

**Report
of
Standing
Committee
of Experts**

REPORT OF STANDING COMMITTEE OF EXPERTS TO INVESTIGATE FAILURE OF TOWERS DURING THE PERIOD MARCH 2013 to APRIL 2014

1.0 As per CEA Order No. 5-41/98/Secy/CEA/809, dated 30.9.1999 and subsequent amendments thereof, a Standing Committee of experts was constituted as per Chapter II Para 3 (viii) of the Electricity (Supply) Act No.54 of 1948 to investigate failure of transmission line towers of power utilities. As per the Electricity Act, 2003, CEA continues to be authorized under Section 73 (l) to carry out or cause to be carried out, any investigation for the purpose of generating or transmitting or distributing electricity. The scope and terms of reference of the Committee are as follows:

- To investigate the causes of failure of towers
- To avert recurrence of such failures in future

During the period from March 2013 to April 2014, Power Grid, Delhi Transco and Odisha Power Transmission Corporation Ltd. (OPTCL) informed CEA regarding the failure of towers of their lines as per the terms of reference of the subject Committee. Whereas the Committee normally investigates failure of towers of transmission lines rated 220kV and above, at the request of OPTCL the failure of towers of 132kV lines was also investigated.

2.0 INCIDENTS OF FAILURE

2.1 Failure of tower(s) of following Transmission Lines of Power Grid, Delhi Transco and OPTCL had taken place during the period from March 2013 to April 2014 on the dates as indicated below:

<u>Sl. No.</u>	<u>Names of the Transmission Lines</u>	<u>Date of Occurrence of Failure</u>
(i)	400 kV D/C Vindhyachal-Jabalpur	14.03.2013
(ii)	765 kV S/C Satna-Bina	14.04.2013
(iii)	400 kV D/C Biharsharif-Koderma	17.04.2013
(iv)	400 kV S/C Farakka-Durgapur	11.05.2013
(v)	400 kV D/C Maithon-Koderma	13.05.2013
(vi)	220 kV D/C Muzaffarpur(PGCIL)-Muzaffarpur(MPTS)	16.05.2013
(vii)	220 kV S/C Meerut-Shatabdi Nagar	27.05.2013

(viii)	400 kV S/C Bhilai-Bhatapara	03.06.2013
(ix)	220 kV D/C Bawana-Rohini	06.06.2013
(x)	400 kV S/C Malerkotla-Ludhiana	06.06.2013
(xi)	765 kV D/C Sasaram-Fatehpur	25.08.2013
(xii)	(a) 132kV Chhatrapur-Ire	12.10.2013
	(b) 132 kV Aska-Berhampur	12.10.2013
	(c) 132 kV Narendrapur-Chhatrapur	12.10.2013
	(d) 220 kV Narendrapur-Theruvalli	12.10.2013
	(e) 220 kV Narendrapur-Mendhasal	12.10.2013
(xiii)	400 kV D/C Bhiwani-Jind	11.03.2014
(xiv)	400 kV D/C Vindhyachal-Satna	18.04.2014

3.0 OBSERVATIONS OF THE COMMITTEE AND RECOMMENDATIONS

All the failure sites of PGCIL, except five, listed at no(s). (i), (iii), (iv), (v) and (x) in the table above were visited jointly by representatives of CEA and PGCIL and preliminary reports on findings were submitted. Meeting of Standing Committee of Experts on failure of the above mentioned lines was held in CEA on 22.05.2014. Copy of the minutes of the meeting is enclosed at **Annexure – A**. The nature and reasons of failures of towers, conductors and insulators of the above mentioned transmission lines were discussed in detail and necessary recommendations to avoid such failures in future were given as under:

(i) 400 kV D/C Vindhyachal-Jabalpur (circuit III & IV) Transmission Line Location No. 81 (DA+18) failed on 14.03.2013

The line was constructed under Vindhyachal Stage-I scheme by M/s RPG Transmission Limited. The line was first charged on 1st February, 1998. The tower failed due to localized storm. PGCIL informed that the tower no. 81 (DA+18) has been replaced with (DD+18) and slightly shifted from its location due to development of a small natural drain adjacent to the tower.

Recommendations :

The Committee noted and agreed with above.

(ii) **765 kV S/C Satna-Bina Transmission Line, Ckt-II**
Location no. 38 (A+3) failed on 14.04.2013

The line was commissioned on 01.07.2012. Supply of towers & erection of the line was carried out by M/s KEC Limited. The line failed due to high wind of localized nature having narrow fronts. The chimneys of the towers were repaired, tower erected and line restored.

Recommendations :

This was the first failure in the line, PGCIL intended to wait & watch till any other failure occurs in the line. The Committee agreed with the above.

