin] = | 150 |
| 26. Angle of Deviation in degrees. | [THETA] = | 60 |
| 27. Angle of Deviation in Radians. | [THETA] = | 1.047197567 |
| 28. Angle of Wind Direction (θ) in deg | [THEETA]= | 0 |
| 29. Angle of Wind Direction (θ) in radians | [THEETA]= | 0 |

I. RELIABILITY REQUIREMENT

A. TRANSEVERSE LOADS.

POWER CONDUCTOR

| | | | |
|--|---|------|-------|
| a) Wind on conductor $[P_c \cdot \sin^2 \Omega \cdot W_{SNC} \cdot DC] \cdot N_c$ | = | 510 | |
| b) Wind on Insulators $[P_i \cdot L_i \cdot D_i \cdot N_i \cdot 0.5] \cdot \cos(\theta)$ | = | 114 | |
| c) Due to Deviation $[2 \cdot CT_1 \cdot \sin(\theta/2)] \cdot N_c$ | = | 5213 | |
| | | | ----- |
| | | 5837 | ----- |

GROUND WIRE.

| | | | |
|---|---|------|-------|
| a) Wind on Ground wirer $[P_{gw} \cdot \sin^2 \Omega \cdot W_{SNC} \cdot D_{gw}]$ | = | 243 | |
| c) Due to Deviation $[2 \cdot GT_1 \cdot \sin(\theta/2)]$ | = | 1263 | |
| | | | ----- |
| | | 1506 | ----- |

B. LONGITUDINAL LOADS

| | | | |
|--|---|---|-------|
| a) CONDUCTOR | = | 0 | |
| b) Wind on Insulators $[P_i \cdot L_i \cdot D_i \cdot N_i \cdot 0.5] \cdot \sin(\theta)$ | = | 0 | |
| | | | ----- |
| | | 0 | ----- |

| | | | |
|-----------------|---|---|--|
| a) GROUND WIRE. | = | 0 | |
|-----------------|---|---|--|

C. VERTICAL LOADS.

CONDUCTOR

| | | | |
|---|---|--------------------|--------------------|
| | | <u>Max.</u> | <u>Min.</u> |
| a) Weight of Conductor $[W_c \cdot W_1, W_c \cdot W_2] \cdot N_c$ | = | 375 | -375 |
| b) Weight of Inulator string $[W_{lmax}, W_{lmin}] \cdot N_i$ | = | 600 | 300 |
| | | | ----- |
| | | 975 | -75 |
| | | ----- | ----- |

GROUND WIRE

| | | | |
|--|---|-----|------|
| a) Wght. of Ground Wire $[W_{gw} \cdot W_1, W_{gw} \cdot W_2]$ | = | 101 | -101 |
|--|---|-----|------|

II SECURITY REQUIREMENTS

A. TRANSEVERSE LOADS.

CONDUCTOR

| | | | |
|--|---|-------|-------|
| a) Wind on conductor $[P_c \cdot W_{SNC}/W_{SBWC} \cdot DC] \cdot N_c$ | = | 306 | 510 |
| b) Wind on Insulators $[P_i \cdot L_i \cdot D_i \cdot N_i \cdot 0.5]$ | = | 114 | 114 |
| c) Due to Deviation $[1 \cdot CT1 \cdot \sin(\theta/2) \cdot N_c, 2 \cdot CT1 \cdot \sin(\theta/2) \cdot N_c]$ | = | 2607 | 5213 |
| | | ----- | ----- |
| | | 3027 | 5837 |
| | | ----- | ----- |

GROUND WIRE

| | | | |
|--|---|-------|-------|
| a) Wind on Ground wire $[P_{gw} \cdot W_{SNC}/W_{SBWC} \cdot D_{gw}]$ | = | 146 | 243 |
| b) Due to Deviation $[1 \cdot GT1 \cdot \sin(\theta/2) \cdot N_c, 2 \cdot GT1 \cdot \sin(\theta/2) \cdot N_c]$ | = | 632 | 1263 |
| | | ----- | ----- |
| | | 778 | 1506 |
| | | ----- | ----- |

B. LONGITUDINAL LOADS

| | | | |
|-----------------------|---|------|---|
| a) <u>CONDUCTOR</u> | = | 4515 | 0 |
| b) <u>GROUND WIRE</u> | = | 1094 | 0 |

