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विश्व में विद्युत का पर्याय
BHEL
भारत की सबसे बड़ी अभियांत्रिकी एवं विनिर्माण कम्पनी, भारत हेवी इलेक्ट्रिकल्स लिमिटेड को आज विश्व की प्रमुख विद्युत संयंत्र उपस्कर आपूर्ति करने वाली कम्पनियों में से एक का दर्जा प्राप्त है। भारत हेवी इलेक्ट्रिकल्स लिमिटेड अपने 17 विनिर्माण इकाइयों, 4 पावर क्षेत्र के क्षेत्रीय कार्यालयों, 8 सेवा केंद्रो, 15 परिचालन केन्द्रों के अपने व्यापक नेटवर्क तथा विश्व के 76 देशों में अपनी उपस्थिति द्वारा ग्राहकों की सेवा के लिए प्रतिबद्ध।
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EDITOR'S NOTE

V.K. Kanjlia
Secretary & Treasurer
CIGRE India

CIGRE the International Council on Large Electric Systems founded in 1921, is leading worldwide Organization on Electric Power Systems, covering technical, economic, environmental, organisational and regulatory aspects. It deals with all the main themes of electricity. CIGRE is the unique worldwide organization of its kind - 14,000 equivalent members in around 90 countries. CIGRE is focused on practical technical applications. The main aim of CIGRE is to facilitate and develop the exchange of engineering knowledge and information, between engineering personnel and technical specialists in all countries as regards generation and high voltage transmission of electricity. CIGRE achieves its objective through the 16 Study Committees, each consisting of about 24 members from different countries. It is a matter of pride for India that we are representing in all the 16 Study Committee of CIGRE.

Besides National Committees in about 60 Countries CIGRE has also constituted its regional chapters in the world. The chapter created for Asia is named as CIGRE-AORC (Asia Oceans Regional Council). CIGRE-AORC is a forum for sharing experience and knowledge regarding pertinent technical issues particularly those affecting power systems in the Asia-Oceana Region. The countries from Asia Oceana Region, who are associated with the forum are Australia, China, Cambodia, Gulf Cooperative Council, Hong Kong, India, Indonesia, Iran, Jordan, Japan, Korea, Malaysia, New Zealand, Taiwan and Thailand.

It is a matter of great honor for India that CIGRE AORC has approved the name of India for the Chairman ship of CIGRE AORC for next two years from 2016-18. Dr. Subir Sen, ED, POWERGRID has taken over as Chairman and Shri P.P. Wahi, as Secretary of CIGRE AORC for two year during the last meeting of CIGRE AORC held at Paris on 24th August 2016.

CIGRE (India) was set up as society in the year 1991 with Central Board of Irrigation & Power (CBI&P), Malcha Marg, Chanakyapuri, New Delhi as its secretariat. It functions as the National Committee, i.e., CIGRE (India) for CIGRE HQ (Paris). The CIGRE (India) coordinates interest of Indian members; organises National Study Committee (NSC) meetings. It recommends appropriate persons for CIGRE Study Committees. The National representatives are instrumental in providing feed back to CIGRE Study Committees at Paris.

The aims and objectives for which the committee, i.e., CIGRE (India), is constituted, is to implement and promote objectives of the International Council on Large Electric Systems (CIGRE) and accelerate its activities, which include the interchange of technical knowledge and information between all countries in the general fields of electricity generation transmission at high voltage and distribution etc.

All-out efforts are being made to increase the CIGRE membership and activities in India. Five International Conferences with participation of about 300 in each of the conference were organized by CIGRE India in the year 2015-16 and the membership has also been increased from 250 in 2015 to 611 in the year 2016. There was excellent participation from India in CIGRE session 2016 at Paris. Total 18 papers were presented and more than 100 officers from India including CEOs & Sr. Officers from various PSUs, State Electricity Corporation and various Regulatory commissions participated in CIGRE session 2016. This issue covers the report on the participation of India in CIGRE session 2016 at Paris besides informative and useful technical articles and statistical data on the subject.

We are bringout this Journal on half yearly basis. The last issue was published in the month of July 2016.

I am thankful to the Governing Council and the Technical Committee of CIGRE India for their valuable time and guidance, but for which, it would not have been possible to achieve the above significant progress, appreciated by CIGRE HQ Paris.

I am also thankful to all the senior experts from India and abroad and also to one and all who have supported in the past to realize the goal set forth for CIGRE India and expect the similar support in future too.

V.K. Kanjlia

Secretary & Treasurer CIGRE India

TRANSMISSION AND DISTRIBUTION INTEGRATED ANALYSIS AND EVALUATION SYSTEM FOR DISTRIBUTED GENERATION

J. Suh, S.Yoon and G. Jang
Korea University, Korea

ABSTRACT

As the amount of distributed generation supplied to distribution systems has expanded, neighbouring distribution systems or even transmission systems have been more affected according to penetration of distributed generation. However, until now, power system analysis has been conducted separately for the transmission system and distribution system. This way of analysis has had no problem in the existing power systems. However, with the rising DG connection in the distribution system, the need to reflect mutual interaction has elevated and the separated method became unable to do it properly. Transmission and distribution integrated analysis aims to enabling mutual interaction analysis. In this paper, a new methodology to evaluate the effect of distributed generation in the integrated transmission and distribution systems using on-line data. And by simulating mutual interaction, which could not be observed in previous system, case study results shows the need for transmission and distribution integrated systems with distributed generation.

Keywords *: DG, Distribution. PSS/E, SCADA, SOMAS, DAS, Transmission*

1. INTRODUCTION

Recently as distributed generation (DG) has increased, the distributed power generation has increasingly affected power systems. Large-scale DGs in distribution system can affect transmission and other adjacent distribution system. However the monitoring, analysis and evaluation associated with DG have been performed separately until now. In this separate method, DG could be connected and operated to local power system without considering its effect on other distribution feeder and transmission system. This paper presents a new methodology to evaluate the effect of DG and recommend the optimal operation of DG in the integrated transmission and distribution systems. In order to analyze the effect of DG in the on-line environment, transmission and distribution integrated system is connected to distribution automation system (DAS) and supervisory control and data acquisition (SCADA). When Transmission and distribution integrated system analyze DG connected power system, both SCADA and DAS system date is integrated automatically. Case study, which is performed by using the real-time data of Jeonnam region, shows effectiveness of integrated method.

2. TRANSMISSION AND DISTRIBUTION INTEGRATED SYSTEM

In Korea power system, transmission system is monitored in real-time by SCADA system. And Substation Operating results Management System (SOMAS) records and provides the real-time data (Main transformer, transmission line, breaker, etc.) of the Korea Electric Power Corporation (KEPCO) system from SCADA every 30 seconds. DAS monitors and provides the operating conditions of the distribution system in real-time[1-2]. Feeder remote terminal units, which are installed in distribution system, send the state data of equipment to the main server via communication device. Transmission and distribution system had been analyzed and operated separately in Korean power system. However, as installed DG has increased, the necessity of transmission and distribution integrated analysis is occurred[3-5]. Transmission and distribution integrated system acquires monitoring data from SOMAS and DAS to process transmission and distribution integrated monitoring and analysis. Fig. 1 shows the architecture of transmission and distribution integrated monitoring and analysis system.

There are two types of transmission and distribution integrated system such as network version and stand-alone version. In stand-alone version, operator has to install the transmission and distribution integrated analysis program to stand-alone computer for monitoring and analysis. And this version uses the power system data file which is extracted from DAS and SOMAS. In network version, integrated sever acquire and store power

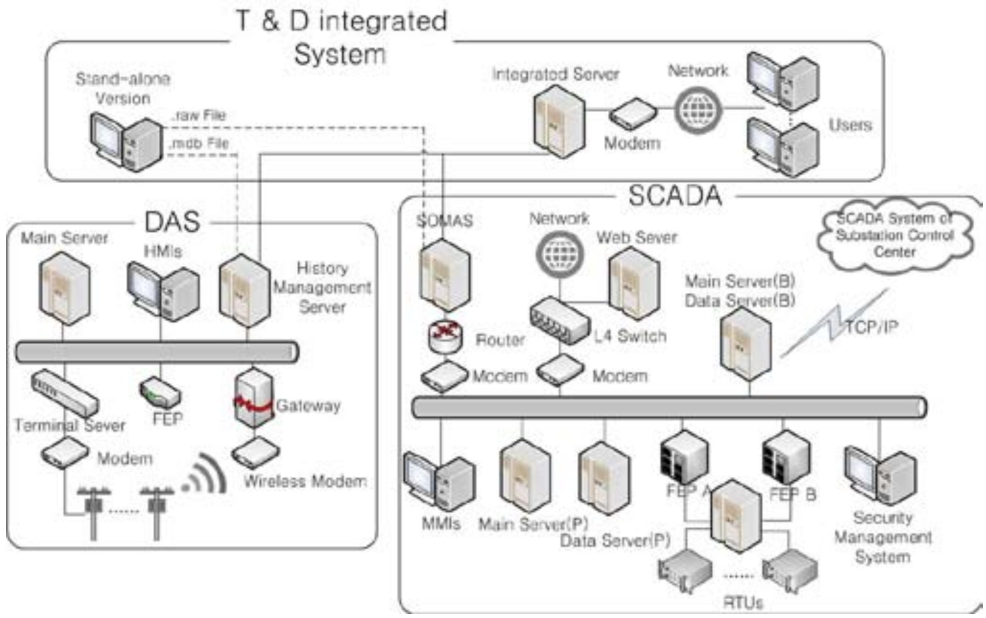

Fig. 1 : System diagram of transmission and distribution integrated system

system data from SOMAS and DAS automatically. And every PC, which is connected in KEPCO network, can run transmission and distribution integrated monitoring and analysis function without installation of software. By using this network version, system operators in regional headquarters can use transmission and distribution integrated monitoring and analysis system easily.

A. Power System Analysis

Transmission and distribution integrated monitoring and analysis system uses PSS/E engine for power flow and fault current calculation. The system compares automatically with Korean power system regulation and gives a violation warning to user. Following analyses, which are hard to be performed with the conventional system which analyzes transmission and distribution separately, can be possible in the transmission and distribution integrated system.

- Automated preliminary evaluation of DG connection
- DG connection impact on neighbouring distribution system or transmission system
- Transmission system fault current contribution of DG in distribution system
- Phase angle information for distribution system normally open switch movement

B. Preliminary Evaluation of DG Connection

Main purpose of transmission and distribution integrated monitoring and analysis system is to analyze DG connection impact. Before DG connection, System operator have to consider the effect of DG on power system. In conventional system, operator evaluate the effect of DG manually before it connected[6]. And the operator only consider the effect of DG on distribution line which connected to DG and they ignore effect of DG on transmission and other distribution system. However, in real operation, DG affects power quality of other distribution or transmission system. As the DG penetration increase, those effect become a considerable problem in Korean power system. When system operator receive request the permission of new DG installation from electricity suppliers, transmission and distribution integrated monitoring and analysis system evaluated the impact of new DG connection and gives a warning to operator when violation of regulation is predicted. In this preliminary evaluation transmission and distribution integrated analysis makes more accurate evaluation possible by covering the entire power system and previously installed DG. And prevent the DG installation which causes problem. This automated preliminary evaluation process considers voltage fluctuation, short-circuit capacity, possibility of violation of voltage regulation, and capacity regulation.

C. Determination of Area of Vulnerability

Voltage sag is one of the most significant problem for power system. And it can causing damage to sensitive equipment in power system[7]. Transmission and distribution integrated monitoring and analysis system can determine the area of vulnerability for voltage sag in entire power system. In separated analysis, distribution system fault could not be considered for area of vulnerability in transmission system. However those faults, especially in high DG connected system, can cause the voltage sag in transmission system or other distribution system. Transmission and distribution integrated monitoring and analysis system uses fast method to determine an area of vulnerability[8] and integrated analysis results. By using integrated analysis for area of vulnerability determination, unlike conventional system, area of vulnerability in entire power system can be determined.

D. Application

Transmission and distribution integrated monitoring and analysis system is used for distribution system optimization platform. Following applications, which are based on transmission and distribution integrated analysis result, are included in the system.

- Optimal placement of ESS/FACTS
- OLTC Control
- Distribution system reconfiguration

More applications will be developed and applied to the transmission and distribution integrated monitoring and analysis system by further study.

3. CASE STUDIES

For the case studies, real distribution network data of Jeollanam-do province and whole transmission network date of the KEPCO systems are used. There are about 70 substations in Jeollanam-do province. Seven major substations became targets for case study simulation. Fault current, power flow, voltage fluctuation, preliminary evaluation of DG are simulated. Simulations focused on the problems which had not been seen through previous methodologies. The power flow simulation was performed in order to compare the difference between conventional method and integrated method. In the analysis for only one distribution system, the effect of DG in other distribution system couldn't reflect to the power flow. This makes difference of two analyses. The results for the fault current and voltage fluctuation show that the effect of DGs was considered to other distribution system and transmission system.

Simulation focused the problems which had not been seen through previous methodologies to demonstrate the need for transmission and distribution integrated monitoring and analysis system where DG input rose.

3.1 Comparison of Power Flow Analysis Result

The simulation was performed with same transmission system data in order to see the difference between conventional method and integrated method. In conventional transmission monitoring and analysis system, effect of DG in distribution system couldn't reflected to transmission analysis result. This makes difference of two analysis result. And in conventional distribution analysis, substation which connect between distribution system and transmission system is assumed as slack bus. Usually slack bus's voltage is assumed as 1<0° which neglect effect of transmission system or other distribution system. Especially voltage angle difference is huge because voltage angle is relative value.

Table 1 : Comparison between conventional transmission analysis and integrated method

Substation	Transmission and distribution integrated analysis		Conventional transmission analysis	
	Magnitude (P.U)	Angle	Magnitude (P.U)	Angle
Hwasun	1.0293	-16.39	1.03	-16.54
South Gwangju	1.0279	-17.58	1.029	-17.78
Songjung	1.0211	-15.97	1.0315	-17.13
Naju	1.0262	-16.81	1.0291	-17.2
Maewol	1.0216	-17.51	1.0223	-17.66
Hwajeong	1.0205	-17.93	1.0213	-18.09
Nogseong	1.0201	-18.03	1.0209	-18.19

Table 2 : Comparison between conventional distribution analysis and integrated method

Automatic switch number in distribution system	Transmission and distribution integrated analysis		Conventional distribution analysis	
	Magnitude (P.U)	Angle	Magnitude (P.U)	Angle
160028	1.025	-19.27	0.997	-0.77
160029	1.025	-19.28	0.997	-0.78
160030	1.024	-19.28	0.996	-0.78
160031	1.023	-19.29	0.995	-0.79
160032	1.021	-19.3	0.993	-0.8

3.2 DG impact on Neighboring Distribution System and Transmission System

The Korea Electric Power Corporation (KEPCO) conducted influence assessment only on each feeder when determining DG connection. However, if large scale distributed generation is connected in distribution system, other neighbouring distribution systems or transmission systems would have a higher risk of a voltage problem. Previously, as the distribution system was analyzed separately, such a problem had never been considered. In this case study, the occurrence of a voltage problem in neighbouring distribution systems or transmission systems according to distribution system DG connection is simulated. Fig. 2 and Fig. 3 show the voltage profile of Hwasun and South Gwangju distribution system regarding DG on Whasun distribution system. The simulation result shows that if DG was supplied to the feeders below Hwasun substation, then the feeders below Hwasun substation did not have a voltage problem but the feeders below South Gwangju substation could have a voltage problem due to DG on Hwasun distribution system. Such a possibility has not been noticed in previous analysis, demonstrating the need for distribution and transmission integrated monitoring and analysis system for DG supply consideration.