(iii) **400 kV D/C Biharsharif- Koderma Transmission Line**
Location no. 6 (DA+3) failed on 17-04-2013

The line was commissioned on 08.06.2011. Supply of towers and construction of line was done by M/s KEC Limited. The line failed due to sabotage activity by miscreants. The tower became very weak and could not withstand the storm which occurred on 17-04-2013. The line has been under satisfactory operation for the last 2 years. PGCIL informed that Koderma being an industrial place, the G I angles used in towers are easily sold by the miscreants to small traders and industries, hence theft of tower members is rampant in that area. The foundation of the tower was repaired, the tower was erected and the line restored. PGCIL have also informed that patrolling of the line has been increased, now using GPS also. Local residents are engaged for patrolling the line. Helicopter patrolling would be explored in future.

Recommendations :

As this was the first failure in the line, Committee recommended to wait and watch till any other failure occurs in the line.

(iv) **400 kV S/C Farakka- Durgapur line -II**
Location no. 361 (A+0) failed on 11-05-2013

The transmission line was designed and constructed by M/s EMC. The line was commissioned on 01-07-1987. Previously, the said location (361) had failed twice on 04.06.1998 and 04.06.2005 due to heavy storm. The

present failure was due to narrow front high intensity thunder storm followed by rain.

Recommendations :

PGCIL informed that strengthening work of the line is going on & would try to complete it within this season upto base level. PGCIL had also informed that arial patrolling award has been placed for 15,000 Kms. as a Pilot Project. The Committee agreed with the above.

- (v) **400 kV D/C Maithon-Koderma Transmission line**
Location no. 102/3 (DB+6), 103/0(DB+3), 103/1 (DA+0), 103/2 (DA+0)
and 104/0 (DD+0) failed on 13/05/2013.

This transmission line was designed by Power Grid and constructed by M/s Tata Projects Limited, Hyderabad and M/s Jyoti Structures Limited, Mumbai. The line was commissioned on 31st January, 2013. The tower failure occurred in the section constructed by M/s Tata Projects Ltd. The towers failed due to high intensity wind followed by rain. The affected stretch of the line is passing in the vicinity of two hillocks.

Recommendations :

This was the first failure of towers in the line. The suspension tower at location no. 103/2 (DA+0) which was spotted in a vulnerable place has been replaced by (DB+0). The Committee agreed with the above.

- (vi) **220 kV D/C Muzaffarpur (PGCIL)-Muzaffarpur (MPTS) Transmission line of Powerlinks associated with Tala Hydroelectric Project.**
Location no. 24 (DD+18) Power line crossing tower failed on 16.05.2013.

This line was designed & tested by M/s RPG Transmission Ltd. (Formerly M/s SAE India Lrd.) Testing was witnessed and approved by M/s Power Grid for their Unchahar Transmission System and the same design was

used in this line. The line was commissioned on 01.09.2006. The tower failed due to very high velocity storm and the tower got twisted, buckled and finally collapsed from the stub level.

Recommendations :

Power Grid officials informed that M/s Powerlinks have strengthened their towers. The Committee agreed with the above.

(vii) **220 kV S/C Meerut-Shatabdinagar Transmission Line**
Location no. 21 (DA+18) and 22 (DD+25) failed on 27/05/2013

This transmission line was constructed by M/s L&T Ltd. This line is crossing 220 kV D/C (single circuit strung) Modipuram-Muzaffarnagar Transmission Line of UPPCL and 220 kV S/C Modipuram-Mataur Transmission Line of UPPCL by using double circuit towers at location nos. 21 and 22. The line was commissioned on 01-07-2005. The towers failed from the bottom portion at stub level due to high intensity westerly cyclonic storm with very high wind velocity.

Recommendations :

This was the first failure of the line. PGCIL informed that tower at location no. 21 (DA+18) has been changed to 21 (DD+18). Hip bracings were strengthened. The Committee agreed with the above.

(viii) **400 kV S/C Bhilai-Bhatapara Transmission Line**
Location no. 425 (D+6), 426(A+25), 427(B+6) and
428 (A+0) failed on 03.06.2013

The line was commissioned as Korba-Raipur-II in October 1999. Subsequently, the LILO was carried out at Bhatapara in 2007. Later, the line was shifted to Bhilai from Raipur to accommodate the incoming line Korba-Raipur ckt-III & IV in 2011. The line was constructed by M/s EMC. Tower nos. 426 & 427 completely fell on the ground and earthwire peaks of location nos. 425 & 428 were damaged due to localized heavy wind

storm confined to limited area near Tulsi village which could have exceeded the design load limits.

Recommendations :

PGCIL informed that location no. 425 being adjacent to the important Howrah-Mumbai railway line, tower at location no. 426 (A+25) has been changed to (D+25) and tower at location no. 427 (B+6) has been changed to (C+6). The Committee agreed with the above.

(ix) **220 kV D/C Bawana-Rohini Transmission Line of Delhi Transco Location no. 27(A+3) and 24(C+6) failed on 06.06.2013.**

The construction of this line was started by M/s K.S. Construction in 1990 and completed by M/s Aquarian Enterprises in 2005 & the line was commissioned in August, 2005. The towers were damaged due to heavy storm weather conditions which prevailed on 06.06.2013 as the tower no. 27(A+3) was already weak due to missing members & bolts, rusting of stubs etc., Delhi Transco was advised to replace the missing members, anti-climbing devices in the line and to clean all the chimneys from soil, weeds etc to prevent rusting. Frequent patrolling of the line was also suggested. Delhi Transco submitted action taken report to CEA on 14/10/2013, wherein it was mentioned that the legs of the towers were cleaned and action for painting of tower legs, fixing of missing members, anti-climbing devices has also been initiated. Other Transmission Lines of DTL had been thoroughly inspected and were regularly being patrolled by the field staff and corrective action had been initiated. Material test report of the failed tower parts was received from them and found to be generally in order.