C. VERTICAL LOADS.

CONDUCTOR.

| | | | |
|---|---|----------------------|--------------------|
| | | <u>BROKEN</u> | |
| | | <u>MAX.</u> | <u>MIN.</u> |
| a) Weight of Conductor $[W_c \cdot W3/W1, W_c \cdot W4/W2] \cdot N_c$ | = | 225 | -225 |
| b) Weight of Inulator string $[W_{lmax}, W_{lmin}] \cdot N_i$ | = | 600 | 300 |
| | | ----- | ----- |
| | | 825 | 75 |
| | | ----- | ----- |

GROUND WIRE

| | | | |
|---|---|----|-----|
| a) Weight of Ground wire $[W_{gw} \cdot W3, W_{gw} \cdot W4]$ | = | 61 | -61 |
|---|---|----|-----|

III. SAFETY REQUIREMENT (NORMAL CONDITION)

A. TRANSEVERSE LOADS.

POWER CONDUCTOR

| | | | |
|--|---|------|-------|
| a) Wind on conductor $[0 * WSNC * DC] * Nc$ | = | 0 | |
| b) Wind on Insulators $[0 * LI * DI * NI * 0.5] * COS(\theta)$ | = | 0 | |
| c) Due to Deviation $[2 * CT2 * SIN(THETA/2)] * Nc$ | = | 4074 | |
| | | | ----- |
| | | 4074 | ----- |

GROUND WIRE.

| | | | |
|--|---|-----|-------|
| a) Wind on Ground witer $[Pgw * SIN^2\Omega * WSNC * Dgw]$ | = | 0 | |
| c) Due to Deviation $[2 * GT2 * SIN(THETA / 2)]$ | = | 456 | |
| | | | ----- |
| | | 456 | ----- |

B. LONGITUDINAL LOADS

| | | | |
|-----------------|---|---|--|
| a) CONDUCTOR | = | 0 | |
| a) GROUND WIRE. | = | 0 | |

C. VERTICAL LOADS.

CONDUCTOR.

| | | | |
|--|---|-------------|-------------|
| | | <u>MAX.</u> | <u>MIN.</u> |
| I) Weight of Conductor $[2 * Wc * W1, 2 * Wc * W2] * Nc$ | = | 750 | -750 |
| ii) Weight of Insulator $[Wimax * NI * 2]$ | = | 1200 | 1200 |
| iii) Weight of line man with tools. | = | 150 | 0 |
| | | ----- | ----- |
| | | 2100 | 450 |
| | | ----- | ----- |

GROUND WIRE.

| | | | |
|--|---|-------|-------|
| ii) Weight of Ground Wire $[Wgw * W3 * 2, Wgw * W1 * 2]$ | = | 203 | -203 |
| iii) Weight of line man with tools. | = | 150 | 0 |
| | | ----- | ----- |
| | | 353 | -203 |
| | | ----- | ----- |

IV. SAFETY REQUIREMENT (BROKEN CONDITION)

A. TRANSEVERSE LOADS

POWER CONDUCTOR

| | <u>BRKN</u> | <u>INTACT</u> |
|--|-------------|---------------|
| a) Wind on conductor $[0 * WSNC * DC] * Nc$ | = 0 | 0 |
| b) Wind on Insulators $[0 * LI * DI * NI * 0.5] * COS(\theta)$ | = 0 | 0 |
| c) Due to Deviation $[1 * CT2 * SIN(THETA/2)] * Nc$ | = 2037 | 4074 |
| | ----- | ----- |
| | 2037 | 4074 |
| | ----- | ----- |

GROUND WIRE.

| | | |
|--|-------|-------|
| a) Wind on Ground witer $[Pgw * SIN^2\Omega * WSNC * Dgw]$ | = 0 | 0 |
| c) Due to Deviation $[2 * GT2 * SIN(THETA / 2)]$ | = 228 | 456 |
| | ----- | ----- |
| | 228 | 456 |
| | ----- | ----- |

