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From Power Grid

POWERGRID CORPORATION OF INDIA LTD.

TOWER SPOTTING DATA

FOR

**400 KV D/C TRANSMISSION LINE.
ACSR CONDUCTOR-MAX TEMP-85 DEG C**

FOR WIND ZONE-2 (39 M/Sec)

DRG.No. TSD/WZ2

REV:0

**No of Pages: 6
(excluding this page)**

Base Document:

**400kv KOHLAPUR - PONDA (MAPUSA) TRANS. SYSTEM
for wind zone-2, 39m/s**

**THIS DRAWING IS ALSO TO BE USED FOR 400 Kv D/C MAITHON - RANCHI
TRANSMISSION LINE WITH TWIN BUNDLE CONDUCTOR AGAINST SPECIFICATION
NO. C-45905-L195A-3 (PACKAGE -A5)**

| Revision | Date | Description | Prepared By | Reviewed By | Approved By |
|----------|------|-------------|-------------|-------------|-------------|
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W.O. : AZ 03 A & B

THIS DRAWING IS ALSO TO BE USED FOR

- I) LILO of both circuits of Neelmangala - Somanahally 400kV D/C Transmission Line at Bidadi associated with SRSS-X Transmission system.
 - II) LILO of both circuits of 400kV D/C Udamaipet-Trichur Transmission Line at Palakad S/S associated with SRSS-XI Transmission system.
- Against Ref. NOA No. : C-56902-L168-3/G4/NOA-I/3237 & NOA-II/3238
TOWER PACKAGE - A, Dated : 17.02.2010

POWER GRID CORPORATION OF INDIA LTD
TOWER SPOTTING DATA FOR
400KV D/C TRANSMISSION LINE FOR WIND ZONE (39m/sec)

| SL NO | DESCRIPTION | DA | | DB | | DC | | DD | |
|-------|---|------------------|---|-------------|--|---|--|---|-----------|
| | | 0 DEGREE | | 0-15 DEGREE | | 15-30 DEGREE | | 30-60 DEGREE | |
| | | DOWNWARDS | DOWNWARD | UPWARD | DOWNWARD | UPWARD | DOWNWARD | UPWARD | UPWARD |
| | | MAX | MAX | MIN | MAX | MIN | MAX | MIN | MIN |
| 1 | MAXIMUM ANGLE OF DEVIATION | | | | | | | | |
| 2 | VERTICAL LOAD LIMITATION ON WEIGHT SPAN (FOR BOTH GW & CONDUCTOR) (I) ON BOTH SPANS (m) (II) ONE SPAN (m) | 600 360 | 600 360 | 0 -200 | 600 360 | 0 -200 | 600 360 | 0 -300 | 0 -300 |
| 3 | PERMISSIBLE SUM OF ADJACENT SPANS IN METERS FOR VARIOUS DEVIATION ANGLES (SUBJECT TO AVAILABILITY OF MINIMUM SPECIFIED LIVE METAL CLEARANCES). PERMISSIBLE ONE SPAN FOR VARIOUS DEVIATION ANGLES SHOULD NOT EXCEED 50% OF THE VALUE SHOWN FOR SUM OF ADJACENT SPANS. | DEVN ANGLE 0° | DEVN ANGLE 15° 14° 13° 12° 11° 10° 9° 8° 7° & BELOW | SPAN 800 | DEVN ANGLE 30° 29° 28° 27° 26° 25° 24° 23° 22° & BELOW | SPAN 800 845 890 935 980 1025 1070 1115 1160 | DEVN ANGLE 60° 59° 58° 57° 56° 55° 54° 53° 52° 51° 50° & BELOW | SPAN 800 840 880 920 960 1000 1040 1080 1120 1160 1200 | |

NOTE: Max. conductor temperature has been considered 85 deg.C for 400 KV D/C line. The tower has been designed considering Max. temperature of conductor 75 deg.C. Therefore tower can be spotted at normal span if required ground clearance is available, other wise span shall be reduced accordingly.

4. +18/+25m Extn. For Tower type DA.

- a. Max. wind span = 300 M
- b. Deviation angle = 0 deg.

