INSTRUCTION FOR BOOSTER TRANSFORMER /RETURN CONDUCTORS IN 25 kV AC TRACTION SYSTEM –NORMS TO BE ADOPTED

The norms which are to be followed for the provision of BT & RC in the 25 kV electrified section are given below. The letter from Director (OF) , DOT, Sanchar Bhavan , New Delhi addressed to CGM, RE project circle ,DOT, Nagpur is at Annexure –1. Method of calculation for induced voltage in Telecom line due 25 Kv OHE is at Annexure-II. Soil resistivity which plays an important role in electromagnetic induction has also been given in table form indicating the mutual impedance in ohm/km, to be adopted in the calculation of induced voltage.

No. 88/RE/141/4 New Delhi, dated. 27.5.94.

General Manager (Electrical),
General Manager (S&T)
All Zonal Railways except N. F. Railway.

Sub: Booster transformers/Return Conductors in Electrified territories - norms to be satisfied.

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The matter regarding norms to be satisfied for providing booster transformers (BT) and return conductor (RC) while electrifying Railway tracks had been under consideration with the Department of Telecommunications (DOT) for some time. The Railways' view-point that the standards prescribed in the International Telegraph and Telephone Consultative committee (CCITT) Directives are required to be followed and the norms accordingly revised and all concerned advised has been accepted by the DOT. The DOT has also accepted the principle that Railways will provide protective works for existing installations of DOT while for their future installations, the DOT itself would take necessary measures for protection. A copy of DOT's letter No. 114/2/92/TPL (CF) dated 17.05.1994 in this regard is at Annexure-I.

The revised norms required to be satisfied are: -

i) The longitudinal induced voltage on DOT lines due to railway electrification shall not exceed 60V under normal working conditions and 430 V under faulty conditions.

ii) The limit of 5 V shall be applicable only for transverse induced voltage on the DOT lines.

iii) The rail screening factor shall be 0.28 where all four (4) rails are conducting on a double track section.

The methodology for calculating the longitudinal induced voltage and the length of parallelism of DOT overhead lines with the 25 kV a.c. 50 H_z single phase traction overhead equipment for various soil resistivities based on the above norms is at Annexure - II.

Taking into account the revised norms, the need for continuing the BT/RC in all sections wherever provided should be reviewed in consultation with the General Manager of the concerned Telecommunications circle to determine the sections in which the BT/RC can be dispensed with altogether. To start with the sections where the voltage profile of the OHE is poor - particularly where two streams of traffic meet say like at Bhusaval- Should be reviewed first and thereafter the other. The sections over which BT/RC are proposed to be removed may perhaps be utilised as spares or in those sections where essentially required. It is desired that action be initiated immediately required. It is desired that action be initiated immediately and completed by 30.09.1994 and a completion report sent to this office.

The receipt of this letter may please acknowledged.

Sd.(Noel Lobo Prabhu)
Adviser (Electrical)
Railway Board

Enc.: Two

Copy to:

General Manager/CORE/Allahabad together with copy in each of the above Annexures. The BT/RC shall be provided in accordance with the revised norms only. The requirement of BT/RC in the sections being electrified and to be electrified may be determined in consultation with the Chief General Manager/Telecommunication, RE Project/Nagpur to determine the sections where BT/RC is needed and this office advised. The BT/RC removed by the various Zonal Railways may perhaps be utilised for these sections where BT/RC is essentially needed . The estimate of various projects may be reviewed and recast/revised as needed. The action taken in the matter be advised to this office . The receipt of this letter may please be acknowledged.

Sd.(Noel Lobo Prabhu)
Adviser (Electrical)
Railway Board

Enc.: Two

Annexure 'I'

Sanchar Bhavan
20, Ashoka Road,
New Delhi - 110 001.

No. 114/2/92/TPL/(CX) May 17,1994.

The Chief General Manager Telecom.
RE Project Circle,
Nagpur - 440 010.

1.0 Recommendations of the Technical committee.

A Technical Committee consisting of following members form DOT and Railways was constituted in December, 1992 to study the requirement of BT/RC_s as well as payment to DOT for protective works due to Railway Electrification.