Recommendations :

As discussed, it was suggested that DTL may carry out replacing all missing members, bolts & nuts, anti-climbing devices, Galvanization/

painting of leg members and increase the Chimney height to 500mm in all the towers of the line. The Committee agreed with the above.

(X) **400kV S/C Materkotla-Ludhiana Transmission Line**
Location no. 37(A+0), 38(A+0) and 39(A+6) failed on 06.06.2013.

This line was designed by Power Grid and constructed by M/s Deepak Cables, Bangalore. The line was commissioned on 31/3/2008. The towers failed due to high intensity storm followed by light rainfall.

This was the first instance of tower failure in the line.

Recommendations :

Power Grid intended to wait & watch till any other failure occurs in the line.

The Committee agreed with the above.

(XI) **765 kV S/C Sasaram-Fatehpur (Circuit-II) Transmission Line**
Location no. 61A/0(D+25) and 61/0(D+0) failed on 25.08.2013.

This line was constructed under Sasan UMPP scheme by M/s Tata Projects in the year 2013. The delta configuration towers used in this line were developed in house by Power Grid. The line was commissioned on 31-05-2013 and this was the first failure after commissioning. The towers failed due to flash flood in river Ganga. As per the newspaper report, the river was flowing 1.2m to 2.4m above danger mark both at the upstream and downstream side of the crossing location.

Recommendations :

Power Grid informed that the tower no. 61 A/0 (D+25m) has been erected & strengthened with raised chimney and with tie beams. The Committee agreed with the above.

(XII) **Failure of Towers of Odisha Power Transmission Corporation Ltd. in cyclonic storm Phailin on 12th October, 2013.**

a) **132kV Chhatrapur-Ire line – Location no. 07(PA+3)**

The line was commissioned in 1981. The towers were designed by M/s HIW and the line was constructed by OSEB, departmentally. The tower completely collapsed and was bent from Chimney level due to very severe cyclonic storm, 'Phailin'. The tower was replaced with a tower of same design and strengthened.

b) **132 kV Aska-Berhampur line-Location no. 108(A)**

The line was commissioned in 1980. The towers were designed by M/s HIW and the line was constructed by OSEB, departmentally. The tower was completely collapsed due to very severe cyclonic storm, 'Phailin'. The tower was replaced with a tower of same design and strengthened.

c) **132 kV Narendrapur-Chhatrapur line-19 towers**

The line was commissioned in 2004. The towers were designed and the line was constructed by M/s EMC Ltd. All the towers completely collapsed and were bent from Chimney level due to very severe cyclonic storm, 'Phailin'. Each of the towers was replaced with a tower of same design and strengthened.

d) **220 kV Narendrapur-Theruvalli Line-15 Towers**

The line was commissioned in 1999. The towers were designed by M/s Kalpataru, M/s EMC Ltd & M/s HIW. The line was constructed by M/s HIW . Most of the towers completely collapsed and were bent from Chimney level and a few were partially damaged. The towers were replaced with towers of same design and strengthened.

e) **220 kV Narendrapur-Mendhasal Line-56 Towers**

The line was commissioned in 2004. The towers were designed by M/s Kalpataru, M/s EMC Ltd & M/s HIW and the the line was constructed by M/s HIW . Most of the towers of the line completely collapsed and were

bent at Chimney level and a few were partially damaged due to very severe cyclonic storm 'Phailin'. Restoring work of the line is going on.

Recommendations :

It was noted that these lines were designed for wind speed 50m/sec (180 kmph) whereas 'Phailin' storm wind speed crossed 200 kmph.

The representative from OPTC Ltd. had submitted material test report for 4 samples. CE(I/C),SETD requested them to submit one sample each for the towers fallen completely. OPTCL representative mentioned that all the failed towers were dumped at one place and hence it is very difficult to identify & collect samples of all failed towers. CE(I/C), SETD requested them to collect samples as much as possible & submit material test report. OPTC Ltd. representative informed that all the failed towers were replaced and strengthened. CE(I/C) enquired about the possibility of adopting higher return period for these towers. OPTCL representative informed that earlier recommendations were made for 60-65 m/sec design wind load. But the wind map is not revised so far. Different opinions were received from experts and hence OPTCL was not able to ensure the safety of towers in a cyclone. It was suggested that 1.5 times normal wind load be adopted for narrow front wind and the design checked. The Committee agreed with the above.