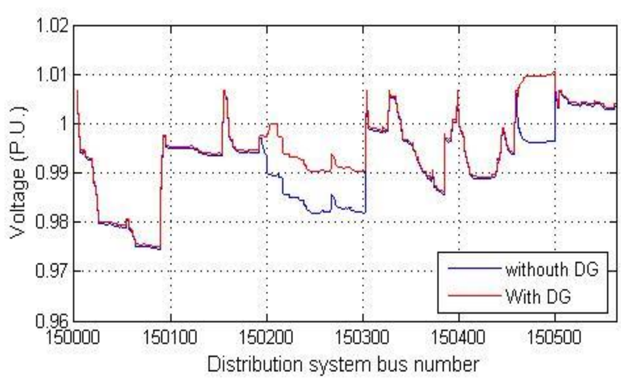

Fig. 2 : Voltage profile of Hwasun distribution system

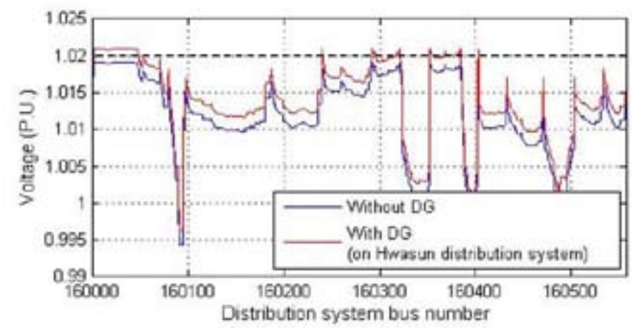

Fig. 3 : Voltage profile of South Gwangju distribution system

3.3 Phase Angle Difference at Both Ends of Normally Open Switch

Currently, KEPCO's distribution system is structured in connection with other feeder in the same substations or other substations via the normally open switches on the end of the distribution line. By controlling such a switch, distribution systems can be more efficiently operated or supply power during system failure or maintenance. But in closing the normally open switches, the difference of phase angles on both overhead transfer buses are important. If the phase angle difference becomes larger than a certain level, the switches become impossible to connect. Through conventional distribution analysis method, which is performed by each substation individually, it is possible to figure out both phase angles above the switches in same substation but impossible to measure both phase angles above the switches between different substations. In transmission and distribution integrated analysis, such switch phase angles can be measured and phase angle changes according to different DG supply can also be identified. Case study is performed by using the real data of distribution systems below South Gwangju and Hwajeong substation. Table 3 shows information of the distribution and normally open switch. Baekun distribution feeder is belong to South Gwangju and Daemyung distribution feeder is belong to Hwajeong substation. And those two distribution feeder is connected with normally open switch to supply electric power in abnormal condition.

Table 3 : Information of switch between two substations

Substation 1	Bank No.	Feeder name	Substation 2	Bank No.	Feeder name
South Gwangju	3	Baekun	Hwajeong	1	Daemyung

Table 4 shows the voltages and phase angles of both switch sides when DG output and location is changed. Before DG connected, there is only slight difference exist between both ends of switch. However DG output and location make increase of phase difference which interrupt the close of normally open switch. As DG penetration has increased distribution system operator has to consider the phase difference between both ends of normally open switch before it close. And this case study shows the effectiveness of verifying the phase difference changes due to DG output and location.

Table 4 : Phase angle difference between both ends of switch

	Baekun feeder		Daemyung feeder		Difference	
	Magnitude (P.U)	Angle	Magnitude (P.U)	Angle	Magnitude (P.U)	Angle
Without DG	1.0164	-19.37	1.0062	-19.74	0.0102	0.37
9 MW DG in South Gwangju distribution	1.0273	-17.62	1.0097	-18.86	0.0176	1.24
30 MW DG in South Gwangju distribution	1.0302	-16.88	1.0112	-18.44	0.0190	1.56
9 MW DG in Hwajeong distribution	1.0200	-18.48	1.0179	-17.89	0.0021	-0.59

3.4 Contribution of DG to Transmission System Fault Current

In the previous SCADA system, it was impossible to figure out the fault current contribution of DG to transmission system when DG is connected on distribution system. However, the transmission and distribution integrated monitoring and analysis system makes possible to find out such fault current contribution. Table 5 shows the result of comparing the sizes of transmission system's fault current as 27 MW distributed power was connected to South Gwangju substation systems. In this case study result, not all substations showed a huge increase in fault current but fault current largely increased in substations, which have large amount of DG in distribution line, such as South Gwangju substations and Hwasun substation.

Table 5 : Fault current comparison

Substation	Fault current without DG (A)	Fault current with DG (A)
Hwasun	18572.8	20033.1
South Gwangju	17437.8	19879.5
Songjung	24416.4	24858.8
Naju	24332.7	25626.7
Maewol	17439.1	18748.6
Hwajeong	17029.2	18432.7
Nongseong	16969	18411.7

5. CONCLUSION

In conventional radial distribution system, the necessity of transmission and distribution integrated analysis was less than DG connected distribution system. However, as DG penetration has increased, DGs have a large impact on power systems. Those DGs make hard to analysis and operate the power system, especially in distribution system. This paper introduced a methodology to evaluate the effect on DGs in the transmission and distribution integrated system on South Korea's power systems. In addition, cases study which has been impossible with the existing separated method was conducted. Case study results show the necessity and effectiveness of transmission and distribution integrated analysis. More applications such as distribution system reconfiguration, optimal placement of ESS/FACTS and OLTC control based on transmission and distribution integrated analysis will be developed by further research.

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INTEGRATED ROLE OF DIELECTRIC FLUIDS IN POWER TRANSFORMERS AND SHUNT REACTORS

K. Baburao, Nalin Nanavati and P.N. Narayanan
Raj Petro Specialities Pvt. Ltd.

ABSTRACT

The earliest research on electricity began in the sixteenth century through the pioneering efforts of William Gilbert hailed as the father of 'electricity'. Several other great scientists followed the path breaking research and worked on many areas viz., static electricity and principal of conduction, electric current, impulse, induction, electromagnetism, electric motor and their applications during the period 1660 to 1890. Over the last century and beyond the world has witnessed exponential growth in the demand for electric power since every sphere of activity is dependent on it. This has resulted in rapid development of HV, EHV, and UHV, generation, transmission and distribution systems. Further in the recent times smart power grid systems have emerged revolutionizing entire power sector functioning. The smart power grid offers integrated services employing digital high end technology systems to gather and act on information to the benefit of power producers, transmission & distribution agencies and consumers.

Mineral oil based dielectric fluids have been integral part of transformers starting from 1890 and continue to be the preferred medium due its track record, good performance and competitive costs. As the generation and transmission systems grew from, LV, MV, HV, EHV & UHV the quality of dielectric fluids also kept pace to conform to the rigid standards, thanks to the technological advancements in refining. Modern catalytic hydro processed mineral dielectric fluids apart from meeting the thermal and electrical stresses constantly varying due to load factors have also proven characteristics to comply with environmental issues; a major factor in the present times. We have the present generation mineral oil based dielectric fluids, synthetic ester and natural ester based fluids fulfilling all these requirements.

The prime function of dielectric fluids has always been to insulate and cool the system. In the present times its role has been expanded far beyond these two important functions. Dielectric fluids today are the most accurate diagnostic media to monitor and assess the overall health of the power transformers and shunt reactors.

In this paper we are discussing about the integral role of dielectric fluids in the life management of transformers and reactors. We also present one case study about the exceptional quality of present generation hydro processed dielectric fluids.

Keywords *: power transformer; shunt reactor; present generation dielectric fluid; conventional naphthenic oils; dielectric status; ageing status; degradation status; biodegradability;*

1. INTRODUCTION

Transformer like its creator - the human being leads a stressful life. It is subjected to multiple stresses like thermal, electrical, magnetic and mechanical. In order that it is able to perform under these varying conditions all the components in the system have to be in perfect working condition. While this is an ideal situation the very complex nature of the transmission system where new and aged transformers co-exist a strict regime of continuous monitoring system has to be created and maintained to ensure good health and trouble free service.

Dielectric fluids have been integral part of transformers starting from 1890. The role of dielectric fluids is to insulate, cool and carry information about the health of the system. Transformers and reactors are composed of a number of specialized functional sub systems integrated into a unit. Each one of these sub systems has a unique role to perform within the overall system. The critical functions of the individual sub system[1] should always be maintained at optimum condition to prevent failures (Dielectric System, Electromagnetic Circuit, Current carrying circuit, Mechanical system, Voltage regulating system, Containment system, External Interface System and Cooling system).

Interestingly there are similarities between a transformer and a human body particularly the circulating fluids which furnish information for diagnostic studies as shown in Figure 1.

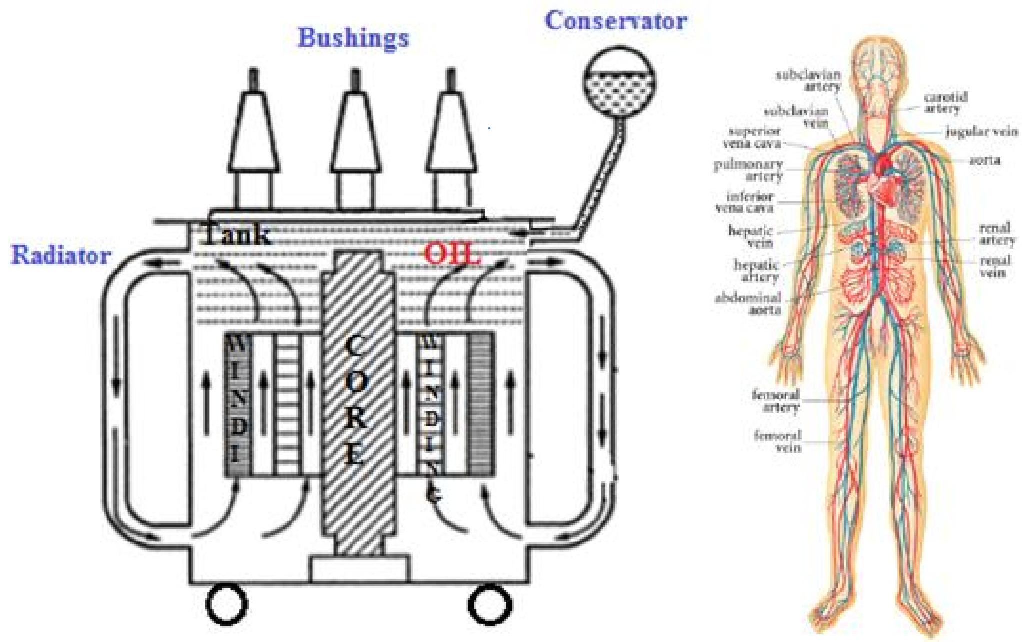

Figure 1 : Circulating Fluids – Similarities between a Transformer and a Human Body

In this paper we present the exceptional performance of the present generation modern dielectric fluids in 400 kV, 315 MVA transformers.

1.1 Deterioration of Insulation (Liquid & Solids) System

Dielectric fluid primarily functions as insulating and cooling medium in the transformer & reactor. The operational stress inside the equipment in service and ageing factors cause generation of moisture, acids and gases. Excessive presence of the decay products[2],[3] will lead to accelerated deterioration in the dielectric strength of the fluid apart from damaging the cellulose. This will calls for timely in-depth analysis of dielectric fluid to determine whether re-conditioning will suffice or replacement is the solution to ward off equipment failure.

1.1a *Moisture Contamination in the System and its consequences*

The presence of oxygen coupled with moisture and elevated temperature will pose serious hazard to the insulation system. Even trace moisture is harmful to power transformers and reactors. Moisture has three sources – ingress caused by defective sealing, entry from atmosphere via breather, structural components inside the transformer. Moisture is responsible for the rapid deterioration of both the dielectric fluid and the paper insulation[4]. Reactions in the presence of moisture increase the water availability leading to transformer failure. As per experts oxygen levels more than 2,000 ppm in dielectric fluid greatly accelerate paper deterioration. It is recommended that if oxygen reaches 10,000 ppm in the DGA, the oil should be de-gassed and new oxygen inhibitor installed. Delay in initiating remedial measures to remove moisture and dry the equipment can result in failure with financial implication.

1.1b *Particulate Contamination in the System and its consequences*

Particles in insulating oil in transformers & reactors are a major source of concern in the life management of the asset[5]. Several types of particles are found due to a variety of causes. Cellulose fibres, iron, aluminium, copper, zinc and other particles are generated at the manufacturing stage and due to operational wear and ageing. Migrations of carbon particles from OLTC into insulating fluids also contaminate critical parts. Hence constant monitoring of particulate in the dielectric fluid will enable timely intervention. Failures to initiate timely action can result in failure of the equipment.

1.1c *Ageing of Insulation (solid and liquid) System*

Ageing of insulation system is an inevitable and irreversible phenomenon in the service life of transformer and reactor. Aging of insulation is predominantly due to hydrolysis, pyrolysis and oxidation. Temperature, moisture and oxygen are the main agents of cellulose and oil decomposition. The activation energy of pyrolysis is higher than the hydrolysis leading to continuous decomposition of insulation even at 110-120°C temperatures. The ageing process of insulation is initiated by moisture in presence of acid catalysts from the oxidized oil. One of the important by-products due to degradation of solid insulation is furanic compounds. Significant presence of furanic compounds particularly 2FAL indicates the deterioration in the degree of polymerization (DP) of the cellulose paper. Ageing process can be slowed if timely preventive actions are initiated to remove water, oxygen, acids and keeping the system cooler.

1.1d *Dissolved Gas Analysis (DGA) and its consequences*

Diagnostic study of the dissolved gas through dielectric fluids is one of the most important tools to understand the health of Transformers and reactors. Transformers and reactors in service are prone to developing gases due to various operational stresses[6]. Fault gases like Hydrogen -H2, Methane-CH4, Ethane-C2H6, Ethylene-C2H4, Acetylene-C2H2 & Carbon Monoxide-CO if found in significant ppm levels will need to be monitored and appropriate corrective actions initiated without loss of time to protect the costly equipment. Gases like Oxygen-O2, Nitrogen-N2, and Carbon dioxide-CO2 are related to atmosphere and will in no way affect the insulation system. One important factor to bear in mind while analyzing DGA is not to rush into any hasty remedial action without a proper trend analysis.

DGA data can provide

- Early warning of faults developing in the transformers & reactors.
- Plan repair schedules
- Trend analysis of the fault gases to monitor any major release

1.1e *Collateral Damages of Degradation*

The dielectric fluids also reveal several other abnormalities developing inside transformers and reactors in service such as

- Conductive particles – reduction in dielectric strength
- Dissolved water – reduction in dielectric safety margin
- Bubble formation – partial discharge-PD, reduction in interfacial tension - IFT
- Furanic Compounds – reduction in mechanical strength of cellulose paper (DP) & carbon oxide gas formation
- Sludge formation – increase in viscosity, increase in acidity of the oil

2. DIELECTRIC FLUID - AS A DIGNOSTIC MEDIA

It is well established that integrated role of dielectric fluid furnishes more than 70% of the diagnostic information relating to the functional status of the power transformers and shunt reactors. Study of different functional properties of the dielectric fluid facilitates understanding and corrective action as required in the life management of the power transformers and reactors as shown in Table 1.