5. +18/+25m Extn. For Tower type DD.

| Permissible sum of adjacent spans in meters for various deviation angles (subject to availability of minimum specified live metal clearances). Permissible one span for various deviation angles should not exceed 50% of the value shown for sum of adjacent spans | DEVN ANGLE | SPAN |
|--|------------|------|
| Note: The span may however be increased than the value indicated in table for reduced angle of line deviation. The detail proposal alongwith the profile shall be forwarded to CC Engg for their review / approval. | 50° | 720 |
| | 49° | 762 |
| | 48° | 804 |
| | 47° | 846 |
| | 46° | 888 |
| | 45° | 930 |
| | & below | |

I. General Details

Normal Span : 400

Design Wind Span (m)

| | DA | DB | DC | DD |
|-----|-----|-----|-----|-----|
| NC | 400 | 400 | 400 | 400 |
| BWC | 240 | 240 | 240 | 240 |

II. ELECTRICAL CLEARANCE FOR RAILWAY CROSSING:

- > Prior approval of Railway Authority is to be obtained.
- > Minimum Clearance between lowest point of 400kV line Conductor and Rail level shall be 17.9m. However approval of railway crossing from railway authority has to be obtained in each case
- > The crossing span shall be limited to 300 M
- > The crossing shall normally be at right angle to the railway track.
- > Crossing should be done with DD type tower.

III. Minimum Clearance for Power line crossing

- For 400kV : 5490 mm
- For 220kV : 5490 mm
- For 132kV : 5490 mm

IV. TELECOMMUCATION LINE CROSSING:

The angle of crossing shall be as near to 90 deg. as possible. However, deviation to the extent of 30 deg. May be permitted under exceptionally difficult situations.

The number of consecutive spans between the section points shall not exceed 15 or 5 Km. in plain terrain, and 10 spans or 3 Km. in hilly terrain. A section point shall comprise of tension point with DB type or DC type or DD type towers as applicable.

- VI. Minimum ground clearance required : 8840mm
- VII. For all National Highway crossing, tension tower is to be used and the crossing span is not to exceed 250meters.
- VIII. Way leave clearance : 23 M either side from the C.L. of the tower.
- IX. Maximum Span of Adjacent Spans for various Angles of deviation are subject to the condition that Minimum specified Live Metal Clearance & Minimum Ground Clearance are available.
- X. Tower type "DC" shall be used for transposition with 0 deg Deviation with modification of cross arms
- XI. Maximum deviation of line for dead end tower shall be 15 deg. both side i.e. line side and substation side (slack span side).
- XII. Vertical load of individual spans are acting downwards for suspension towers.
- XIII. Broken wire Conditions :

| | |
|-------------------------------------|--|
| Suspension Tower (DA) | Any ground wire broken or both sub-conductors of a bundle in one phase only. |
| Small/Medium Angle Towers (DB,DC) | Breakage of two phases on same side and on same span or breakage of any one phase and any one earthwire on same span. |
| Large angle/Dead End towers (DD/DE) | Breakage of all three phases on same side and on same span or breakage of any two phases and any one earthwire on same span. |

XIV. Design Load Tensions :

For Ground Wire : 1212.69 kgs (32° & NW) (For T.T "DA")
2619.96 kgs (32° & FW)

| Deviation Angle | 0° | 15° | 30° | 60° |
|-----------------|---------|---------|---------|---------|
| Tension (kgs) | 2619.96 | 2597.54 | 2530.68 | 2268.95 |

For Conductor : 3614.16kgs (32° & NW) (For T.T "DA")
6333.2 kgs (32° & FW)

| Deviation Angle | 0° | 15° | 30° | 60° |
|-----------------|--------|---------|---------|---------|
| Tension (kgs) | 6333.2 | 6279.01 | 6117.40 | 5484.71 |

Sag-Tension Calculation of CSR Moose

(Brajesh Kumar, Eoan-I/L)

Conductor Properties

Conductor Name: ACSR Moose
 UTS (kg): 10428
 Area of Conductor (sqmm): 587
 Wt. of Conductor (kg/m): 2.004
 Dia of Conductor (mm): 31.77
 Modulus of Elasticity (kg/sqmm): 7034
 Coeff of linear Expansion (per deg C): 0.0000193

Initial Condition

Normal Span (m): 400
 Wind Pressure on Cond. (Kg/sqmm): 109.9937
 Initial Cond. temp. (deg C): 32
 Initial Wind %: 0
 Initial Cond. tension at above temp. and wind condition (% of UTS OR value in Kg): 22

Note: The tension should be below 22% of UTS in day to day condition and should not exceed 70% of UTS in any condition.