(XIII) 400 kV D/C Bhiwani-Jind Transmission Line-Location no. 193 (DD+3), 194(DA+0), 195(DA+6), 196(DB+0) & 197(DC+0) failed on 11/03/2014

This line was designed by Power Grid and constructed by M/s Aravali Infrastructure Ltd., New Delhi. The line was commissioned on 31st March, 2013. The towers failed due to high speed wind fronts with rain. This was the first instance of tower failure in this line,

Recommendations :

Power Grid intended to wait & watch till any other failure occurs in the line.
The Committee agreed with the above.

**(XIV) 400 kV D/C circuit no. I&II of Vindhychal-Satna Transmission Line
Location no. 688 (DA+0), 699(DA+0) and 698(DB+6) failed on
18.04.2014.**

This line was designed by Powergrid and constructed by M/s KPTL, Gandhinagar. Circuit I&II of the line were commissioned in May, 1999 & June 1999 respectively. These towers failed due to whirling effect of high intensity wind storm. The affected stretch of the line is passing in the vicinity of two hillocks. There have been three previous failures on 5th June, 2003, 29th April 2005 and 2nd July, 2005. Strengthening of towers upto bottom cross arm has already been done. Strengthening upto Top 'X' arm would be done during shut down period.

Recommendations :

The Committee agreed with the above.

(P.K. Mishra)
Director (Transmission)
SETD
And
Member Secretary,
Standing Committee of
Experts to investigate
failure of towers

(Dr. P. Mohan)
Chief Engineer – in –charge
SETD
And
Chairman,
Standing Committee of
Experts to investigate
failure of towers

New Delhi

Date :

**Composition
of
Standing
Committee
of
Experts**

COMPOSITION OF STANDING COMMITTEE OF EXPERTS TO INVESTIGATE THE FAILURE OF TOWERS

1. Dr. Prabhat Mohan, Chief Engineer-in-Charge SETD, CEA - Chairman
2. Additional Director, Central Power Research Institute Mechanical Engineering Division Post Box No. 8066, Prof. Sir C.V. Raman Road Sadashivnagar, Bangalore – 560 080 Tel No. 080-23604664 / 23601905 **Fax No. 080- 23601213** - Member
3. Head of Deptt. Deptt. Of Civil Engg. Delhi Technological University Bawana Road Delhi - 110042 **Fax No. of VC - 27871023** - Member
4. Representatives from Power Utilities where tower failure occurred - Member
5. Member Secretary, Regional Power Committee where tower failure occurred - Member
6. Sh. P.K.Mishra, Director (Transmission) SETD, CEA - Member Secretary

REPRESENTATIVES OF UTILITIES :

<u>Name of the Organisation</u>	<u>Nominee and their address</u>
CENTRAL SECTOR	
PGCIL	General Manager (Engg - TL) Powergrid Corporation of India Ltd., SAUDAMINI, Plot No.2, Sector-29, Gurgaon Ph : 0124 - 2571794 Fax: 0124 – 2571951/809

<u>Name of the Organisation</u>	<u>Nominee and their address</u>
DVC	S.E. (E), PSR Deptt., Damodar Valley Corporation, DVC Towers, VIP Road, Kolkata – 700 054 Ph : 033 – 66072930 Fax: 033 - 23559618
STATE SECTOR	
EASTERN REGION	
Jharkhand	Chief Engineer (Transmission) Jharkhand State Electricity Board, Engineering Building, HEC, Dhurwa, RANCHI – 834 004 Fax:0651-2400008/2400799
Bihar	Chief Engineer (Transmission) Bihar State Electricity Board, Vidyut Bhawan, Baily Road, PATNA – 800 021 Fax:-0612-2504655/2504937/2504968 011-26711603
West Bengal	Chief Engineer (CPD) West Bengal State Electricity Transmission Company Limited, Vidyut Bhawan (9th floor), DJ Block, Sector-II Salt Lake Kolkata-700091, Fax-033-23591955/23373002
Odisha	Sr. General Manager (TP & C) Transmission Project and Construction Orissa Power Transmission Corpn., Ltd., Vidyut Bhawan, 1st Floor, Sahid Nagar Bhubaneshwar – 751 022 Fax No: 0674 -2547261/2541904

<u>Name of the Organisation</u>	<u>Nominee and their address</u>
Sikkim	Chief Engineer (I), Energy & Power Department Government of Sikkim, Gangtok – 737 101 Fax: 03592-2029227/228186/201148
WESTERN REGION	
Chattisgarh	Chief Engineer(Transmission) Chattisgarh State Electricity Board, Dagania RAIPUR – 492013 Fax No: 0771 5066900/4066566
Gujarat	Chief Engineer (Project), Gujarat Energy Transmission Corporation Limited, Sardar Patel Vidyut Bhawan, Race Course, VADODARA-390 007 Fax No: 0265-2338164
Goa	Chief Engineer Electricity Department, Government of Goa, IIIrd Floor, Vidyut Bhawan, PANAJI(GOA)-403 001 Fax No: 0832-2222354
Madhya Pradesh	Chief Engineer(Power System), Madhya Pradesh Power Transmission Company Limited, Shakti Bhavan, Vidyut Nagar, Rampur, Block-3 JABALPUR - 482 008 Fax No: 0761-2665593/2665593
Maharashtra	Chief Engineer (Tr. Projects) Maharashtra State Electricity Transmission Co. Ltd., Prakashganga, Bandra Kurla Complex,Plot No C-19, E-Block, Bandra (E), MUMBAI – 400 051 Fax No: 022 – 26598587