Table 1 : CIGRE's Dielectric Fluid Based Information for Transformer Life Management[2]

Dielectric Fluid Characterization	Dielectric Fluid Based Information		
Dielectric Status	Ageing Status	Degradation	
Fluid Composition – Carbon Types	Water Content	Visible Spectrum	DGA
Specific Gravity	Percent Saturation	Acidity	Furanic Compounds
Kinematic Viscosity	Bound Water	Inhibitor Content	Phenols
Dielectric Constant	Particle Profile	IFT	Cresols
PCA content	Dielectric Strength	FTIR	Dissolved Metals
Inhibitor Content	Impulse Strength	Dielectric Dissipation Factor	Particle Profile
Metal Passivator Content	Charging Tendency	Resistivity	Extended DGA
PCB content	Resistivity	Turbidity	
Total Sulphur	Dielectric Dissipation Factor	Sludge content	
Corrosive Sulphur	Insoluble Sludge	Free Radicals	
Refractive Index	Gassing Tendency	Furanic Compounds	
PD Inception Voltage	Polarization Index	Oxidation Stability Test	

3. EXPERIMENTAL RESULTS AND DISCUSSIONS

Present Generation modern catalytic hydroprocessed dielectric fluids (PGHDF) are in use in many power transformers and reactors in Indian utilities since the last two decades. From the year 2009 onward we are monitoring 25 power transformers and reactors to evaluate their performance

CASE STUDY

One of the EHV transformer taken up for our studies was manufactured in 2003 and comissioned in the year 2004. The historical data on the loading conditions, types of repairs and information on dielectric fluid is as shown in Table 2. This power transformer is being monitored for the integrated role of present generation hydroprocessed dielectric fluid since 2009 for its diagnostic information – characterization of fluid parameters, dielectric status, ageing status, degradation status and key combustible gas concentration as shown in Figures 2 - 5. All the dielectric properties[7],[8] are regulary analysed as per IEC 60422 and DGA as per IEEE-C57.104. The dielectric properties of the fluid are well within the recommended limits prescribed in IEC 60422. In Figures 4 & 5 the total acidity-TA, total sludge-TS & dissolved metals-DM values are zero and are not readable.

Table 2 : Monitoring Data on EHV Transformer

Loading Conditions, Repiars & Dielectric Fluid Based Information - 315 MVA, 400 kV/220 kV EHV Transformer							
Quantity of MCHDF, Ltr	84000						
Age in-Service	11 Years						
Details of Repairs	OLTC Oil changed in 2012						
Year of Monitoring	2009	2010	2011	2012	2013	2014	2015
Peak Load, MW	180	160	140	150	180	180	300
Off Peak Load, MW	90	85	74	55	110	55	50
Peak Temperature, °C	56	55	55	54	56	60	70
Winding Temperature, °C	50	50	56	56	58	52	57
Dielectric Status							
Water Content, ppm	5	7	4	12	9	11	9
BDV, kV	78	75	80	67	63	65	75
DDF (Tan Delta) at 90°C	0.002	0.0107	0.0063	0.0064	0.0134	0.0056	0.0065
Resistivity at 90°C	10	15	21	26	16	17	25
Ageing Status							
IFT, mN/m	38	35	38	38	35	35	38
TA, mg KOH/g	0.001	0.001	0.001	0.001	0.001	0.001	0.001
TS, by wt%	0.001	0.001	0.001	0.001	0.001	0.001	0.001
2FAL, ppb	0	0	0	0	0	0	0
Degradation Status							
Particle Profile-(14/11/8 to17/15/12) NAS 1638	7	7	7	7	8	8	8
Dissolved Metals (DM)	0	0	0	0	0	0	0
2FAL, ppb	0	0	0	0	0	0	0

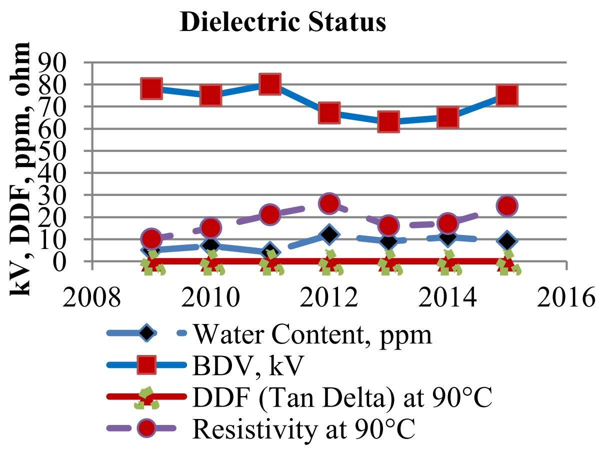

Fig. 2 : Dielectric Status of PGDF in PT

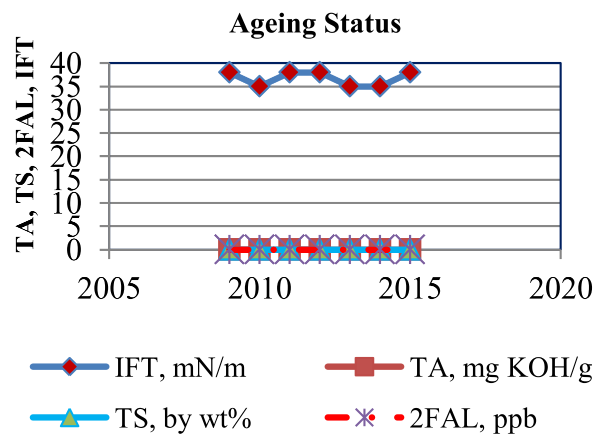

Fig. 3 : Ageing Status of PGDF in PT

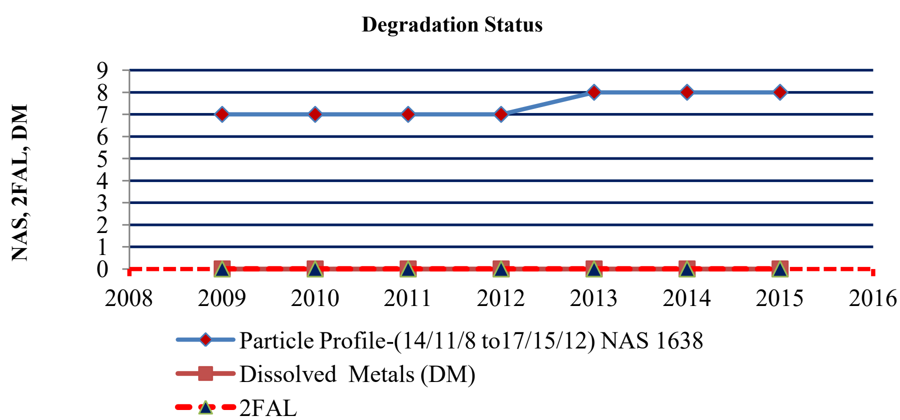

Fig. 4 : Degradation Status of PGDF in PT

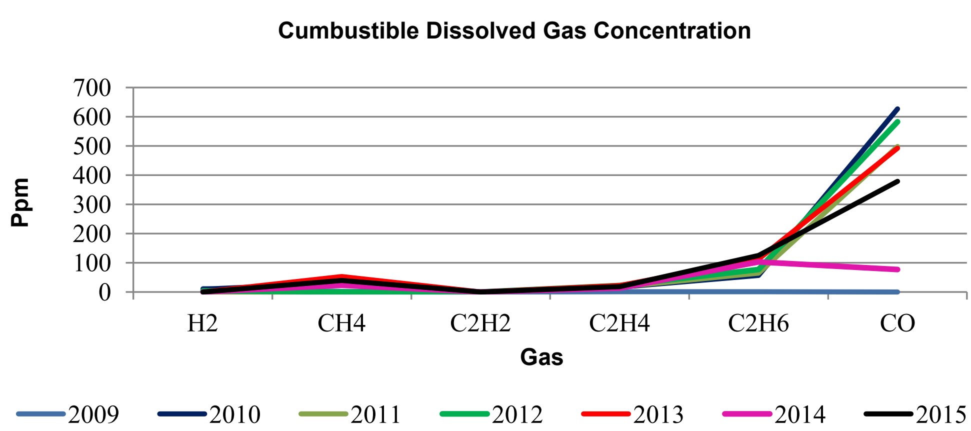

Fig. 5 : DGA of present generation dielectric fluids in PT

The dissolved combustible gas concentration is well within the limit as per IEEE guide for the interpretation as given in Table 3. Where as the ethane gas is in conditon 2 limit apparently due to the contaminaion from the OLTC oil.

Table 3 : Dissolved Gas Analysis of EHV Transformer

Gas, ppm	Hydrogen	Oxygen	Methane	Ethane	Ethylene	Acetylene	Carbon Monoxide	Carbon Dioxide	Nitrogen
2009	11	17900	2	1	1	0	0	270	38700
2010	9	2580	31	57	16	0	627	1969	61600
2011	0	4000	0	64	17	0	498	2154	32100
2012	4	25000	0	77	22	0	582	2216	50640
2013	0	5192	53	112	22	0	492	2350	56229
2014	0	22000	23	103	13	0	77	1709	59000
2015	0	3000	39	125	18	0	379	3029	70000

4. CONCLUSION

As it will be observed the present generation hydro processed dielectric fluids perform excellently in its integrated role in the power transformer and reactors.

The present generation dielectric fluids offer several advantages

- Free from harmful corrosive sulfur, other contaminants and have better stability
- Excellent response to oxidation inhibitors – very slow depletion of inhibitor
- Excellent heat transfer capability at all temperature gradients including cold start
- Exceptional good stability ensure longer life for the asset
- Nontoxic, biodegradable and hence environmentally safe
- Better asset reliability, less breakdown risks
- Easily available at affordable costs
- Reduced maintenance requirements

Acknowledgements

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OPERATIONAL EXPERIENCE IN 1200 KV NATIONAL TEST STATION (UHVAC), INDIA

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ABSTRACT

POWERGRID in association with Indian manufacturers have established a 1200kV National Test Station (NTS) at Bina, Madhya Pradesh, India with an objective of developing indigenous Ultra High Voltage AC (UHVAC) equipment and to gain first hand operational experience before full scale commercialization of UHVAC technology in Indian grid. The other objectives of this test station are to facilitate long term performance evaluation and carrying out optimization studies on 1200kV class equipment. Operational experience gained from NTS is very crucial for finalizing specifications of 1200kV equipment for the upcoming 1200 kV projects in India.

This paper gives a glimpse on present status of 1200 kV NTS facility and challenges faced during manufacturing, installation, commissioning and operation of the facility. This paper also describes a typical fault experienced in 1200 kV National Test Station (NTS) and its systematic investigation. Immediately, after charging of 1200 kV test station from 400 kV side of 400/1200 kV transformer (three single phase units) a flashover was seen on outer side of tank of one of these transformers and all three single phase units got tripped on over-current. It was initially assumed that there was fault internal to transformer however all test results showed that transformer was in healthy condition. In-depth study was carried out in PSCAD software, to simulate the actual scenario. The results of the simulation study are also discussed in this paper.

***Keywords** : 1200 kV, National test station, UHVAC, SFRA, Inrush current, Corona, Thermo vision scanning, Transformer, Circuit breaker, Fault*

BACKGROUND

1200 kV National Test Station, Bina has been established with an objective of indigenous development of UHVAC equipment in India and to facilitate long term performance evaluation & optimization of 1200 kV class equipment. 1200 kV NTS project has been developed under Public-Private-Partnership model (PPP), where-in equipment has been developed by manufactures indigenously and POWERGRID has provided test bed for performance evaluation & optimization studies. 35 Indian manufacturers have joined the endeavour with POWERGRID to establish this project.

1. 1200 kV NATIONAL TEST STATION - SALIENT DESIGN CONSIDERATIONS

Considering requirement of high power transfer capability, large size of equipment, transportation limitations and cost optimization, the Indian 1200kV system has been designed with an optimum insulation level (LIWL & SIWL) (Fig.1(a)) and reduced protection margin by utilizing high performance multi-column surge arrestors (Fig.1(b)). Continuous remote monitoring is put in place to monitor performance of severely stressed surge arrestors. It was envisaged during design stage that tap changing shall be carried out at lower voltage level like 400 kV and accordingly tap changers have not been provided with auto-transformers. Though 1200 kV test station is Air Insulated Switchgear (AIS) type, 1200 kV Circuit Breakers chosen are dead tank type (Fig.1 (c)) instead of live tank because of stability considerations. Bus post insulators are of tripod arrangement. Tower structures at the test station have been provided with provision to vary ground clearance as well as phase-phase clearance for experimentation. Engineering of the switchyard was carried out further to experimental studies finalizing the clearance (Fig.1 (d)) and conductor and bus bar configuration. Conductors used in switchyard and test line are having 8 sub-conductors for Corona and Audible noise control. Technical parameters of 1200kV equipment were obtained by carrying out various studies and were not extrapolated from existing 400/800kV system.

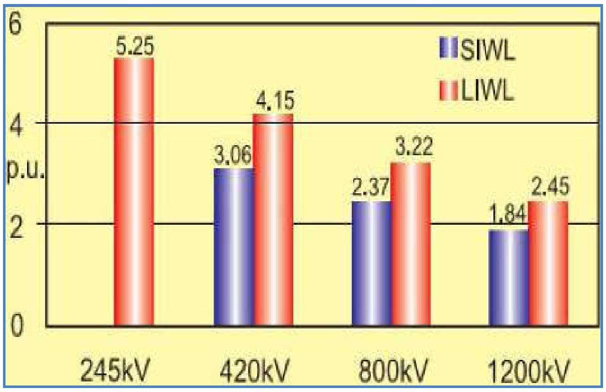

Fig. 1(a) : Insulation level requirement for different voltage levels

Figure 1(b): 1200 kV Multi-column surge arrestors

Fig. 1(c): 1200 kV Dead tank breaker

Fig. 1(d) : 1200 kV tower window simulation

2. 1200 kV PROJECT OVERVIEW AND SINGLE LINE DIAGRAM

1200kV National test station project is being implemented in two phases (Phase-I & Phase-II). Single Line Diagram (SLD) of 1200 kV NTS indicating Phase-I & II of 1200 kV NTS, Bina is given in Fig.2. Phase-I of 1200 kV project comprises of one 1200 kV bays & 1.1 km of single circuit (S/C) test line (Fig. 3(a)) while Phase-II comprises of other 1200 kV bay & 0.8 km double circuit (D/C) test line (Fig. 3(b)). Phase-I of 1200 kV NTS including S/C test line was charged under no-load condition on 26th May, 2012. Erection works in phase-II are already completed and interconnection works on 400 kV side of phase-II are in progress. Commissioning of Phase-II will establish power flow through 1200 kV line.