1. Sh. A.K. Trikha, Advisor (P), DOT.
2. Sh. M.V. Bhaskara Rao, CGM/REPC, Nagpur.
3. Dr. D. P. S. Seth, Dy. Dir. General, (TX), DOT.
4. Sh. N. K. Goel, EDRE (S&T), Railway Board.
5. Sh. Lobo Prabhu, Director (TI), RDSO, Lucknow.
6. Sh. M. L. Gambhir, Director (Tele), RDSO, Lucknow

2.0 The recommendations of the Technical Committee have been examined in the Telecom Commission and the following guidelines, approved by the Telecom Commission, is furnished below for information and necessary action.

1. The following guidelines will be a decision factor for providing booster transformer by the Railways:

a) The voltage on DOT Lines due to Railway Electrification should not exceed 60 volts longitudinal voltage and 5 volts as transverse voltage under faulty conditions as per CCITT recommendation.

b) Railway Reduction Factor for the new schemes can be taken as 0.28 where all the four Rails are conducting under the following condition:

i) The Rails have been provided with bonded joint and not mechanical bonds.

ii) After the Railways Electrification work is completed, if on actual measurements, the Railway Reduction Factor as observed is not more than 0.28. In all other cases, RRF will be taken as 0.44.

No overhead alignment should exist within 50 meters from the railway track in electrified sections due to static charging by higher working voltage.

III) For the purpose of trunk diversion for protection, the cash component and 50% of the stores component of the overhead alignment, considering as if this alignment is to be provided new along the railway track, may be taken for the purpose of calculating the cost of protective works. The cost of cash component and 50% of stores component should be after surrender of railway circuits due to railway electrification. The cost of transferring the circuits on the microwave/PCM etc. should be taken as the lower of the two options for payment by Railways to DOT.

IV) The committee recommends that the track sections will be categorised into rural and urban areas for the purpose of protective works. Urban and rural will be identified as per the norms laid down in the consensus report.

3.0) Further, it is also clarified that Railways will provide the protective equipment only for the existing installations and not for future installations.

Sd. (P. GANESH)
DIRECTOR (OF)

Copy to:

1) Shri. N. K. Goel, Executive Director, RE (S&T), Railway New Delhi for information.

2) Shri. R. Lalwani, DDG (LL) T.E.C., New Delhi.

3) Shri. T. K. Sampath Kumar, DDG (ML), DOT, New Delhi.

Annexure -II

INDUCED VOLTAGE ON TELECOMMUNICATION LINES DUE TO 25 kV ELECTRIFICATION

INDUCED VOLTAGE ON TELECOMMUNICATION LINES

IV = 2π | m I L K volt, where
| = frequency of inducing current in H_z.
I = Inducing current in Ampere.
m = Modulus of mutual inductance per unit length in Henry per km between. the OHE and telecom. lines with earth return
L = Length of parallelism in km.
K. = Screening factor.

For the frequency of 50 H_z, the mutual impedance for a given earth resistively. 2π m has been taken from the mutual impedance graph and the same is denoted as M.

Therefore,

IV = M (Mutual. Impedance in ohm per km)

X L (Length of parallelism in km)

X K (Screening factor)

X I (Circuit current in A)

= ML X 600 X 0.28

= 168 ML

Where, K = 0.28 Rail Screening factor for double line section.
I = 600 A.
If M is the mutual impedance in ohm/1000 m ,then

IV = 168 X ML

If IV = 60 V, then

$$ML = \frac{60}{168} = 0.3571428$$

$$\text{or L in km} = \frac{0.3571428}{M \text{ (Mutual impedance for 1000 m.)}}$$

TABLE FOR PERMITTED LENGTH OF PARALLELISM FOR 60V. INDUCED VOLTAGE AT DIFFERENT SOIL RESISTIVITIES

Distance from OHE in meter	M in ohm/km.	Length of O/H in km	Length of cable in km. (Cable S/F O.8)
SOIL RESISTIVITY (ohm. Cm.)	500		
35.0	0.12500	2.857	3.57
50.0	0.10500	3.401	4.25
100.0	0.06500	5.49.5	6.87
200.0	0.03500	10.204	12.76
300.0	0.02200	16.234	20.29
400.0	0.01300	27.473	34.34
500.0	0.00820	43.554	54.44
600.0	0.00550	64.935	81.17
700.0	0.00380	93.985	170.48
800.0	0.00290	123.153	153.94
900.0	0.00220	162.338	202.92
1000.0	0.00180	198.413	248.02
SOIL RESISTIVITY (ohm. Cm.)	1000		
35.0	0.14500	2.463	3.08
50.0	0.12500	2.857	3.57
100.0	0.08500	4.202	5.25
200.0	0.04900	7.289	9.11
300.0	0.03300	10.823	13.53
400.0	0.02150	60.611	20.76
500.0	0.01450	24.631	30.79
600.0	0.01100	32.468	40.58
700.0	0.00760	46.992	58.74
800.0	0.00590	60.533	75.67
900.0	0.00450	79.365	99.21
1000.0	0.00360	99.206	124.01
SOIL RESISTIVITY (ohm. Cm.)	3000		
35.0	0.18000	1.984	2.48
50.0	0.15500	2.304	2.88
100.0	0.11000	3.247	4.00
200.0	0.07500	4.762	5.95
300.0	0.05500	6.494	8.17
400.0	0.04800	8.306	10.38
500.0	0.03300	10.823	13.53
600.0	0.02600	13.736	17.17
700.0	0.02100	17.007	21.26
800.0	0.01600	22.321	27.90
900.0	0.01400	25.510	31.89
1000.0	0.01100	32.468	40.58