<u>Name of the Organisation</u>	<u>Nominee and their address</u>
Daman	Executive Engineer Power House Building, Sea Face Road, Nani Daman – 396 210 Fax NO: 0260-2254745
NORTHERN REGION	
Uttar Pradesh	Chief Engineer (Control & Monitoring), U.P. Power Transmission Corporation Ltd., Shakti Bhawan Extn. 11th Floor, 14, Ashok Marg, Lucknow – 226 001 Fax No: 0522-2288410/2287785
J&K	Chief Engineer(S&O) Power Development Department, 220 kV Grid Substation, Narwal Bala Gladni Jammu (J&K) Ph : 0191 – 2437038 Fax : 0191 - 2476213
BBMB	Chief Engineer (Trans) Bhakra Beas Management Board, Administrative Block, SLDC Complex, Madhya Marg, Chandigarh – 160019 Fax : 0172 - 2654590
Delhi	General Manager (O & M), Delhi Transco Limited, Shakti Sadan, Kotla Road, New Delhi – 110 002 Fax No: 23366160
Uttrakhand	General Manager(Project), Power Transmission Corporation of Uttrakhand (PTCUL), 650 Kanwali Road, Dehrudun-248001 Fax No: 0135-2762460

<u>Name of the Organisation</u>	<u>Nominee and their address</u>
Punjab	Chief Engineer (Planning), Punjab State Transmission Corporation Ltd., The Mall, Patiala – 147 001 Fax No: 0175-2213199
Himachal Pradesh	Chief Engineer (Transmission), Himachal Pradesh State Electricity Board, Vidyut Bhawan, Kumar House, Shimla – 171004 Fax No: 0177-2658984
Haryana	Chief Engineer (Plg. & Design), Haryana Vidyut Prasaran Nigam, Shakti Bhawan, Sector – 6, Panchkula – 134 113 Fax No:0172-2560640
Rajasthan	Chief Engineer (T&C), Rajasthan Rajya Vidyut Prasaran Nigam Limited, Old power House, Ram Mandir , Jaipur – 302 006 Fax No: 0141-2740168/2740794
SOUTHERN REGION	
Andhra Pradesh	Chief Engineer, 400kV APTRANSCO, Vidyut Soudha, Hyderabad – 500 082 Fax No: 040 23320565/23313791
Karnataka	Chief Engineer (E), Karnataka Power Transmission Corporation Ltd. Ananda Rao Circle Bangalore – 560 009
Kerala	Chief Engineer (SO) Kerala State Electricity Board Vidyuthi Bhavanam, Pattom, Thiruvananthapuram – 695 004 Fax No: 0471-2543850

<u>Name of the Organisation</u>	<u>Nominee and their address</u>
Tamil Nadu	Chief Engineer (Transmission) Tamil Nadu Electricity Board, 6th Floor, NPKRR Maaligai, 800, Anna Salai, Chennai – 600 002 Fax No: 044-28516362
Puducherry	Superintending Engineer-I, Electricity Department, U.T. of Puducherry, No. 58, Subhash Chandra Bose Salai, Puducherry-605001, Ph. 0413-2336361, Fax No. 0413-2331556
NORTH - EASTERN REGION	
Tripura	Chief Engineer Tripura State Electricity Corpn.Ltd., Vidyut Bhawan, Agartala – 799 001 Ph: 0381 2323286 Fax: 0381 2323286
Meghalaya	Chief Engineer (Transmission), Meghalaya State Electricity Board Lumjingshai, Short Round Road, Shillong.– 793 001 Fax No: 0364 – 2590335
Assam	Chief General Manager, Assam Electricity Grid Corporation Ltd., Bijulee Bhawan, Paltan Bazar, Guwahati – 781 001
Mizoram	Chief Engineer Power & Electricity Department, Government of Mizoram, Aizwal – 796 001 Ph: 0389 325 635 Fax: 0389 322776/2311070

<u>Name of the Organisation</u>	<u>Nominee and their address</u>
Arunachal Pradesh	Chief Engineer (Power) Department of Power Govt. of Arunachal Pradesh, Itanagar – 791 111 Ph: 0360 212595 Fax: 0360 2127446/2217302
Manipur	Chief Engineer (Power) Electricity Department, Govt. of Manipur, Imphal – 795 001 Fax: 0385 2222629/2450702/2220143/2220702
Nagaland	Chief Engineer , Department of Power, Govt. of Nagaland, Kohima – 797 001 Ph: 0370 2270110 Fax: 0370 2290470

21. Member Secretary of the concerned Regional Power Committee where failure of tower has taken place.

ANNEXURE -A

**Minutes
of the
Meeting**

Minutes of meeting of the Standing Committee of Experts held on 22-05-2014 at CEA Headquarters regarding failure of Towers in 132 kV and Higher Voltage Transmission Lines during March 2013 to April 2014.