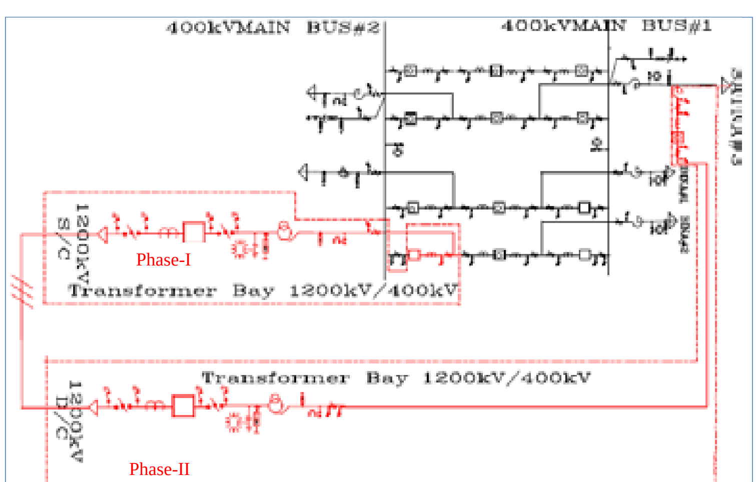

Fig. 2 : Single Line Diagram (SLD) of 1200kV National Test Station (NTS), Bina

Fig. 3(a) : 1200kV Single circuit test line
(S/C tower height: 55 m)

Fig. 3(b) : 1200kV Double circuit test line
(D/C tower height: 125 m)

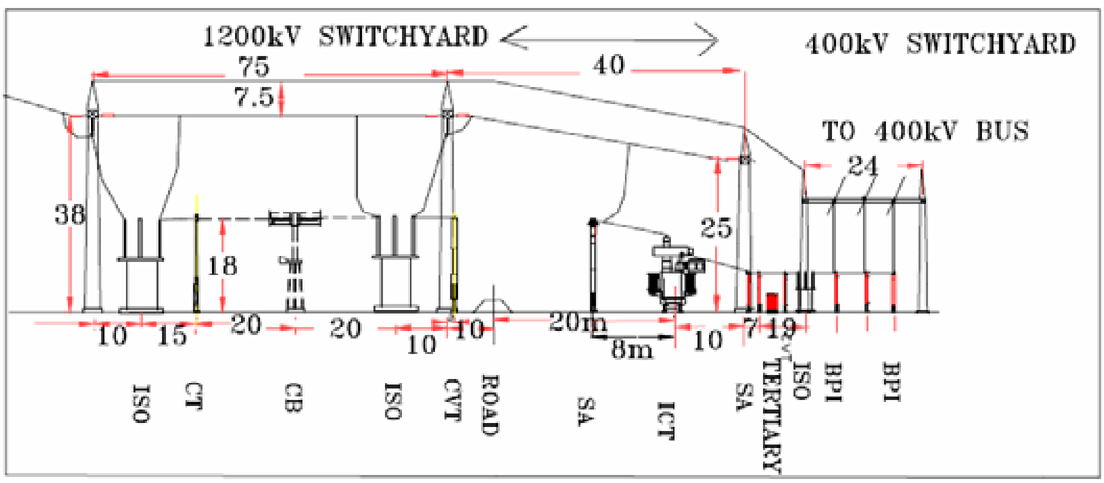

Fig. 4 : Sectional layout of 1200 kV bay

3. PERFORMANCE EVALUATION OF EQUIPMENT AFTER 1ST CHARGING

One major objective of this project is to carry out performance evaluation and to carryout optimization studies on equipment. All Pre-commissioning & on-site acceptance tests were carried out on equipment of different makes and design, before charging equipment in NTS. Additionally, various routine tests and measurements like Electric field, Magnetic field, Thermo-vision scanning, Corona imaging, SFRA, In-rush current measurements, voltage profiling, etc. are being carried out to evaluate performance of equipment and feedback is shared with respective manufacturers. Brief details/results of some of the key measurements carried out after the successful charging event are presented below:

(a) *Recorded Voltage and Current Waveforms*: 1200 kV voltage and current waveforms recorded under no-load condition are shown in Fig. 5 and their typical values are tabulated below:

Table 1 : 1200kV Voltage and Current under no-load conditions

Sl. No.	Parameter	R-N	Y-N	B-N
1.	1200 kV side voltage	700 kV	722 kV	715 kV
2.	1200 kV side current	22.2 A	18.8 A	17.6A

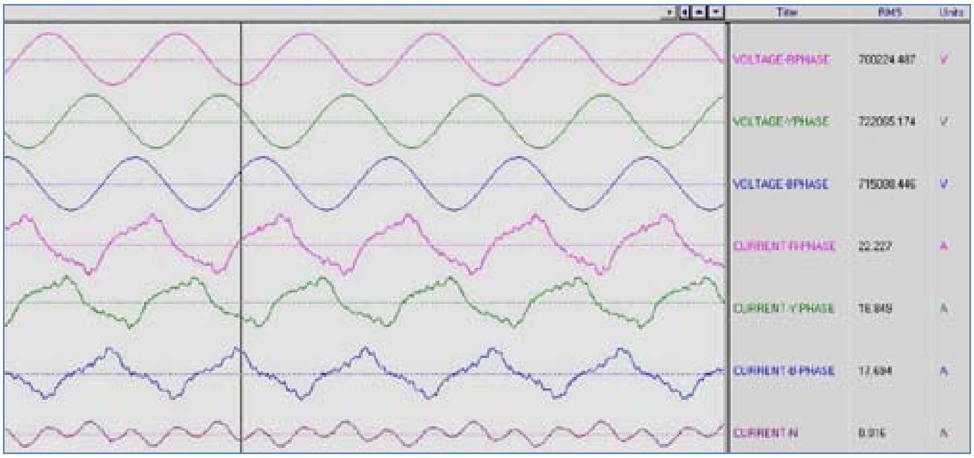

Fig. 5 : Recorded 1200 kV phase voltage and current waveforms

(b) *Inrush Current* : Inrush currents are recorded to keep a check on transformer core condition. A typical inrush current recorded from 400kV side during charging of NTS phase-I are tabulated below. Fig.6 shows inrush current waveforms recorded during a typical charging event.

Table 2 : Inrush currents drawn during a charging

R-phase (rms)	Y-phase (rms)	B-phase (rms)
1.16 kA	1.16 kA	2.71 kA

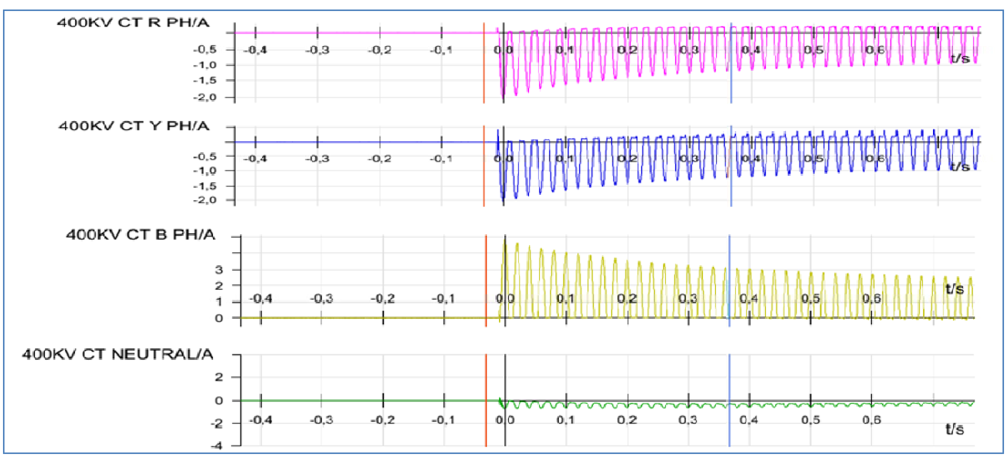

Fig. 6 : Recorded inrush current waveforms during a typical charging event

(c) *Corona Measurements*: Corona performances of all equipment after charging were assessed for their effectiveness in limiting corona. Fig. 7 shows the corona performance of 1200kV corona ring installed on transformer bushing. Issue of high corona was faced with some of the line connectors due to surface distortion and same were re-installed after repair/ smoothening of surfaces as a part of corrective action.

(d) *Thermo-vision Scanning*: Thermo-vision scanning of equipment was carried out under no-load condition to detect any abnormalities in the operating temperature or hot spots in the equipment.

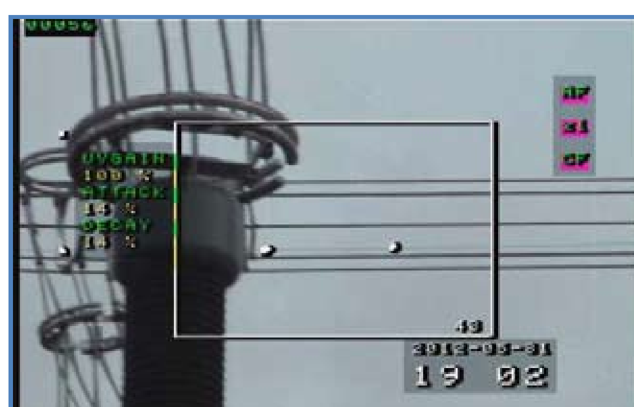

Fig. 7 : Corona image taken by handheld corona camera near 1200 kV bushing

No abnormalities were observed during the test except in one of the line connectors and it was attributed to loose connection, which was resolved. Fig. 8 shows thermo-vision scanning images taken for transformer, bushing of 1200 kV CB and 1200 kV surge arrestor.

Once power flow is established after works in phase-II and interconnection activities are completed from 400kV side, thermo-vision scanning of the equipment will be carried out again which will be helpful in validating their thermal design.

Fig. 8(a) : Thermograph image of bushing turret of transformer

Fig. 8(b) : Thermograph image of the transformer body

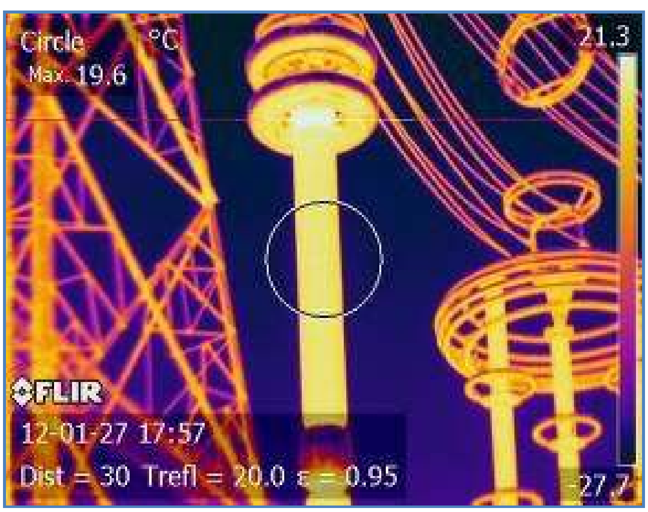

Fig. 8(c) : Thermograph image of 1200kV CB

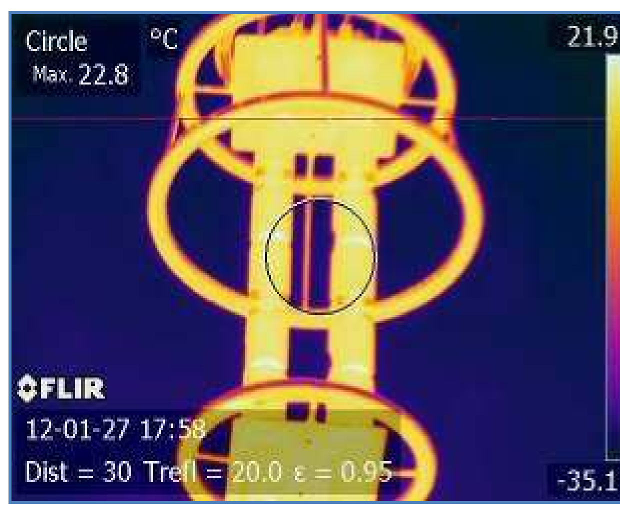

Fig. 8(d) : Thermograph image of 850kV surge arrestor

(e) *Assessment of Electrostatic Induction* : The electric field strength was measured around the periphery of the major equipment in 1200kV bay at 1 m&1.8m above the ground level and 1m away from the equipment and measured values were found generally in order (< 4kV/m).

4. FAULT EXPERIENCED IN 1200KV NTS FACILITY AND ITS INVESTIGATION

Progressively equipment were developed, installed and charged in NTS facility. The 1200kV test station was re-charged after the installation of following 1200kV equipment:

(a) Circuit Breakers in R & Y-phase

(b) One three phase isolator

(c) Single phase isolator installed in R-phase

After charging from 400kV side, R-phase of NTS phase-I was tripped by instantaneous over-current protection and a flashover was observed outside the tank (Fig. 10) between transformer tank cover and main tank body. General technical parameters of 400/1200kV transformer are given in Table 3.

Table 3 : General technical parameters of 400/1200kV Transformer

Parameter	Specification
Rated Power	333/333/111 MVA, single phase
Voltage Ratio	1150/√3 / 400/√3 /33 kV
Rated frequency	50 Hz
Connection	Ynaod11
% Im edance	HV-IV 18% HV-LV 40% IV-LV 20%
Winding LIWV	2250/1300/325 kVp
Winding SIWV	1800/1050/325 kVp
Bushing LIWV	2550/1425/325/95 kVp
Bushing SIWV	1950/1050/325/5 kVp
C oling type	ODAF or OFAF
Cooling equipment	4*33% Unit OFAF coolers
Temp Rise	45 degC : Wdg 40 degC : Top Oil

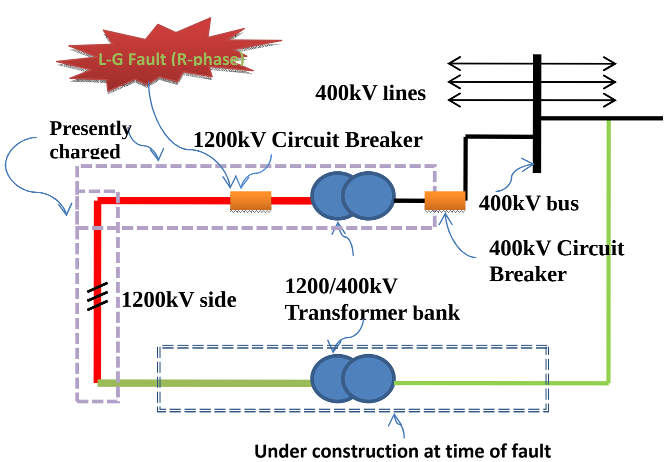

Fig. 9 : Schematic diagram of 1200kV National Test Station indicating location of fault

Fig. 10 : Snapshot of the flashover seen on the R phase transformer

As flashover was seen on outer side of transformer tank in order to ensure the healthiness of transformer, series of tests were carried out on transformer and same are listed below:

- DGA, BDV, PPM, Tan δ etc. of transformer oil and bushing oil
- Capacitance & Tan δ measurement from windings to tank and between windings
- Capacitance & Tan δ measurement of bushings
- Insulation resistance measurement of CC to Frame
- Insulation Resistance Measurement of bushing CTs
- Continuity test on bushing CT (IV/HV)
- Winding resistance of IV Bushing CT
- Magnetizing current test
- Transformer winding resistance measurement
- Earth pit resistance measurement
- SFRA measurements of Transformer

All the test results were found to be in line with pre-commissioning test results except SFRA results and magnetizing current. Magnetizing current of transformer increased slightly but it was not significant. SFRA results were showing a minor shift in low frequency range as shown in Fig. 11. Shorting strips connecting tank cover and main tank body were found to be intact; however as a safety measure shorting strips were replaced after cleaning of contact surface.