B. LONGITUDINAL LOADS

| | <u>BRKN</u> | <u>INTACT</u> |
|--|-------------|---------------|
| CONDUCTOR @ INTACT POINTS $(1.5 * 0.5 * CT2)$: | = | 3056 |
| CONDUCTOR @ STRINGING POINTS $(2.0 * 0.5 * CT2)$: | = 4074 | |
| | ----- | ----- |
| | 4074 | 3056 |
| | ----- | ----- |

| | | |
|--|-------|-----|
| GROUND WIRE @ INTACT POINTS $(1.5 * 0.5 * GT2)$: | = | 342 |
| GROUND WIRE @ STRINGING POINTS $(2.0 * 0.5 * GT2)$: | = 456 | |

C. VERTICAL LOADS

CONDUCTOR.

| | <u>BROKEN</u> | |
|--|---------------|-------------|
| | <u>MAX.</u> | <u>MIN.</u> |
| i) Weight of Conductor $[2 * Wc * W3, 2 * Wc * W4] * Nc$ | = 450 | -450 |
| ii) Weight of Insulator $[Wimax * NI * 2]$ | = 1200 | 1200 |
| iii) Weight of line man with tools. | = 150 | 0 |
| | ----- | ----- |
| | 1800 | 750 |
| | ----- | ----- |

GROUND WIRE.

| | | |
|--|-------|-------|
| ii) Weight of Ground Wire $[Wgw * W3 * 2, Wgw * W4 * 2]$ | = 122 | -122 |
| iii) Weight of line man with tools. | = 150 | 0 |
| | ----- | ----- |
| | 272 | -122 |
| | ----- | ----- |

V. ANTI - CASCADING REQUIREMENTS.

A. TRANSEVERSE LOADS (Only deviation loads)

| | | |
|---|---|------|
| a. Conductor ($1 \cdot CT2 \cdot \sin(\theta/2)$) | = | 2037 |
| b. Ground Wire ($1 \cdot GT2 \cdot \sin(\theta/2)$) | = | 228 |

B. VERTICAL LOADS.

| | | <u>MAX.</u> | <u>MIN.</u> |
|--|---|--------------------|--------------------|
| a) Weight of Conductor [$W_c \cdot W1/W2 \cdot 0.5$] $\cdot N_c$ | = | 187 | -187 |
| a) Weight of Insulators. [$W_{imax} \cdot N_I$] | = | 600 | 600 |
| | | ----- | ----- |
| | | 787 | 413 |
| | | ----- | ----- |
| a) Weight of Ground wire [$W_{gw} \cdot W1 \cdot 0.5$] | = | 51 | -51 |

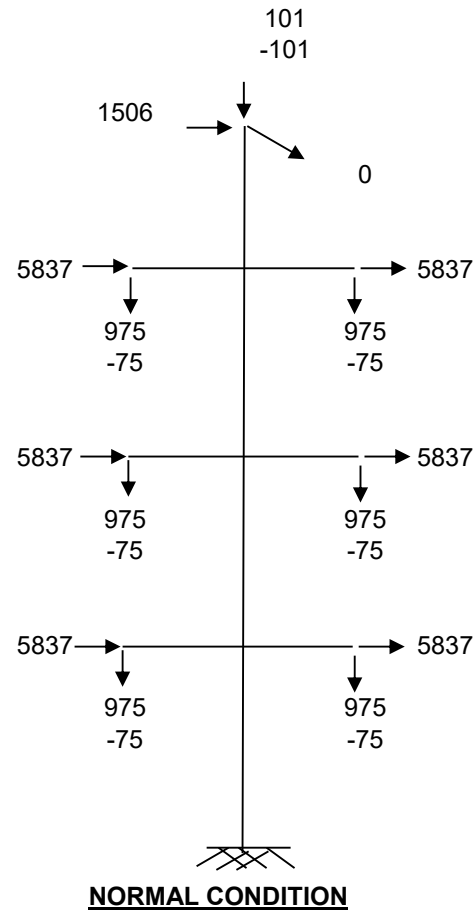
C. LOGITUDINAL LOADS

| | | |
|------------------------------------|---|------|
| a) Conductor [$CT2$] $\cdot N_c$ | = | 4074 |
| b) Ground Wire [$GT2$] | = | 456 |