The list of participants is at Annex-I.

Chief Engineer-in-Charge (SETD) and Chairman of the Committee welcomed the participants. He informed that this meeting is being held after 20 months from the last meeting due to delay in compilation of reports by Powergrid and shortage of personnel in CEA. He also desired that in future meeting shall be held at least once in a year.

Action taken report on the last meeting:

Chairman enquired from the Powergrid officials regarding the theft of members of towers in the Eastern Region especially in Naxalite prone area as the number of failures are more in Eastern Region and about the strengthening of towers as discussed in the last meeting. Powergrid officials have informed that O&M norms are strengthened. There are some practical difficulties in rectification works as some lines are located in disturbed area. Now they have introduced helicopter patrolling in these areas as a Pilot Project to find out any deficiency in structures/missing of members by taking arial photographs, thermographs etc. HD cameras are used in this operation so that the structures can be zoomed to check any missing members.

Regarding strengthening of towers in some lines, Powergrid officials have informed that the strengthening work is in process. PGCIL official intimated that the towers of Powergrid lines in Odisha had withstood the cyclonic storm 'Phailin' in October, 2013. They also informed that Suspension Towers are designed at 75% wind load under broken wire condition with FOS 1.1 where as the old lines of Odisha were designed for zero wind load under broken wire condition with a factor of safety of 2. PGCIL officials have informed that strengthening of existing lines is done up to a certain elevation only.

The record of discussion in respect of each failed transmission line is given below:-

1. **400 kV D/C Vindhyachal-Jabalpur (circuit III & IV) Transmission Line Location No. 81 (DA+18) failed on 14.03.2013**

The line was constructed under Vindhyachal Stage-I scheme by M/s RPG Transmission Limited. The line was first charged on 1st February, 1998. The tower failed due to localized storm. PGCIL informed that the tower no. 81 (DA+18) has been replaced with (DD+18) and slightly shifted from its location due to development of a small natural drain adjacent to the tower.

The Committee noted and agreed with the above.

2. **765 kV S/C Satna-Bina Transmission Line, Ckt-II Location no. 38 (A+3) failed on 14.04.2013**

The line was commissioned on 01.07.2012. Supply of towers & erection of the line was carried out by M/s KEC Limited. The line failed due to high wind of localized nature having narrow fronts. The chimneys of the towers were repaired, tower erected and line restored. This was the first failure in the line, PGCIL intended to wait & watch till any failure occurs in the line. The Committee agreed with the above.

3. **400 kV D/C Koderma-Biharsharif Transmission Line Location no. 6 (DA+3) failed on 17-04-2013**

The line was commissioned on 08.06.2011. Supply of towers and construction of line was done by M/s KEC Limited. The line failed due to sabotage activity by miscreants. The tower became very weak and could not withstand the storm which occurred on 17-04-2013. The line has been under satisfactory operation for the last 2 years. PGCIL informed that Koderma being an industrial place, the G I angles used in towers are easily sold by the miscreants to small traders and industries, hence theft of tower members is rampant in that area. The foundation of the tower was repaired , the tower was

erected and the line restored. PGCIL have also informed that patrolling of the line has been increased, now using GPS also. Local residents are engaged for patrolling the line. Experience of helicopter patrolling would be explored in future.

The Committee agreed to the above.

**4. 400 kV S/C Farakka- Durgapur line -II
Location no. 361 (A+0) failed on 11-05-2013**

The transmission line was designed and constructed by M/s EMC. The line was commissioned on 01-07-1987. Previously, the said location (361) had failed twice on 04.06.1998 and 04.06.2005 due to heavy storm. The present failure was due to narrow front high intensity thunder storm followed by rain. PGCIL informed that strengthening work of the line is going on & would try to complete it by this season upto base level. PGCIL had also informed that arial patrolling award has been placed for 15,000 Kms. as a Pilot Project

The Committee agreed to the above.

**5. 400 kV D/C Maithon-Koderma Transmission line
Location no. 102/3 (DB+6), 103/0(DB+3), 103/1 (DA+0), 103/2 (DA+0)
and 104/0 (DD+0) failed on 13/05/2013.**

This transmission line was designed by Power Grid and constructed by M/s Tata Projects Limited, Hyderabad and M/s Jyoti Structures Limited, Mumbai. The line was commissioned on 31st January, 2013. The tower failure occurred in the section constructed by M/s Tata Projects Ltd. The towers failed due to high intensity wind followed by rain. The affected stretch of the line is passing in the vicinity of two hillocks. This was the first failure of towers in the line. The suspension tower at location no. 103/2 (DA+0) which was spotted in a vulnerable place has been replaced by (DB+0).

The Committee agreed with the above.

6. **220 kV D/C Muzaffarpur (PGCIL)-Muzaffarpur (MPTS) Transmission line of Powerlinks associated with Tala Hydroelectric Project.**
Location no. 24 (DD+18) Power line crossing tower failed on 16.05.2013.