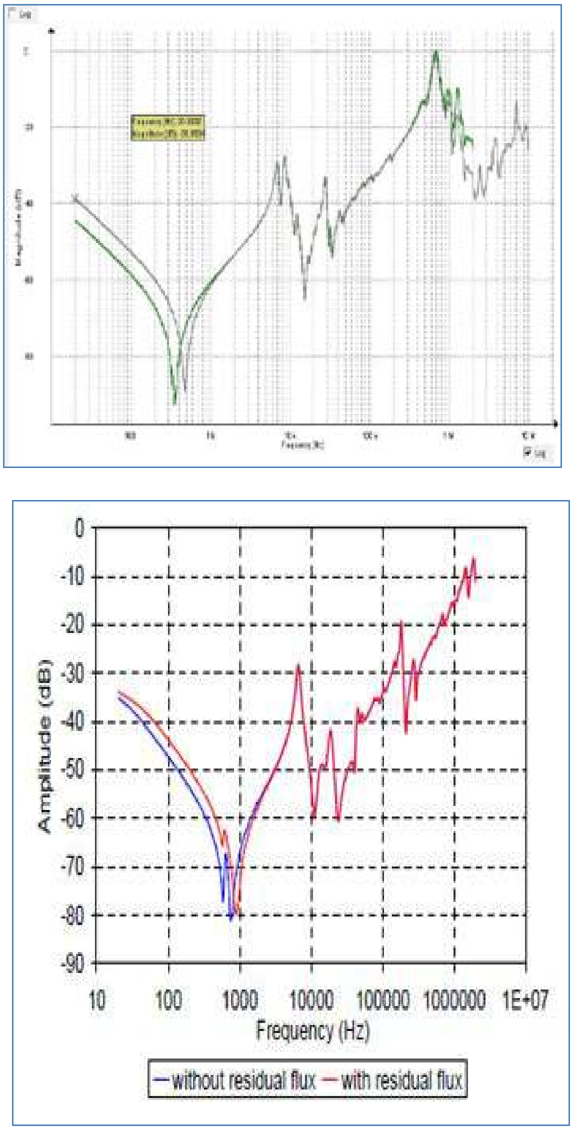

Fig. 11 : SFRA of 1200kV transformer winding showing shift in Low frequency range & snapshot of CIGRE TB:342showing effect of magnetized core on SFRA results

Following were considered as the probable causes of flashover seen on outer side of transformer tank before detailed investigation:

- Loosening of shorting strips between tank cover and main tank
- Change in earth resistance between the earth pit and neutral earthing terminal
- Improper earthing of transformer tank, cooler bank and firefighting pedestals
- Saturation of transformer core due to over voltage
- Presence of winding earth Fault
- Failure of one of the bushing's
- Failure of bushing CTs

5. OBSERVATIONS FROM DISTURBANCE RECORDER (DR) WAVEFORMS

Disturbance recorder waveforms were studied in detail, to get an overall idea of fault scenario. Observations made from the disturbance recorder waveforms are as under:

1. Inrush current drawn by R-phase (IV_SIDE_IL123 (R, Y and B-phase) in Fig. 12) transformer for first few cycles was of the same order as drawn by Y-phase, B-phase and during previous charging events. Also it was observed that inrush current drawn by transformer were decaying in first few cycles before fault occurred. Hence it was concluded that transformer core was not saturated prior to charging.
2. Before occurrence of fault, 400kV side R-phase voltage (HV_PT_UL1_3MS/kV in Fig.13) was quite stable and was within acceptable limits. There was no over-voltage situation which can saturate transformer core. Further, it was found (Fig.13) that during fault period, R-phase voltage and current were in phase and a DC component was present in R-phase current.

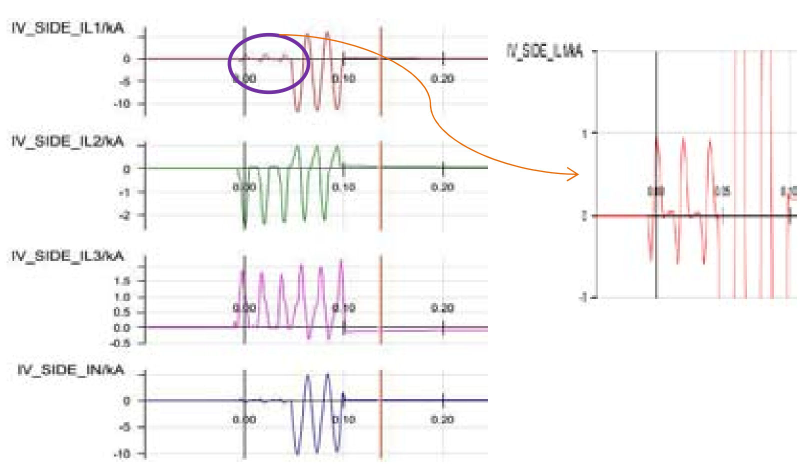

Fig.12 : Disturbance recorder waveforms of 400 kV side bay CT currents

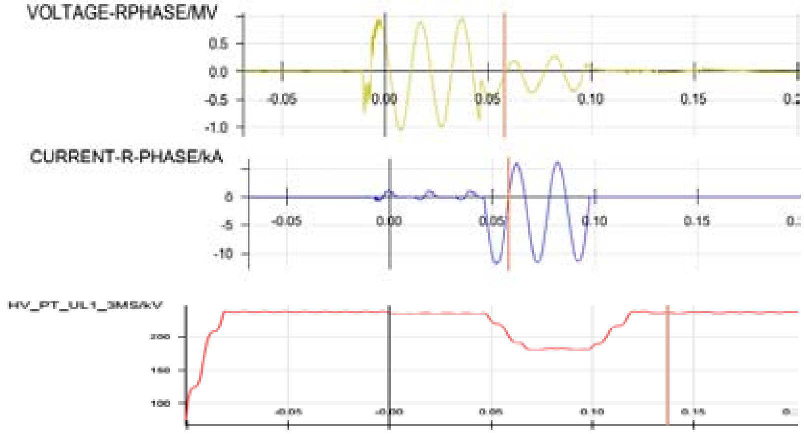

Fig. 13 : Recorded waveforms of 400 kV side voltage and currents

3. Currents recorded by REF protection (REF_IL123 for R, Y and B-phase in Fig.14) relays were almost zero and hence winding to earth fault was not present.

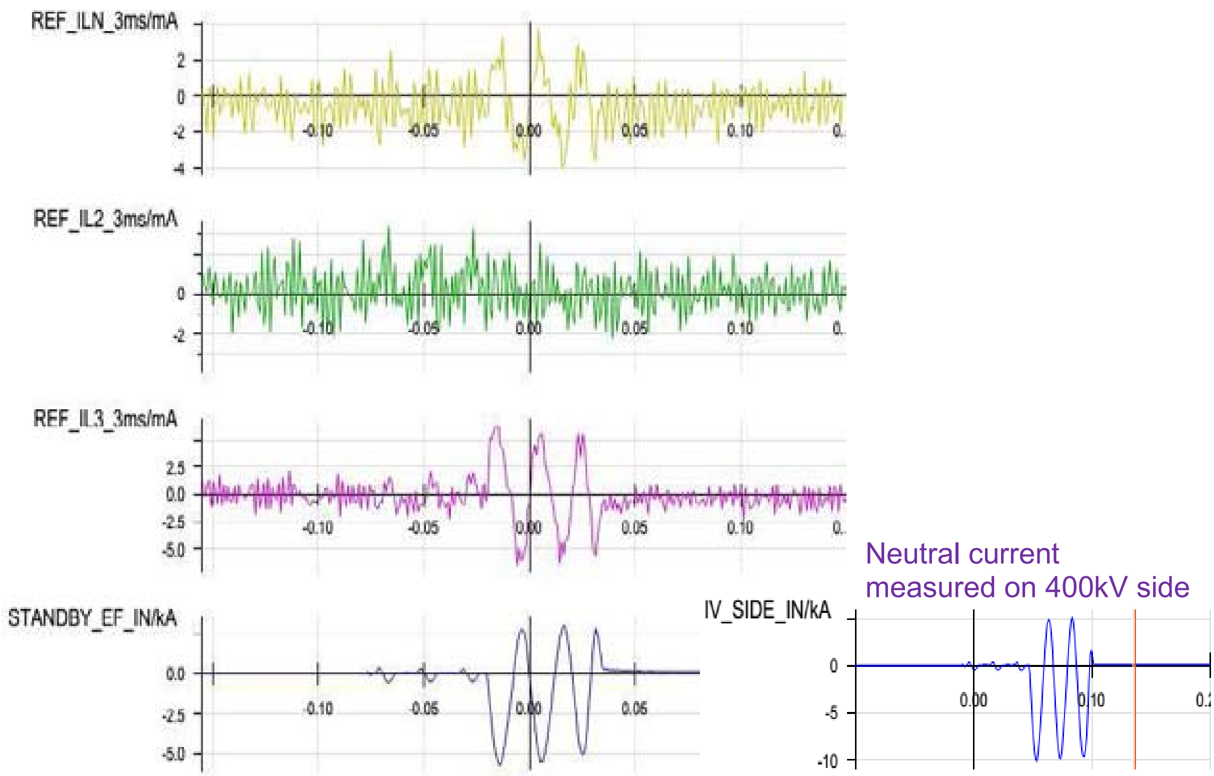

Fig. 14 : Recorded waveforms of REF protection of transformer, stand-by earth Fault relay and neutral current measured on 400kV side

4. R-phase standby earth fault CT current (STANDBY_EF_IN/kA Fig.14) was found to be less than that of 400kV side neutral current which indicated a possibility of line to earth Fault on 1200kV side (outside the R-phase transformer) and hence there was a presence of DC bias in R-phase current.

6. SIMULATION RESULTS AND ANALYSIS

Based on the observation made from the disturbance recorder waveforms above, it was decided to carry out detailed simulation study for single phase line to ground fault on 1200kV side. In order to simulate the L-G fault a model of 1200kV NTS was prepared in PSCAD software (Fig. 15) and same was simulated. 1200kV circuit breakers were provided in R and Y-phase in the simulation model, as it was in actual condition.

CVT has been modelled with an equivalent capacitance value since parameters such as burden, compensation inductances, and losses were not available. Charging of the NTS is governed by 400 kV circuit breakers and same has been used in the simulation model and their operation was defined in the time logic.

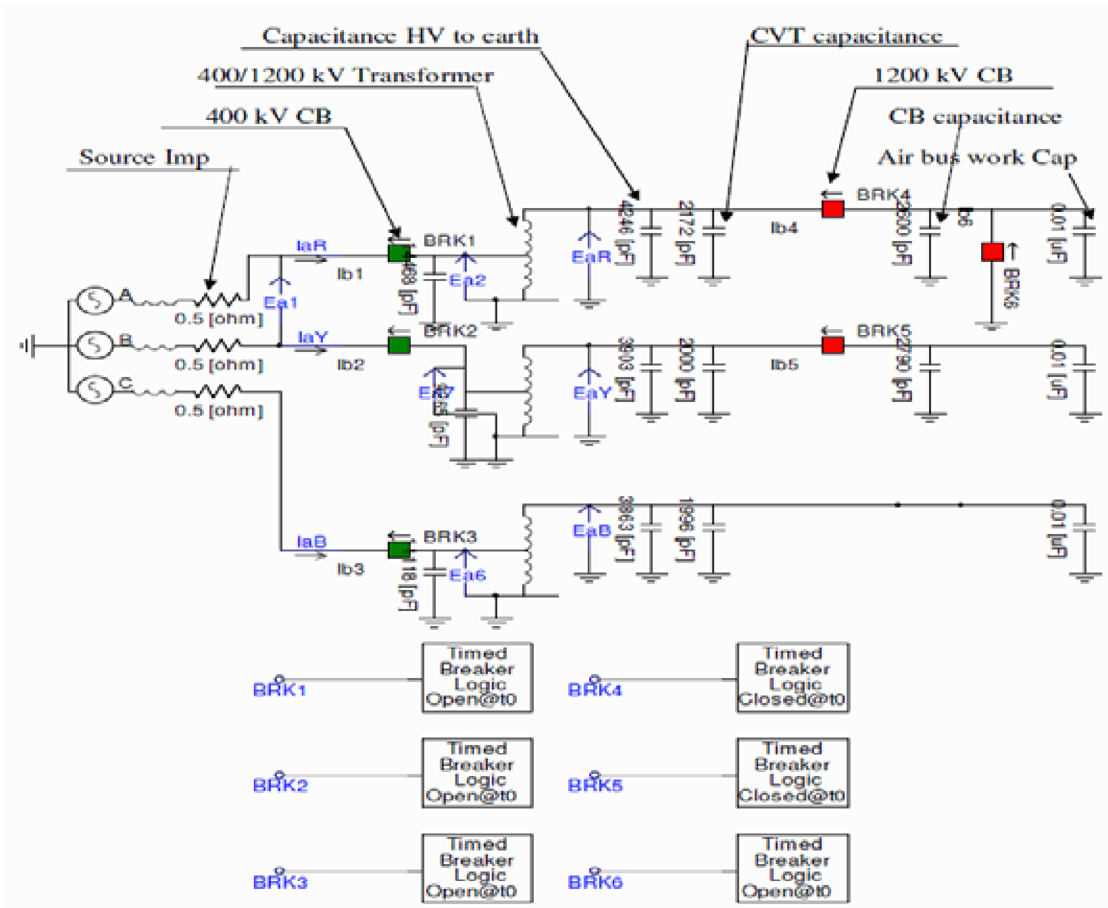

Fig. 15 : 1200kV NTS Circuit model to simulate and analyze the Fault condition

A condition similar to the single phase line-to-ground fault was created in the model using the circuit breaker BRK6 in Fig. 15, the instant of the fault was chosen to approximately to match with the actual measurement. The switching sequence of the breakers was chosen similar to the actual charging sequence at the site.

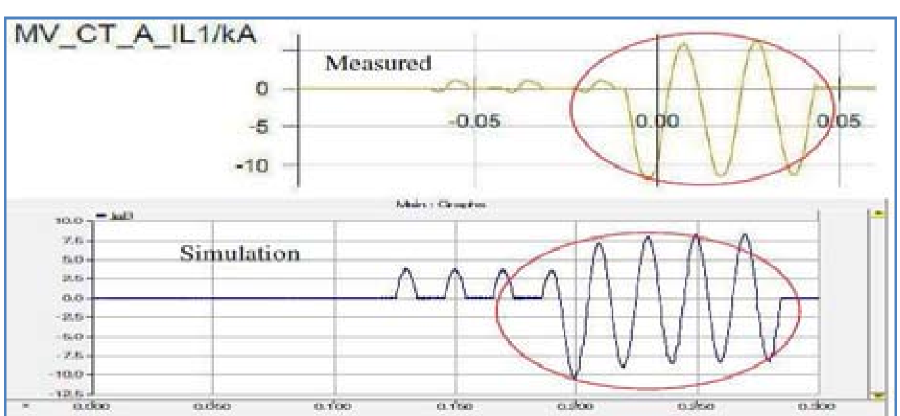

Fig. 16 : 400kV side R-phase current measured and simulated waveform

It can be seen from Fig.16 that when line is charged under normal condition, charging currents are drawn by all three single-phase transformers. However, when single phase line-to-earth fault is created in the R-phase, high fault current flows in R-phase, and while other two phases still carry charging currents of the transformers (Fig. 17).

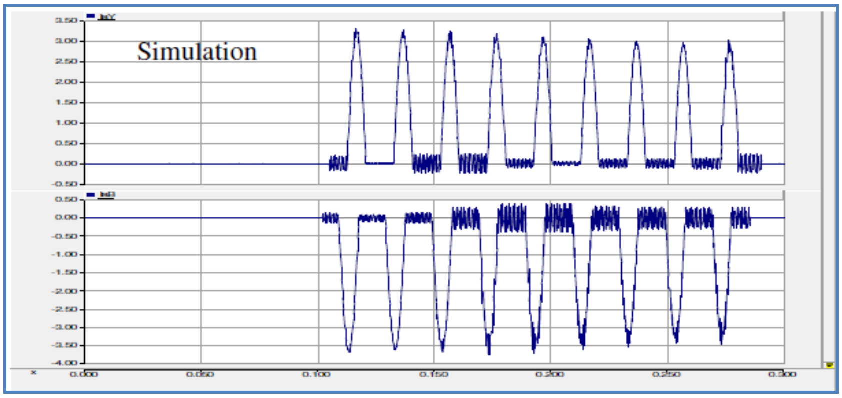

Fig. 17 : 400kV side current Y and B-phase currents – Simulation

400kV side R-phase voltage as seen in Fig. 18 reduces during the fault condition and is similar to that observed in the actual recorded waveforms at the site (the peak pre-fault voltage = (400/√3)√2 = 326.6 kV). This significant voltage drop is due to very high fault current flowing through the line.