| | |
|-------------------------|-------------------------|
| 22% of UTS = 3614.16 Kg | 70% of UTS = 11489.6 Kg |
|-------------------------|-------------------------|

| Initial Sag, Ten at 32 deg C, 0% Wind | | |
|---------------------------------------|--------------|-----------|
| Tension (%) | Tension (kg) | Sag (mts) |
| 22.00 | 3614.16 | 11.09 |

| Standard Conditions | | | | | | Any other condition |
|---------------------------|---------|---------|---------|---------|---------|---------------------|
| Temperature (deg C) | 0 | 32 | 75 | 0 | 32 | 85 |
| Pressure (% of full wind) | 0 | 0 | 0 | 36 | 100 | 0 |
| Resultant Tension (Kg) | 4144.81 | 3614.16 | 3114.26 | 4698.92 | 6333.22 | 3022.04 |
| Resultant Sag (mts) | 9.67 | 11.09 | 12.87 | # | # | 13.26 |

Starting Conditions

- a) For equivalent span less than or equal to Normal Span i.e. 400m (For both conductor & Earthwire) - 32 °C & No Wind
- b) For equivalent greater than Normal Span i.e. 400m (For both conductor & Earthwire) - 32 °C & Full Wind

L span

Sag-Tension Calculation of Earthwire

(Dr. Rajesh Kumar, Engg. IIT)

Conductor Properties

Conductor Name Earthwire
 UTS (Kg) 8972
 Area of Conductor (sqmm) 73.65
 Wt. of Cond (Kg/m) 0.583
 Dia of Cond. (mm) 10.98
 Mod. of Elasticity (Kg/sqmm) 19381
 Coeff. of linear expansion (per deg C) 0.0000115

Initial Condition

Normal Span (m) 400
 Wind Pressure on Cond. (Kg/sqcm) 137
 Initial Cond. temp. (deg C) 0
 Initial Wind % 0
 Initial Cond. tension at above temp. and wind condition (% of UTS OR value in Kg) 1339.91

| | |
|---|------------------------|
| Note: The tension should be below 20% of UTS in day to day condition and should not exceed 70% of UTS in any condition. | |
| 20% of UTS = 1384.4 Kg | 70% of UTS = 4980.4 Kg |

| Initial Sag, Ten at 0 deg C, 0% Wind | | | |
|--------------------------------------|---------|-------|-------|
| #REF! | #REF! | #REF! | #REF! |
| 19.22 | 1339.91 | 8.70 | 8.70 |

| Standard Conditions | | | | | | Any other condition |
|----------------------------|---------|---------|---------|---------|---------|---------------------|
| Temperature (deg C) | 0 | 32 | 75 | 0 | 32 | 63 |
| Pressure (% of full wind) | 0 | 0 | 0 | 38 | 100 | 0 |
| Resultant Tension (Kg) | 1339.91 | 1212.66 | 1080.08 | 1677.98 | 2619.98 | 1143.24 |
| Resultant Sag (mts) | 8.70 | 9.62 | 10.80 | # | # | 10.20 |

• Tension WITHIN Indian Standard limits

TABLE FOR EXTRA GROUND CLEARANCE TO BE PROVIDED FOR EQUIVALENT SPAN IS LESS THAN THE NORMAL SPAN (i.e. 400 M)

| SENo. | Equivalent span | Tension as per string chart 85 deg.c in kg. (T ₁) | Tension as per sag template at 85 deg.c in kg. (T ₂) | Formula for calculating extra ground clearance for all individual span in meter |
|-------|-----------------|--|---|---|
| 1. | 400 | 3022.04 | 3022.04 | $(2.004/8) \times (\text{SPAN})^2 \times (1/T_1 - 1/T_2)$ |
| 2. | 390 | 3001 | 3022.04 | |
| 3. | 380 | 2979 | 3022.04 | |
| 4. | 370 | 2956 | 3022.04 | |
| 5. | 360 | 2933 | 3022.04 | |
| 6. | 350 | 2907 | 3022.04 | |
| 7. | 340 | 2881 | 3022.04 | |
| 8. | 330 | 2854 | 3022.04 | |
| 9. | 320 | 2825 | 3022.04 | |
| 10. | 310 | 2794 | 3022.04 | |
| 11. | 300 | 2762 | 3022.04 | |
| 12. | 290 | 2729 | 3022.04 | |
| 13. | 280 | 2693 | 3022.04 | |
| 14. | 270 | 2656 | 3022.04 | |
| 15. | 260 | 2617 | 3022.04 | |
| 16. | 250 | 2575 | 3022.04 | |
| 17. | 240 | 2532 | 3022.04 | |
| 18. | 230 | 2486 | 3022.04 | |
| 19. | 220 | 2437 | 3022.04 | |
| 20. | 210 | 2386 | 3022.04 | |
| 21. | 200 | 2332 | 3022.04 | |