This line was designed & tested by M/s RPG Transmission Ltd. (Formerly M/s SAE India Lrd.) Testing was witnessed and approved by M/s Power Grid for their Unchahar Transmission System and the same design was used in this line. The line was commissioned on 01.09.2006. The tower failed due to very high velocity storm and the tower got twisted, buckled and finally collapsed from the stub level. Power Grid officials informed that M/s Powerlinks have strengthened their towers.

The Committee noted.

7. **220 kV S/C Meerut-Shatabdinagar Transmission Line**
Location no. 21 (DA+18) and 22 (DD+25) failed on 27/05/2013

This transmission line was constructed by M/s L&T Ltd. This line is crossing 220 kV D/C (single circuit strung) Modipuram-Muzaffarnagar Transmission Line of UPPCL and 220 kV S/C Modipuram-Mataur Transmission Line of UPPCL by using double circuit towers at location no. 21 and 22. The line was commissioned on 01-07-2005. The towers failed from the bottom portion at stub level due to high intensity westerly cyclonic storm with very high wind velocity. This was the first failure of the line. PGCIL informed that tower at location no. 21 (DA+18) has been changed to 21 (DD+18). Hip bracings were strengthened.

The committee agreed with the above.

8. **400 kV S/C Bhilai-Bhatapara Transmission Line**
Location no. 425 (D+6), 426(A+25), 427(B+6) and 428 (A+0) failed on 03.06.2013

The line was commissioned as Korba-Raipur-II in October 1999. Subsequently, the LILO was carried out at Bhatapara in 2007. Later, the line was shifted to Bhilai from Raipur to accommodate the incoming line Korba-Raipur ckt-III & IV in 2001. The line was constructed by M/s EMC. Tower no.

426 & 427 completely fell on the ground and earthwire peaks of location no. 425 & 428 were damaged due to localized heavy wind storm confined to limited area near Tusli village which could have exceeded the design load limits. PGCIL informed that location no. 425 being adjacent to the important Howrah-Mumbai railway line, tower at location no. 426 (A+25) has been changed to (D+25) and tower at location no. 427 (B+6) has been changed to (C+6).

The committee agreed with the above.

**9. 220 kV D/C Bawana-Rohini Transmission Line
Location no. 27(A+3) and 24(C+6) failed on 06.06.2013.**

The construction of this line was started by M/s K.S. Construction in 1990 and completed by M/s Aquarian Enterprises in 2005 & the line was commissioned in August, 2005. The towers were damaged due to heavy storm weather conditions which prevailed on 06.06.2013 as the tower no. 27(A+3) was already weak due to missing members & bolts, rusting of stubs etc., Delhi Transco was advised to replace the missing members, anti-climbing devices in the line and to clean all the chimneys from soil, weeds etc to prevent rusting. Frequent patrolling of the line was also suggested. Delhi Transco submitted action taken report to CEA on 14/10/2013, wherein it was mentioned that the legs of the towers were cleaned and action for painting of tower legs, fixing of missing members, anti-climbing devices have also been initiated. Other Transmission Lines of DTL had been thoroughly inspected and were regularly being patrolled by the field staff and corrective action had been initiated. Material test report of the failed tower parts was received from them and found to be generally in order.

As discussed, it was suggested that DTL may carry out replacing all missing members, bolts & nuts, anti-climbing devices, Galvanization/ painting of leg members and increase the Chimney height to 500mm in all the towers of the line.

**10. 400kV S/C Materkotla-Ludhiana Transmission Line
Location no. 37(A+0), 38(A+0) and 39(A+6) failed on 06.06.2013.**

This line was designed by Power Grid and constructed by M/s Deepak Cables, Bangalore. The line was commissioned on 31/3/2008. The towers failed due to high intensity storm followed by light rainfall.

This was the first instance of tower failure in the line. Power Grid intended to wait & watch till any other failure occurs in the line. The committee agreed with the above.

11. 765 kV S/C Sasaram-Fatehpur (Circuit-II) Transmission Line Location no. 61A/0(D+25) and 61/0(D+0) failed on 25.08.2013.

This line was constructed under Sasan UMPP scheme by M/s Tata Projects in the year 2013. The delta configuration towers used in this line were developed in house by Power Grid. The line was commissioned on 31-05-2013 and this was the first failure after commissioning. The towers failed due to flash flood in river Ganga. As per the newspaper report, the river was flowing 1.2m to 2.4m above danger mark both at the upstream and downstream side of the crossing location. Power Grid informed that the tower no. 61 A/0 (D+25m) has been erected & strengthened with raised chimney and with tie beams.

The Committee agreed with the above.