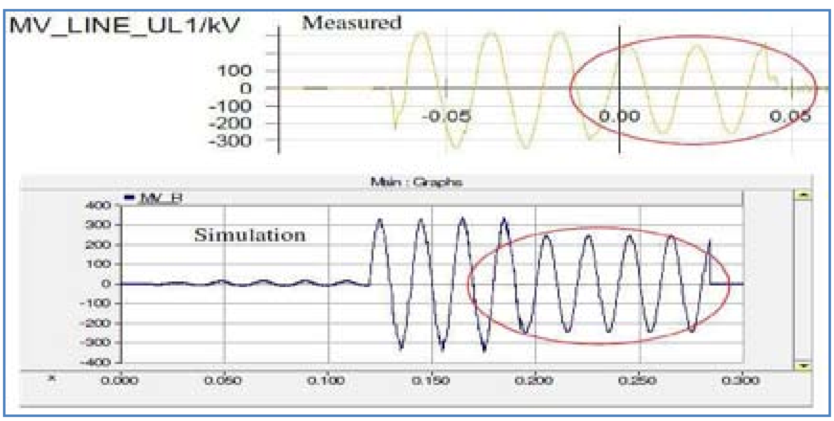

Fig. 18 : 400kV (MV-Medium voltage) side R-phase voltage under measured and simulation

The R-phase 1200kV side voltage reduces significantly because of the fault condition as shown in Fig.19, which is similar to that recorded during the measurements.

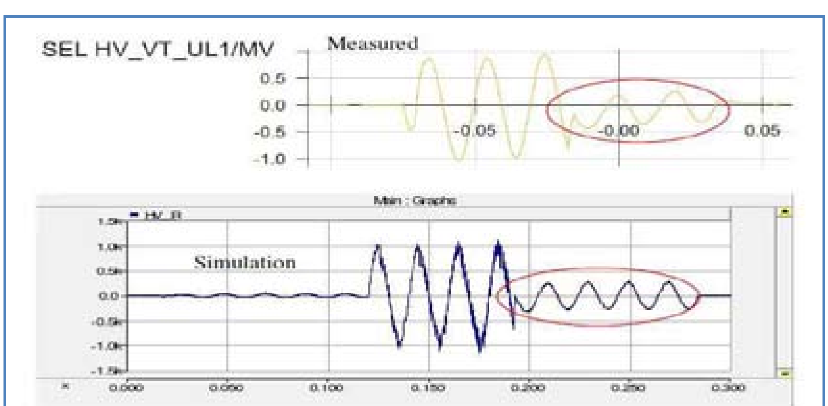

Fig. 19 : 1200kV side voltage comparison – measured and simulation

The agreement of simulation results with the actual recorded waveforms indicated a strong possibility of a single line to earth fault in the R-phase and its presence was confirmed during further investigation of R-phase circuit breaker. Hence it was concluded that single line to earth fault occurred after 50-60ms of charging the line and it was a permanent line to earth fault. Later, 1200kV National Test Station (NTS) was successfully charged after by-passing R-phase circuit breaker in the circuit.

Phenomenon of flashover between the tank cover and main tank of transformer was due to a significant voltage difference between the two parts due to higher contact resistance of the shorting links between them (for example due to paint). The bottom tank part may get raised to a high potential value due to the single phase line-to-earth fault current flowing through the earth circuit, which can raise the bottom tank potential to a few thousands of volts (taking the earth resistance of 0.5 ohms, the voltage level can be approximately 0.5 × peak value of the fault current = 0.5 × 12 kA = 6 kV). This voltage may be enough to cause a momentary flashover between the two tank parts externally.

Minor shift in the SFRA of transformer indicates a possibility of local saturation of transformer core which normally occurs when transformer feeds fault current. Local saturation of core may cause the leakage flux to link with tank and would result into induced voltage in tank cover. If the induced voltage is sufficiently high and if total current discharging capability of shorting links is not sufficient then this voltage may get discharged to earthed tank via air (flashover). This possibility will be further studied in detail.

7. CONCLUSION

The establishment of 1200kV National Test Station, Bina has helped in development and indigenization of UHVAC equipment in India. The experience gained from establishment and operation of 1200kV NTS facility is very crucial for POWERGRID in designing and finalizing technical specification of UHVAC equipment. POWERGRID has used its experience in designing of Wardha-Aurangabad transmission line in India, which has been designed for 1200kV voltage level considering future power requirements, though the line will be charged initially at 400kV voltage level and subsequently will be upgraded to 1200kV after completion of field studies at 1200kV NTS.

The establishment and operation of 1200kV NTS facility has also helped manufacturers to validate design of their equipment and even optimize them, by way of receiving continuous feedback from POWERGRID regarding performance of equipment in test facility. It will also help them to be become global leaders in development of UHVAC products. Experience gained from this fault incident in NTS facility has given a better insight to the transformer & circuit breaker manufacturers regarding their design aspects and same will be taken care off in future designs of their equipment.

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ENSURING HIGH QUALITY INSULATION SYSTEM OF LARGE MOTORS – DESIGN & TESTING REQUIREMENTS

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NTPC Limited

ABSTRACT

In recent past, several high voltage motor winding failures occurred within one year of commissioning in two of NTPC projects. They include bearing failures, winding cable connection failure at termination and winding insulation failures in overhang region. During review it was found that some of the important requirements, which ensures healthy machine insulation system have not been taken care during manufacturing process. The commonly observed deficiencies in manufacturing process of end winding are:

- *Poorly done brazing at bus connection.*
- *Poor workmanship causing uneven air clearances.*
- *Selection of inadequate cable and lug size, leading to heating and subsequent failure.*
- *Pre-VPI activities done in uncontrolled (non-air conditioned) environment.*

This paper discuss the type of failure occurred, analyses the root cause and mitigation measures. It gives insight to best practices being adopted in machine manufacturing and testing to ensure high quality of insulation system.

The importance of minimum clearance between two adjacent coils has been discussed in the paper. The paper also suggests the minimum clearances to be maintain between insulation surface of two adjacent coils of same phase and different phases. It emphasize on use of software based advance coil taping and coil spreader machines instead of old conventional practices to ensure shape of coil as per design. The use of automated coil spreading and automatic taping machine avoids presence of wrinkles, knots and lashes, maintain adequate clearances in overhang, a very important aspect to ensure quality of capsule. The paper describes the effect of taping method on machine life. It discusses the advantages of machine taping over manual taping.

It also covers other critical design requirement in high voltage motor overhang insulation. It suggests criteria for selection of winding cable connection, termination arrangement and best practice for coil brazed joints. Some of very important tests namely Corona Imaging Test, Monitoring of cable lug temperature at termination using RTD, partial discharge test have been suggested to be conducted as `ROUTINE TESTS'. The use of infrared camera as routine test to check healthiness of winding lead termination has been suggested.

CAUSES OF FAILURE

Overhang part of winding experiences high thermal and mechanical stress. It has been seen during testing of large water cooled machine, the temperature of RTD in slot portion is almost 10-12 deg. C lower than the temperature exists in overhang portion. The mechanical forces are also higher in end winding. The current changes direction at the coil end portion, which is poorly supported as compared to slot portion.

As regards to electrical stress, the slot portion of coil is provided with semi conductive coating which keeps the insulation surface at zero potential. As the coil comes out of the slot portion, some length is provided with transition tape for corona protection. The transition tape avoids the surface tracking on the coil as the potential beyond this zone in overhang portion is very high with respect to ground. This potential at insulation surface during high voltage is almost 80% of the applied voltage. Whereas, during running of machine the potential in overhang portion of coil varies, and can be up to 85% of rated ph-ph voltage at the coil connection to phase terminals.

Therefore we can say that the machine coil is subjected to very high thermal, mechanical and electrical stresses in the overhang portion of winding.

It has been seen that several large 6.6 kV and 11 kV machines are being manufactured with manually tapped insulation, where knots, lashes and uneven air gaps between adjacent phases can be seen at several places (Figure 1). These machines can run for few years, but have high winding insulation failure rate. It has been seen that in a span of two years, more than 20 High Voltage motors failed at two of NTPC projects.

Fig. 1 : Presence of Knots, Lashes and Lower Air Gap between Phases

Some of these failures are bearing failure caused by solidification of grease due to long storage of machine and several other failures were attributed to poorly done insulation during manufacturing (Figure 2).

Fig. 2 : Low Clearance between Adjacent Phase Bus Connection

The air gap between the adjacent phase coils and phase bus connection was observed varying from 1.0 mm to 14.0 mm in 11 kV motors. The uneven taping and presence of wrinkles in insulation can be seen almost everywhere (Figure 3).

Such machines have high partial discharge activity and prone to failure on `Line to Ground' faults (Fig. 4).

Fig. 3 : Wrinkle can be Seen in Overhang Connections

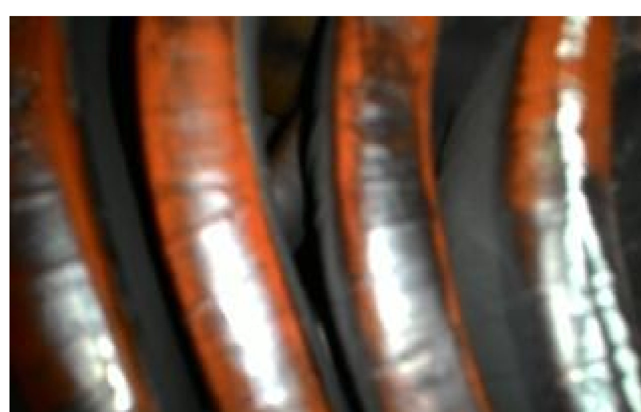


Fig. 4 : Line to Ground Failure in Overhang

Several high voltage machine manufacturers, finds dimensional control in motor winding overhang very difficult.

Coil Spreader Machine

Remedy

The dimensional control can be achieved by use of coil spreader machine. This machine can give the coils desired shape with high dimensional and geometrical accuracy as per pre-loaded software. Coil Spreaders are designed to form coils from loops prior to pressing. They are typically used to form diamond coils of high quality.

Low Clearance at Bus Connection Overlap

It has been seen in some large 11 kV motors that brazing was done at bus connection with two flats overlapping and therefore offering very low clearance between bus-connection of two different phases (Figure 2). These gaps are uneven due to poor workman ship.

Remedy

Especially designed T-connectors can be used to ensure adequate clearances at such locations.

Failure at Cable Termination

The selection of cable and inadequate lug size caused heating and subsequent failure at connection of winding lead to the termination arrangement. (Fig. 6)

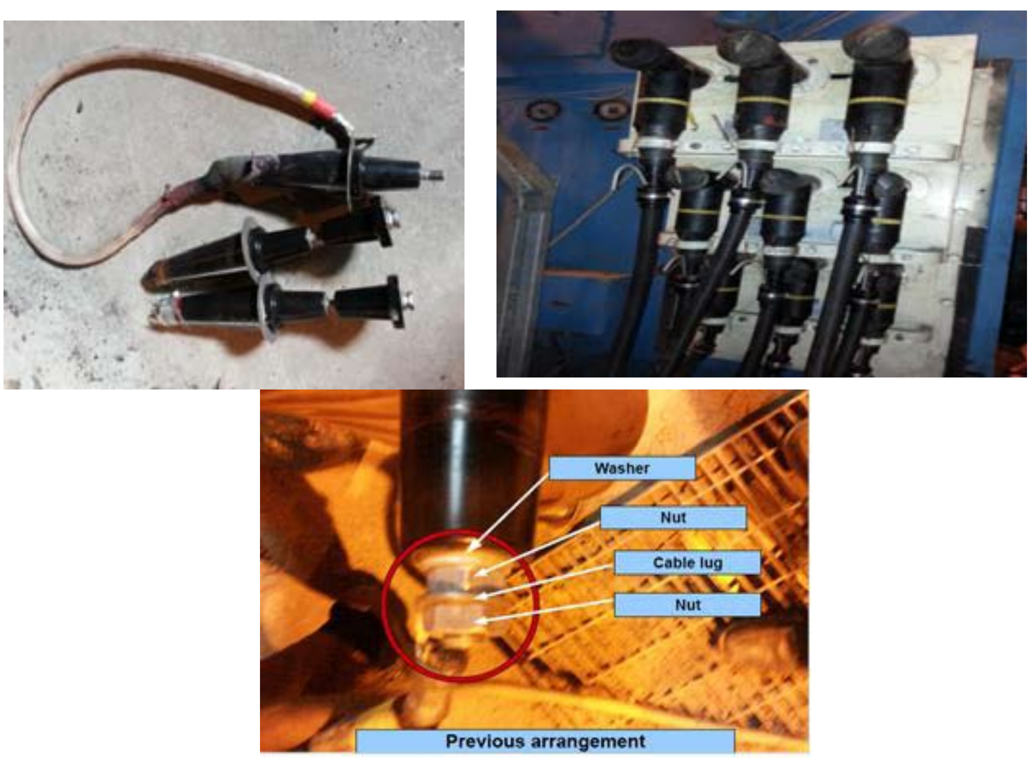


Fig. 6 : Poorly Done Cable Termination Arrangement

In few cases it is found that cross-section of lug at its neck is very low as compared to the winding phase conductor cross section. This adds up high resistance and heating near the cable termination.

Remedy

The section of cable has to be compatible to the cross section of the conductor. As the forces during motor stating is very high between two adjacent phases

$F \alpha I^2$ and $F \alpha 1/d$,

Where 'I' is the starting current and 'd' is the spacing between two adjacent conductors. The cable connection to the termination has to be properly dressed up and supported to take care of high forces during starting of the motor.

Measurement of lead connection temperature at terminal should be made mandatory by placing RTD/ thermocouple. Use of infrared camera to check healthiness of winding lead termination during heat run test can also be considered as routine test.

Avoiding Wrinkles and Lashes in Tapping

The wrinkles and lashes as seen in Fig. 1 and Fig. 3 can be avoided by use of automatic tapping machine. It has been experimented that insulation dielectric strength in automatic tapping is very high as compared to the manual tapping. The time to insulation breakdown of a coil found to be average 50-100 times to that of manually tapped coil, when power frequency high voltage is applied for long duration.

SUGGESTED STEPS DURING VPI CAPSULE MANUFACTURING TO ENSURE HIGH QUALITY IN WINDING OVERHANG:

1. The coil manufacturing of high voltage motors have to be done in controlled environment preferably air conditioned to avoid any contamination deposit on the coils during manufacturing. The moisture and temperature control is also very important to have good quality winding.
2. Storage of insulation material shall be at low temperature (e.g. 5 deg. C to 15 deg.) as per manufacturer's recommendation. The coil manufacturing, assembly and VPI process shall be completed within 30 days of being taken out of cold storage.
3. The insulation taping on bar/coil has to be done using software controlled insulation taping machine, so as to ensure longevity and high resistance to electrical stress.
4. The coil should be formed so as to just fit in the slot to avoid any corona discharge during its life span. The shape consistency has to be ensured by use of special coil spreader machine having software controlled operation. The shape of each coil has to be ensured as per the design requirement.
5. Prior to winding assembly shape of coil has to be checked. It should fit in the slot without putting any impact on the insulation.
6. The winding connections are to be brazed and should use standard T-connectors, wherever overlapping results in low clearance.
7. The VPI process shall be done as per standard procedure and shall be considered complete as and when the tan delta value of winding during curing process reaches to specified value.