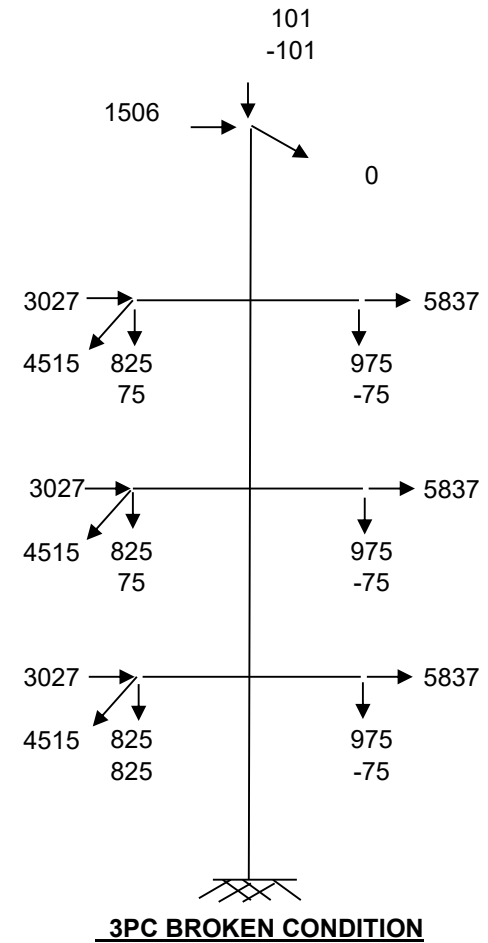
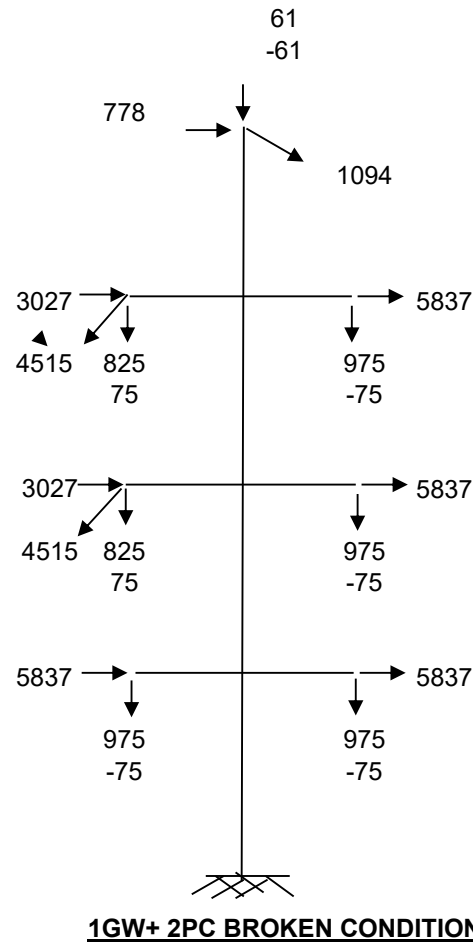
LOADING TREES FOR 220kV D/C MONOPOLE OF TYPE 2P3(30° - 60°)"

(ANGLE OF DEVIATION: 60 Deg & WIND ANGLE: 0 Deg)