12. Failure of Towers of Odisha Power Transmission Corporation Ltd. in Phailin on 12th October, 2013.

a) 132kV Chhatrapur-ire line – Location no. 07(PA+3)

The line was commissioned in 1981. The towers were designed by M/s HIW and the line was constructed by OSEB, departmentally. The tower completely collapsed and was bent from Chimney level due to very severe cyclonic storm, 'Phailin'. The tower was replaced with a tower of same design and strengthened.

b) 132 kV Aska-Berhampur line-Location no. 108(A)

The line was commissioned in 1980. The towers were designed by M/s HIW and the line was constructed by OSEB, departmentally. The tower was completely collapsed due to very severe cyclonic storm, 'Phailin'. The tower was replaced with a tower of same design and strengthened.

c) 132 kV Narendrapur-Chhatrapur line-19 towers

The line was commissioned in 2004. The towers were designed and the line was constructed by M/s EMC Ltd. All the towers completely collapsed and were bent from Chimney level due to very severe cyclonic storm, 'Phailin'. The tower was replaced with a tower of same design and strengthened.

d) 220 kV Narendrapur-Theruvalli Line-15 Towers

The line was commissioned in 1999. The towers were designed by M/s Kalpataru, M/s EMC Ltd & M/s HIW. The line was constructed by M/s HIW . Most of the towers completely collapsed and were bent from Chimney level and a few were partially damaged. The towers were replaced with towers of same design and strengthened.

e) 220 kV Narendrapur-Mendhasal Line-56 Towers

The line was commissioned in 2004. The towers were designed by M/s Kalpataru, M/s EMC Ltd & M/s HIW and the the line was constructed by M/s HIW . Most of the towers of the line completely collapsed and were bent at Chimney level and a few were partially damaged due to very severe cyclonic storm 'Phailin'. Restoring work of the line is going on.

It was noted that these lines were designed for wind speed 50m/sec (180 kmph) whereas 'Phailin' storm wind speed crossed 200 kmph.

The representative from OPTC Ltd. had submitted material test report for 4 samples. CE(I/C),SETD requested them to submit one sample each for the towers fallen completely. OPTCL representative mentioned that all the failed towers were dumped at one place and hence it is very difficult to identify & collect samples of all failed towers. CE(I/C), SETD requested them to collect samples as much as possible & submit material test report. OPTC Ltd. representative informed that all the failed towers were replaced and strengthened. Chairman enquired about the possibility of adopting higher return period for these towers. OPTCL representative informed that earlier recommendations were made for 60-65 m/sec design wind load. But the wind map is not revised so far. Different opinions were received from experts and hence OPTCL cannot ensure the safety

of tower due to cyclone. It was suggested that 1.5 times normal wind load be adopted for narrow front wind and the design checked.

The Committee agreed with the above.

13. 400 kV D/C Bhiwani-Jind Transmission Line-Location no. 193 (DD+3), 194(DA+0), 195(DA+6), 196(DB+0) & 197(DC+0) failed on 11/03/2014

This line was designed by Power Grid and constructed by M/s Aravali Infrastructure Ltd., New Delhi. The line was commissioned on 31st March, 2013. The towers failed due to high speed wind fronts with rain. This was the first instance of tower failure in this line, Powergrid intended to wait & watch till any other failure occurs in the line.

The Committee agreed with the above.

14. 400 kV D/C circuit no. I&II of Vindhychal-Satna Transmission Line Location no. 688 (DA+0), 699(DA+0) and 698(DB+6) failed on 18.04.2014.

This line was designed by Powergrid and constructed by M/s KPTL, Gandhinagar. Circuit I&II of the line were commissioned in May, 1999 & June 1999 respectively. These towers failed due to whirling effect of high intensity wind storm. The affected stretch of the line is passing in the vicinity of two hillocks. There have been three previous failures on 5th June, 2003, 29th April 2005 and 2nd July, 2005. Totally five towers failed. After the failure, the line was restored using normal towers. Powergrid informed that these towers were designed for wind zone-4. Strengthening of the towers upto bottom cross arm has already been done. Strengthening upto Top 'X' arm would be done during shut down period.

CE(I/C), SETD & Chairman of the Committee requested the Powergrid officials for timely submission of tower failure reports. He further added that the Committee will discuss the tower failures by the end of calendar year 2014.

ANY OTHER MATTER

CE(I/C), SETD & Chairman of the Committee asked the participants if any other point was to be discussed in the meeting, General Manager, Delhi Transco Ltd. requested that CEA officers be deputed to inspect and guide about the adequacy of towers for reconductoring of Narela-Rothak Road transmission line of BBMB which is feeding Delhi. CE(I/C), SETD informed about the inadequate staff position in SETD Division. However, DTL was asked to submit a preliminary report to CEA after which the issue would be examined .

The meeting ended with vote of thanks to the Chair.

List of Participants

Central Electricity Authority

1. Dr. Prabhat Mohan, Chief Engineer(I/C), SETD
2. Shri P.K.Mishra, Director(Transmission)
3. Shri C.N.Devarajan, Assistant Director

Powergrid Corporation of India Ltd.

1. Shri Anish Anand, AGM(Engg.TL)
2. Shri Abhishek, CDE(Engg.TL)

Delhi Transco Ltd.

1. Shri Prem Prakash, General Manager
2. Shri Loveleen Singh, AGM

Odisha Power Transmission Corporation Ltd.

1. Shri Nimain Ch Swain, CGM