SUGGESTED TESTS TO ENSURE OVERALL WINDING QUALITY

The overall quality of high voltage motor capsule is ensured by conducting following tests:

(a) Tan delta and tip us test – at factory as well as trending every year at installation.

(b) Corona Imaging test at 115% rated voltage after assembly.

(c) Partial Discharge Measurement after assembly as well as trending every year.

TAN DELTA TIP UP TEST

The tan delta and capacitance tip up test is one of the best tests to establish the healthiness of winding overall insulation system. The winding is stressed to rated voltage level and capacitance is measured at 20% and 80% of rated voltage (refer IEEE286). Ideally the winding capacitance should not change. The results of the manufacturing stage are kept as reference and used while conducting the test at site after machine completed few (3-5) years of operation. Subsequently every year the test has to be conducted. The trending of tip up should not show a deviation of more than 1 percent per year. The conduction of other two tests mentioned above can further augment the result.

CORONA IMAGING TEST

The corona imaging test is done at 115% of rated voltage. This test voltage is applied to the winding and corona discharges are captured using UV camera. The UV camera results can be compared with the blackout test, where the PD activity is seen by naked eye when winding is applied 115% of rated voltage. The test is conducted for 15 minutes, to give adequate time for visual check. No visual discharges shall be seen in the winding during the test. The IEEE 1799-2012 elaborates the test method.

Different remedial measures have been discussed in IEEE 1799 standard to ensure corona free overhang winding. The corona free end winding ensures high quality of insulation and longevity of the equipment.

OFFLINE PARTIAL DISCHARGE TEST

The measurement of off line partial discharges at every machine overhaul and trending with earlier results indicates the overall condition of machine insulation system. Any increasing trend of PD indicates deterioration of insulation system quality.

CLEARANCES BETWEEN ADJACENT PHASES

Inadequate air clearances between insulation surface of adjacent phase conductor results in partial discharge activity in overhang winding and if continues for long duration can damage the winding insulation. The insulation surface of coil is provided with semi conductive coating to maintain zero potential on insulation surface, when machine is applied rated or test high voltage. This ensures no partial discharge in slot portion.

As the coil comes out of slot, transition tape covering adequate length is provided to avoid tracking on insulation surface. The electrical stress (kV/mm) seen by air gap is almost 4-5 times to that across winding main insulation resulting uneven voltage distribution across insulation and air gap. The voltage on overhang winding insulation surface is close to the phase voltage during machine operation.

Table 1 : Clearances between Phase to Phase and Phase to Ground in overhang winding

Sl. No.	Voltage grade in kV	HV test voltage in kV	Ph-Ph clearance in mm (nom./ min.)
1	6.6	14.2	5.0/3.0
2	11	23	8.0/7.0
3	13.8	28.6	10.0/8.0

VOLTAGE DISTRIBUTION BETWEEN ADJACENT PHASES

The voltage distribution worked out as below establish that the coil insulation, which has a very high electrical strength (voltage breakdown level) is subjected to much lower electrical stress (kV/mm) as compared higher electrical stress across air gap, which has a lower voltage breakdown level.

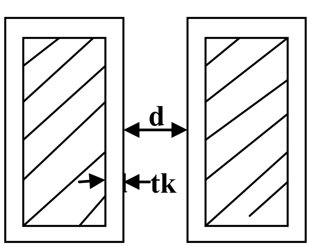


Fig. 7 : Electrical clearance between adjacent conductor in overhang

The insulation thickness 'tk' if considered as 2mm and the gap 'd' as 6mm for 11kV motor winding. The capacitance between two parallel plates is

C= €A/t

Where '€' is the permittivity of medium, 'A' is the area of plate and 't' is the spacing between two plates.

The voltage appears across air gap during high voltage test will be inversely proportional to the permittivity of medium. Therefore electrical stress across air medium will be 5 times that of the measured across insulation.

As per calculation, the voltage applies across air in 11 kV machine will be 20.3 kV and therefore the voltage stress across air during high voltage test will be 3.4 kV/ mm. It will be safe to select the air gap between adjacent phase conductors as nominal 8.0 mm (minimum 7.0 mm). Those machine, which has lower gap between phases are also found in operation but the insulation aging rate is fast. Continuous PD deteriorates the insulation with time and cause failure.

CONCLUSION

The quality of high voltage motor insulation system can to be ensured by adopting best manufacturing practices. Use of software controlled coil taping, coil spreading and other equipments, which ensures the shape consistency is necessary. The design phase to phase and phase to ground clearance are necessarily to be ensured in overhang winding. Also the overall assessment of machine winding insulation system can be done by conducting tan delta & tip up test, partial discharge measurement and corona imaging best using ultra violet camera.

GLIMPSES OF RECENT VISIT OF DR. KONSTANTIN PAPALIU, CHAIRMAN CIGRE SC B2 ON OVERHEAD LINES AND MR. RAJJOTE, CHAIRMAN CIGRE SC A2 TRANSFORMERS TO CBIP & CIGRE INDIA EXCELLENCE CENTER AT GURGAON (DELHI-NCR) ON 18th November 2016

Mr. Michel AUGONNET (FR) , Treasurer, CIGRE HQ Visited CIGRE-India Office at New Delhi on 8th September 2016

CIGRE India Session 2016

NATIONAL CONFERENCE ON GLOBAL TRENDS AND INNOVATIONS IN DEVELOPMENT OF POWER SECTOR

28 -29 July 2016, New Delhi

(L-R) Mr. V.K. Kanjlia, Secretary, CBIP on Podium, Mr. P.P. Wahi, Director, CBIP; Mr. Amitabh Mathur, Director (IS&P), BHEL & Vice President, CIGRE-India; Mr. R.P. Sasmal, Director (Operations), POWERGRID & Chairman –Technical, CIGRE-India; Mr. Atul Sobti, CMD, BHEL, Mr. Gurdeep Singh, CMD, NTPC; Mr. S.D. Dubey, Chairperson, CEA & President, CBIP; Mr. I.S. Jha, CMD, POWERGRID & President CIGRE-India; Mr. K.M. Singh, CMD, NHPC; Mr. K.K. Sharma, Director (Operations), NTPC & Vice President, CIGRE-India, and Mr. N.N. Misra, Former Director (Operations) NTPC & Vice Chairman-Technical, CIGRE- India; during inaugural session

CIGRE (Camseil International des Grands Réseaux Électriques - International Council on Large Electrical Systems) is one of the leading worldwide Organizations on Electric Power Systems, covering the technical, economic, environmental, organizational and regulatory aspects.

CIGRE-Paris as well as CIGRE-India has 16 study groups, each specializing in one specific technical domain. India has a member in each of these groups. Accordingly, CIGRE-India had divided this two-day conference into various sections/ parallel sessions. The respective CIGRE Group member chaired the session. The participants were acquainted with the papers selected by CIGRE Group, by way of a summary presentation of each paper and the queries there to. The participants were asked to present their views in respect of the queries, including, any India-specific issues.

CIGRE (INDIA) IS THE NATIONAL COMMITTEE OF CIGRE PARIS

CIGRE-India had organized a Conference on "Global Trends and Innovations in Development of Power Sector" on 28-29 July 2016 at Scope Convention Center, Lodhi Road, New Delhi. This National Conference was planned prior to CIGRE-Paris Session 2016 to discuss about the following activities.

- To share experience and update knowledge on Developments & Innovations in Power System.
- To have the input and considered opinion from the experts within the country on various topics as well as on technical papers being presented in CIGRE Session 2016 at Paris.

The Unique event addressed by Chairperson, CEA; CMD, POWERGRIDL; CMD, NTPC; CMD, BHEL and CMD NHPC and attended by more than 300 professionals from India and Bhutan

Mr. S.D. Dubey, Chairperson, CEA & President, CBIP, addressing the participants during inaugural session

Mr. I.S. Jha, CMD POWERGRID & President CIGRE-India, addressing the participants during inaugural session

- To propose replies on various questions put up by special reporters of technical session of CIGRE at Paris which could be raised and discussed with the International experts during the session.
- To plan out strategy to be adopted by the Indian delegates attending the CIGRE Paris Session 2016 to ensure maximum benefits for the Indian Engineers.

The conference was widely attended by 300 participants from India and Bhutan.

Prior to Technical session, there was inaugural session on 28th July 2106 in which following dignitaries were present on dais.

- Mr. S.D. Dubey, Chairperson, CEA & President, CBIP
- Mr. I.S. Jha, CMD POWERGRID & President CIGRE-India
- Mr. Gurdeep Singh, CMD, NTPC
- Mr. Atul Sobti, CMD, BHEL
- Mr. K.M. Singh, CMD NHPC
- Mr. R.P. Sasmal, Director (Operations), POWERGRID & Chairman –Technical, CIGRE-India
- Mr. K.K. Sharma, Director (Operations), NTPC & Vice President, CIGRE-India
- Mr. Amitabh Mathur, Director (IS&P), BHEL & Vice President, CIGRE-India
- Mr. N.N. Misra, Former Director (Operations), NTPC & Vice Chairman- Technical, CIGRE-India

In the inaugural session the welcome address was presented by Mr. V.K. Kanjlia, Secretary, CBIP in which he briefed regarding the objective of conference. It was also intimated by him that 18 papers have been selected from India to be presented in CIGRE-Paris session.

While addressing on this occasion Mr. P.P. Wahi highlighted the contribution of Mr. Mata Prasad at National and International level.

Mr. I.S. Jha, CMD, POWERGRID and President CIGRE-India addressed the participants. He appreciated CBIP and CIGRE-India for providing such huge platform to the Engineers to share their experiences. He also emphasized the various problems being faced by the Power sector and corrective actions to be taken.

Mr. Gurdeep Singh, CMD, NTPC, addressing the participants during inaugural session

Mr. Atul Sobti, CMD, BHEL, addressing the participants during inaugural session

Mr. K.M. Singh, CMD, NHPC in his address congratulated the award winners for their significant contribution in Power sector. He also congratulated to the authors whose papers have been selected in CIGRE Paris session. He emphasized that the power sector is in transition stage and a lot of change is going to take place in next decade due to coming up of renewable energy sector which will be major source of Energy in future. There is a need for improvement in the efficiency, reliability and quality power, need for reduction in the generation cost. He also emphasized that CIGRE-India provides the opportunity to discuss the various issues at one platform.

Mr. Gurdeep Singh, CMD, NTPC also congratulated the authors whose papers have been selected in CIGRE Paris session. He expressed his concern that power sector is entering in different scenario everyday and there is a need of environmental friendly, 24x7 reliable power at affordable price. He also highlighted that the average pool price of Power in 1st quarter was around Rs 3/-per unit and hence there is need to reduce the tariff to the customers by the Utilities.

Mr. Atul Sobti, CMD, BHEL emphasized that there is rapid growth in India but still in terms of per capita consumption we are lagging much behind the other Countries. Although we are surplus in power today but we have to think for the next 5 years. Renewable energy has to play key role in the country and we expect that 8% growth can be met by Renewable Energy. Still 70% of generation is from Thermal Power and hence to meet up the growth in the power sector the use of coal is most important. He said that the role of Thermal generation therefore can not be set aside. The replacement of old Thermal units with super critical units is the better alternative. He brought out that policies are still uncertain and needs review.

Mr. S.D. Dubey, Chairperson, CEA and President, CBIP also highlighted the importance of this conference as there will be lot of deliberations on the issues related to power for all, quality power, reliability and at affordable price. He also highlighted the achievements of Power sector in India like 300 + GW of Generation, Construction of 1200 kV lines under the leader ship of POWERGRID, Establishment of high testing lab at Bina etc. He also emphasized that with the induction of 175 GW renewable power up to 2022, a lot of challenges like operational issues in respect of Transmission and Distribution, storage problem etc. are likely to be faced. He also emphasized that in 12th five year plan 40% generation from coal will be from super critical unit and a lot of contribution from the manufacturers will be required

Mr. K.M. Singh, CMD NHPC, addressing the participants during inaugural session

Mr. V.K. Kanjlia, delivering the welcome address during inaugural session

In the last of inaugural session, vote of thanks was presented by Mr. P.P. Wahi, Director, CBIP and Director CIGRE-India. He thanked all the CMD's for sparing their valuable time to grace the inaugural session. He also thanked to all the participants and special invitees. It was also informed by him that 2 no. posts in CIGRE-India has recently been created and Mr. R.P. Sasmal, Director (Operations), POWERGRID is Chairman-Technical, and Mr. N.N. Misra, Former Director (Operations), NTPC as Vice Chairman-Technical of CIGRE-India.

TECHNICAL SESSIONS

16 Technical Sessions were conducted in parallel Halls on 28-29 July 2016 as per following schedule.

PROGRAMME

	28.7.2016		**29.7.2016**	
	Hall 1	**Hall 2**	**Hall 1**	**Hall 2**
1030 - 1200	Transformers	Information Systems & Telecommunications	Substations	System Development & Economics
1200 -1330	Overhead Lines	Electricity Markets & Regulation	Rotating Electrical Machines	System Operation & Control
1430 -1600	High Voltage Equipment	Materials & Emerging Test Techniques	HVDC & Power Electronics	Insulated Cables
1630 -1800	System Technical Performance	Protection & Automation	Distribution Systems & Dispersed Generation	System Environmental Performance

TECHNICAL SESSION ON SYSTEM TECHNICAL PERFORMANCE (SC C4)

Chaired by Mr. S.K. Negi, Chairman, National Study Committee C4 which covers the technical progress in different fields such as power quality, electromagnetic compatibility and interference, insulation coordination, lightning and power system performance models and numerical methods. There are total 35 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Impact of Inverter Based Generation and Energy Storage (17 Papers)

PS2 – Challenges with Modeling and Evaluation of Lightning Performance and Insulation Coordination in the Power System of Future (12 Papers)

PS3 – Bridging the Gap Between EMT, FEM and Positive Sequence Grid Simulation (6 Papers)

Mr. S.K. Negi

TECHNICAL SESSION ON TRANSFORMERS (SC A2)

Chaired by Mr. M. Vijaya Kumaran, Chairman, National Study Committee A2, which covers all kinds of power transformers as well as all activities related to design, manufactures, application of materials, safety / environmental issues, economic / commercial aspects, quality assurance and testing. There are total 37 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Advances in Transformer Diagnostics and Monitoring (16 Papers)

PS2 – EHV/UHV and EHVDC/UHVDC Transformers and their Components, Shunt Reactor (10 Papers)

PS3 – Transformer Windings (11 Papers)

Mr. M. Vijaya Kumaran

TECHNICAL SESSION ON OVER HEAD LINES (SC B2)

Chaired by Mr. Gopal Ji, Chairman, National Study Committee B2 which covers mechanical and electrical design and experimental validation of new line components, performance and assessment of aged line components, construction and operation of overhead lines, up rating of existing overhead lines. There are total 39 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Over Head Lines for High Power Transfer Capacity (15 Papers)

PS2 – Project Management, Construction and Maintenance (12 Papers)

PS3 – Application of New Materials and Technologies (12 Papers)

Mr. Gopal Ji

TECHNICAL SESSION ON HIGH VOLTAGE EQUIPMENT (SC A3)

Chaired by Mr. R.K. Tyagi, Chairman, National Study Committee A3. There are total 29 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – High Voltage Equipment for Emerging System Conditions (19 Papers)

PS2 – Life Time Management of Transmission and Distribution Equipment (5 Papers)

PS3 – Application of Information Technology Tools for Development and Management of High Voltage Equipment (5 Papers)

Mr. R.K. Tyagi

TECHNICAL SESSION ON ELECTRICITY MARKETS & REGULATIONS (SC C5)

Mr. S.K. Soonee

Chaired by Mr. S.K. Soonee, CEO, POSOCO and Chairman of SC C5. Papers presented by Mr. Kaushik Dey, Sr Engineer, Mr. K.V.N. Pawan Kumar, Sr. Engineer, Mr. K.B.V. Ram Kumar, Engineer, Mr. Shubendu Mukherjee, Dy. Manager and Mr. Subhash Kumar, Engineer. There are total 30 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – The Future of Regulation in the Evolving Market: Interactions between Wholesale and Retail Markets. (4 papers).