TABLE FOR PERMITTED LENGTH OF PARALLELISM FOR 60 V. INDUCED VOLTAGE AT DIFFERENT SOIL RESISTIVITIES

Distance from OHE in meter .	M in ohm/km.	Length of O/H in km	Length of cable in km. (Cable S/F O.8)
SOIL RESISTIVITY (ohm. Cm.)		5000	
35.0	0.19500	1.832	2.29
50.0	0.17500	2.041	2.55
100.0	0.13000	2.747	3.48
200.0	0.09000	3.968	4.96
300.0	0.07000	5.102	6.38
400.0	0.05500	6.494	8.12
500.0	0.04500	7.937	9.92
600.0	0.03500	10.204	12.76
700.0	0.02900	12.315	15.39
800.0	0.02500	14.286	17.86
900.0	0.02100	17.007	21.26
1000.0	0.01700	21.008	26.26
SOIL RESISTIVITY (ohm. Cm.)		10000	
35.0	0.21600	1.653	2.07
50.0	0.19500	1.832	2.29
100.0	0.14500	2.463	3.08
200.0	0.10500	3.401	4.25
300.0	0.08500	4.202	5.25
400.0	0.07000	5.102	6.38
500.0	0.06000	5.952	7.44
600.0	0.05200	6.868	8.59
700.0	0.04400	8.117	10.15
800.0	0.03700	9.653	12.07
900.0	0.03200	11.161	13.95
1000.0	0.02800	12.755	15.94
SOIL RESISTIVITY (ohm. Cm.)		20000	
35.0	0.23000	1.553	1.94
50.0	0.21500	1.661	2.08
100.0	0.17000	2.101	2.63
200.0	0.12500	2.857	3.57
300.0	0.10500	3.401	4.25
400.0	0.09000	3.968	4.96
500.0	0.07500	4.762	5.95
600.0	0.06600	5.411	6.76
700.0	0.06000	5.952	7.44
800.0	0.52000	6.868	8.59
900.0	0.04800	7.440	9.30
1000.0	0.04200	8.503	10.64

TABLE FOR PERMITTED LENGTH OF PARALLELISM FOR 60 V. INDUCED VOLTAGE AT DIFFERENT SOIL RESISTIVITIES

Distance from OHE in meter .	M in ohm/km.	Length of O/H in km	Length of cable in km. (Cable S/F O.8)
SOIL RESISTIVITY (ohm. Cm.)		30000	
35.0	0.25000	1.429	1.29
50.0	0.22500	1.587	1.38
100.0	0.18000	1.984	2.48
200.0	0.14000	2.551	3.18
300.0	0.11500	3.106	3.88
400.0	0.10000	3.571	4.04
500.0	0.09000	3.968	4.85
600.0	0.07800	4.579	5.16
700.0	0.07000	5.102	6.28
800.0	0.06400	5.580	6.87
900.0	0.05700	6.266	7.86
1000.0	0.05200	6.868	8.56
SOIL RESISTIVITY (ohm. Cm.)		50000	
35.0	0.26000	1.374	1.72
50.0	0.24000	1.488	1.80
100.0	0.20000	1.786	2.20
200.0	0.15500	2.304	2.88
300.0	0.13000	2.747	3.40
400.0	0.11500	3.106	3.88
500.0	0.10000	3.571	4.40
600.0	0.09000	3.968	4.96
700.0	0.08400	4.252	5.42
800.0	0.07800	4.579	5.78
900.0	0.07000	5.102	6.82
1000.0	0.06600	5.411	6.96