1 - RELIABILITY CONDITION



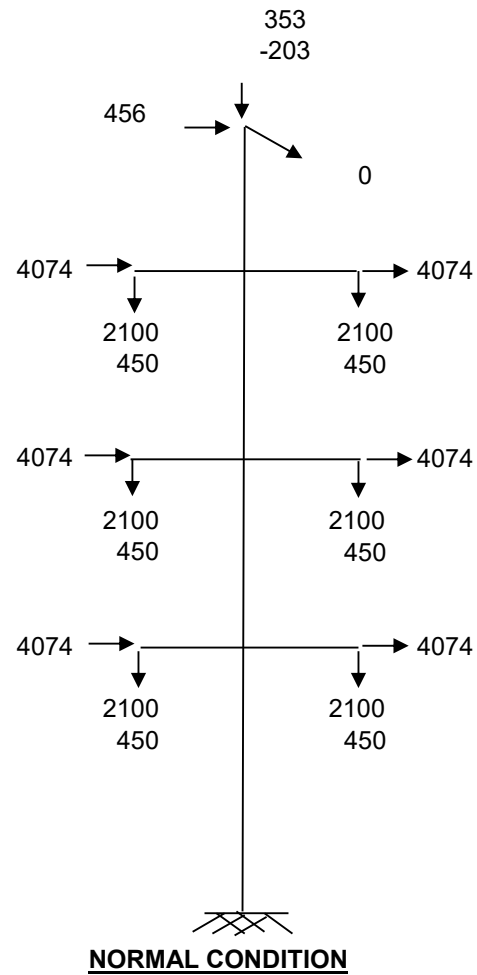
2 - SECURITY CONDITION



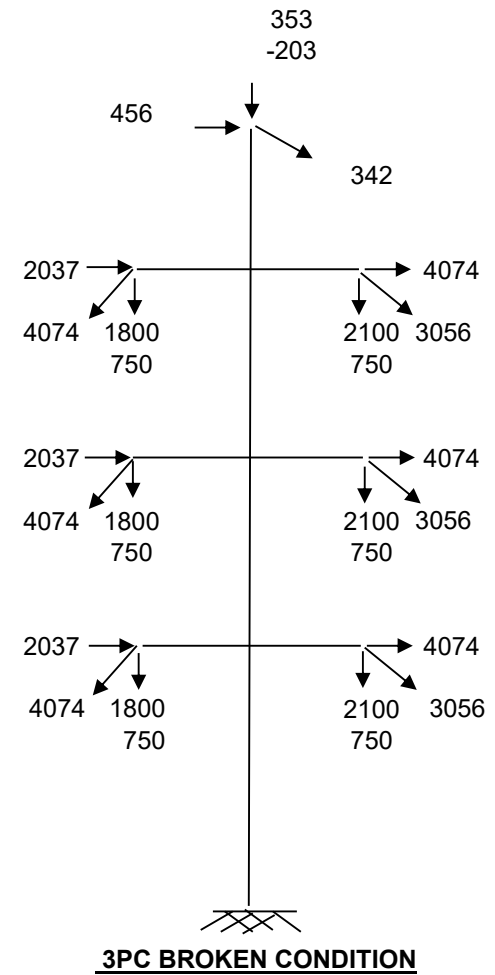
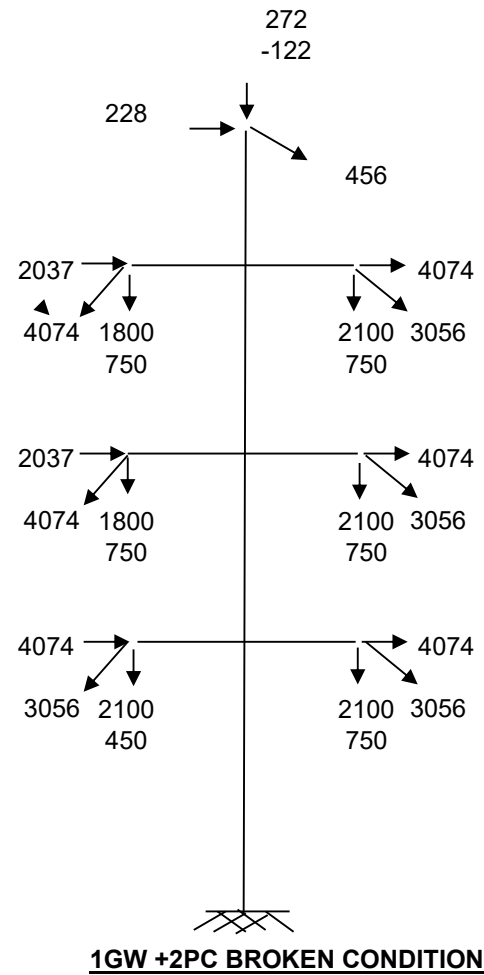
LOADING TREES FOR 220kV D/C MONOPOLE OF TYPE 2P3(30° - 60°)"

(ANGLE OF DEVIATION: 60 Deg & WIND ANGLE: 0 Deg)

3 - SAFETY CONDITION



4 - SAFETY BROKEN CONDITION



LOADING TREES FOR 220kV D/C MONOPOLE OF TYPE 2P3(30° - 60°)"

(ANGLE OF DEVIATION: 60 Deg & WIND ANGLE: 0 Deg)

5 - ANTI-CASCADING