PS2 – Market Models and Regulatory Structures in an Evolving Industry Situation (18 Papers)

PS3 – Distributed Resource, Demand Response and Storage Technology Integration from the Perspective of Electricity Market and Regulatory Structures (8 Papers)

TECHNICAL SESSION ON MATERIALS & EMERGING TEST TECHNIQUES (SC D1)

Mr. Jithin Sunder

Chaired by Mr. Jithin Sunder, ED, BHEL, Chairman NSC D1. He was Supported by Dr M. Mohana Rao, DGM, BHEL, Dr. Sukumar Roy, Sr. DGM, BHEL and Mr. A. Pradeep, Dy. Manager, BHEL. There are total 32 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Compact Insulation Systems (AC and DC) (13 papers)

PS2 – New Materials (8 papers)

PS3 – Non-standardised Stresses and Emerging Test Techniques (11 papers)

TECHNICAL SESSION ON INFORMATION SYSTEMS & TELECOMMUNICATIONS

Mr. N.S. Sodha

Mr. Prakash Nayak

Chaired by Mr. N.S. Sodha, former ED, PGCIL and outgoing Chairman of NSC D2 along with Mr. Prakash Nayak, MD, Power Engg & Automation who is the incoming Chairman of NSC D2. Mr P.K. Agarwal of POSOCO, supported for presentation of papers. There are total 31 papers in the study group in Preferential Subject 1,2 & 3. There are two Indian Papers (D2-302 of Mr P.K. Agarwal & D2-303 of Mr. N.S. Sodha). There are total 31 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Information and Telecommunication Technologies for Connecting Distributed Energy Resources (16 papers)

PS2 – Maintaining Operational IT Reliability in an Evolving Environment (5 papers)

PS3 – Trends in Managing Utility Communication Networks (10 papers)

Technical Session on Protection & Automation (SC B5)

Mr. S.G. Patki

Mr. Subhash Thakur

Chaired by outgoing Chairman Mr. S.G. Patki along with incoming Chairman Mr. Subhash Thakur, AGM, NTPC of NSC B5. After introducing by Mr. S.G. Patki, summary of the papers delivered by Mr. Subhash Thakur. There are total 35 papers in the study group in Preferential Subject 1 & 2.

PS1 – Protection Automation and Control System (PACS) Optimization and Life Time Asset Management (21 Papers)

PS2 – Co-ordination of Generator and Power System Protection (14 Papers)

TECHNICAL SESSION ON ROTATING ELECTRICAL MACHINES (SC A1)

Chaired by Mr. D.K. Chaturvedi, Chairman, National Study Committee A1 which covers research, design and development, manufacture, material technology, operation and maintenance and asset management. There are total 19 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Developments of Rotating Electrical Machine (14 Papers)

PS2 – Asset Management of Electrical Machines (4 Papers)

PS3 – Rotating Machine for Renewable and Dispersed Generation (1 Paper)

Mr. D.K. Chaturvedi

TECHNICAL SESSION ON SUB-STATION (SC B3)

Chaired by Mr. Rajil Srivastava, Chairman, National Study Committee B3 which covers design, construction, maintenance and ongoing management of substation and electrical installation in power station excluding generator. There are total 38 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Advances in Substation Technologies (14 Papers)

PS2 – Developments and New Thinking in Substations Design (13 Papers)

PS3 – Evolution in Substation Management (11 Papers)

Mr. Rajil Srivastava

TECHNICAL SESSION ON HVDC & POWER ELECTRONICS (SC B4)

Chaired by Mr. Oomen Chandy, Chairman, National Study Committee B4. There are total 45 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – HVDC System and their Applications (31 Papers)

PS2 – FACTS and other Power Electronic System for Transmission System (9 Papers)

PS3 – DC, FACTS and other Power Electronic System for Distribution System (5 Papers)

Mr. Oomen Chandy

TECHNICAL SESSION ON DISTRIBUTION SYSTEM AND DISPERSED GENERATION (SC C6)

Chairded by Dr. Subir Sen, Chairman, National Study Committee C6. There are total 38 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Integrated Planning and Operation for Upgrading Distribution Network (19 Papers)

PS2 – Energy Infrastructure for Upgrading Distributions Networks (9 Papers)

PS3 – Microgrids and Off Grid Hybrid System (10 Papers)

Dr. Subir Sen

TECHNICAL SESSION ON SYSTEM OPERATION & CONTROL (SC C2)

Mr. K.V.S. Baba

Chaired and presented papers by Mr. K.V.S. Baba, Chairman of NSC C2 and ED, NLDC, POSOCO supported by Mr Aditya Prasad Das, Mr M.K. Ramesh, Mr Saugat Mandal, Mr. Debashish and Mr. Sunil Kumar. There are total 38 papers in the study group in Preferential Subject 1 & 2.

PS1 – Grid Operation Solutions to Changes in Generation Mix Including Distributed and Renewable Generating Resources (25 papers)

PS2 – Managing System Disturbances and System Restoration (13 papers)

TECHNICAL SESSION ON SYSTEM DEVELOPMENT AND ECONOMICS (SC C1)

Ms. Seema Gupta

Chaired and presented the papers by Ms. Seema Gupta, Chairman of NSC C1 and ED, POWERGRID supported by Mr. Ashok Pal, GM, POWERGRID. There are total 36 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – State of the Art Approaches and Standardization in Asset Management Decision Making (6 Papers)

PS2 – Interface and Allocation Issues in Planning T&D Networks with Multi-Party Projects (7 Papers)

PS3 – New System Solutions and Planning Techniques for Flexible and Robust System Plans (23 Papers)

TECHNICAL SESSION ON INSULATED CABLES (SC B1)

Mr. Deepal Shah

Chaired and presented papers by Mr. Deepal Shah, Chairman of NSC B1. There are total 39 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Newly Installed or Upgraded Cable Systems (9 Papers)

PS2 – Best Use of Existing Cable Systems (16 papers)

PS3 – Future Insulated Cables in Power System (14 papers)

TECHNICAL SESSION ON SYSTEM ENVIRONMENTAL PERFORMANCE (SC C3)

Mr. Anish Anand

Chaired and presented papers by Mr. Anish Anand, Chairman of NSC C3 and General Manager, POWERGRID, India. There are total 17 papers in the study group in Preferential Subject 1, 2 & 3.

PS1 – Environmental Liabilities of Transmission & Distribution Assets (4 papers)

PS2 – Overhead Lines and Underground Cables : Acceptability Issues (8 Papers)

PS3 – Climate Change: Implications for Electric Power Systems (5 papers)

A CD containing the copy of presentations was distributed to the participants.

VOTE OF THANKS

Mr P.P. Wahi, Director, CBIP proposing vote of thanks

Mr. P.P Wahi and Mr. S.K. Lamba presented vote of thanks in Hall-1 and Hall-2 respectively. They thanked all the speakers & delegates. They also appreciated for their presentations and participation in the conference. Mr. Wahi gave good wishes to the authors whose papers have been selected for presentation in CIGRE Paris session 2016.

POSTER SESSION

The poster session was also organized for the authors to present their papers which have been selected for CIGRE Paris session.

AWARDS AND RECOGNITION

Distinguish Members Award was introduced in CIGRE to acknowledge the significant contribution of its members, over a number of years to the work and development of CIGRE. Following three experts were selected for distinguished membership award by CIGRE HQ, Paris for the year 2016: Mr. S.K. Negi, M.D., GETCO for System Technical Performance, Mr. S.K. Soonee, CEO, POSOCO for Market and Regulations, Mr. S.G. Patki from Tata Power for Protection and Automation

The above experts were honoured by CIGRE-India during the Pre-CIGRE conference and the certificates issued by CIGRE, Paris for the above awards were presented by Mr. S.D. Dubey, Chairperson, CEA during the conference at New Delhi

In addition to the above, Mr. Mata Prasad Ji, who is the founder President of CIGRE-India was honoured with presentation of life time achievement awards for his long association with CIGRE-India and excellent contribution for the development of Power sector.

Mr. Mata Prasad, Founder President of CIGRE-India was honoured with Life Time Achievement Awards

Mr. S.K. Negi receiving Distinguish Members Award

Mr. S.K. Soonee receiving Distinguish Members Award

Mr. S.G. Patki receiving Distinguish Members Award

Poster Session

A view of the participants during inaugural session

CIGRE SESSION 2016

21st – 26th August 2016, at Paris

– A Report by CIGRE India

Picture of Inaugural Session of 46 CIGRE Session, the Bi-annual Technical Conclave held in Paris from 21st to 26 August 2016

- CIGRE (International Council on Large Electric Systems) is a permanent, non-governmental and non-profit international association founded in 1921 with its Head Quarter at Paris.
- It is an international technical forum for the Power industry's system operators, equipment manufacturers and research establishments to discuss and provide solutions for all the major technical issues.
- CIGRE is dedicated to the development of solutions to electricity sector.
- CIGRE has Members in more than 90 countries; and is the leading worldwide organization on electric power systems, covering the technical, economic, environmental, operational, organizational and regulatory aspects.
- Held every two years, the CIGRE Session has a reputation for providing a unique opportunity for the delegates and exhibitors to share their knowledge and experience.

OPENING CEREMONY OF BI-ANNUAL SESSION IN 2016

The opening ceremony took placed on Sunday, August 21st. The inaugural keynote was delivered by Mr. Claudio Facchin, President, Power Grids Division, ABB on shaping power systems of the future. Mr. Facchin mentioned various challenges in power sector and developments driving key change in future grids, elements of smart power grids and the shift in power business.

The first day session after opening ceremony included the following sessions:

- **Opening Panel:** Global perspective of Distributed Generation impact on the bulk connected network
- **Workshop :** Large Disturbances: Part 1: System disturbances / Part 2: Market disturbances.
- **Tutorials**
  - o Tutorial on Guide to overall line design (AC & DC) - Part 1 and Guide to the conversion of existing AC lines to DC operation (Part 2) by CIGRE Study Committee (SC) B2 on overhead lines
  - o Tutorial on Modelling and Dynamic Performance of Renewable Energy Systems by CIGRE SC C4 on system technical performance
  - o Tutorial on Air Insulated Substation design for severe climate conditions by CIGRE SC B3 on Substation
  - o Tutorial on High Voltage Direct Current Transmission SC B4
  - o Tutorial on Planning and operation of distribution systems with high shares of Renewable energy by SC C6 on distributed and dispersed generation
  - o Tutorial on Responsible Use of SF6 (Options and Challenges) and Residual life aspects of GIS by CIGRE SC B3 on substation

TECHNICAL PROGRAM

- The event attracted 543 number of technical papers, 500+exhibitors and 8500 senior power sector professionals from around world.

Mr. I.S. Jha, CMD, POWERGRID during CIGRE AORC meeting at Paris

Dr. Subir Sen, ED, POWERGRID, India taking over the charge of Presidentship of CIGRE - AORC (Asia Oceans Regional Council) from Malaysia during meeting at Paris

- The technical program was well structured and spread over a period of five days in parallel with the exhibition,
- The technical program included formal presentations, panel discussions, technical meetings and poster sessions, workshops & Tutorials to address various issues and challenges in the power sector.
- The latest developments linked to key components of the transmission system, namely, rotating machines, substations, transformers, overhead lines and cables were discussed together with system design, operation, control and system performance.
- The session & Exhibition attracted number of the electricity industry's key international manufacturers, network operators, consultants and service providers and offered participants the opportunity to contribute and benefit from the assembled industry experts.

Other Meetings

Besides above, CIGRE Administrative Council meeting, 16 Study Committee and its; Working Group meetings; National committees and Regions Meetings were also held during the session.

PARTICIPATION FROM INDIA IN CIGRE SESSION 2016

- **Mr. I.S. Jha, Chairman & Managing Director, POWERGRID and President, CIGRE-India led the delegation of more than 100 participants from India to CIGRE session 2016 (Participants List at Annexure-1)**
- Participants were from the organizations like : POWERGRID, POSOCO, NTPC, BHEL, NHPC, NEEPCO, NDMC, GETCO, HPGCL, OPGCL, UPPCL, ISGF, PTC, Regulatory Commission of Delhi, HP, UP, Maharashtra, Sikkim and Uttarakhand, ABB, Adani Power Transmission, Alstom T&D, Apar industries, Cargil India Pvt. Limited, CESC, CTR, ERDA, KalkiTech, Kanohar Electricals, PowerTech Global, Scope T&M, Siemens, Sterlite Power Transmission, Supreme & Co, Suzlon Power, Tata Power, Transformers & Rectifiers.
- The Sr. level officers who were present besides Mr. I.S. Jha were : Mr. Atul Sobti, CMD, BHEL; Mr. Amitabh Mathur, Director, BHEL and Vice President, CIGRE-India; Mr. A.P. Mishra, MD, UPPCL; Mr. S.S. Dalal, Director- Technical, HPGCL; Mr. N.N. Misra, Former Director, NTPC & Vice Chairman (Tech.), CIGRE-India;

Mr. I.S. Jha, CMD, POWERGRID and Mr. P.P. Wahi, Director, CIGRE-India during CIGRE Administrative Council meeting at Paris

Mr. P.P. Wahi, Director, CIGRE-India addressing during CIGRE Administrative Council meeting at Paris

(L-R) Mr. Vijaykumar Kisanrao Wakchaure, Mr. P.P. Wahi, Director, CIGRE-India, Mr. Ravindra Vishnu Talegaonkar and Mr. S.G. Jagdale during CTR Exhibition stall at Paris

Mr. I.S. Jha, CMD, POWERGRID and Mr. P.P. Wahi, interatcting with exhibitors during CIGRE session 2016

HIGHLIGHTS & ACHIEVEMENTS

Highlights

- Mr. I. S. Jha, CMD, POWERGRID and President, CIGRE-India lead the delegation of more than 100 participants from India to CIGRE session 2016 at Paris.
- India has taken over the Chairmanship of CIGRE AORC (Asia Oceana Region Council) during the meeting at Paris. Dr. Subir Sen, ED, POWERGRID took over as Chairman and Mr. P.P. Wahi, Director, CIGRE India as Secretary of CIGRE AORC for two years.
- Eighteen (18) Technical Papers were presented in CIGRE session from India
- Keynote presentation in the session on Transformers was made at Paris on 26th August 2016 by Mr. B.N. De Bhowmick, GM, POWERGRID
- CIGRE India participation in all the 16 CIGRE Study Committee meetings during CIGRE session 2016

B.N. De Bhowmick

Achievements

- CIGRE Administrative Council appreciated the efforts of CIGRE-India for their activities and making membership count to double i.e., 550 as compared to 275 last year.
- CIGRE SC A2 on Transformers; B2 on Overhead lines and D1 on Materials have decided to have their meeting and Joint colloquium in India in November 2019
- CIGRE SC A1 on Rotating Machines have decided to have their meeting and conference in India in Feb. 2019
- CIGRE WG JWGC4/B5.41 have decided to visit India for their meeting at Bangalore on 1 & 2 Feb. 2017

Mr. Krishna Saini, Chairman, DERC; Mr. S.K.B.S. Negi, Chairman, HPERC; Mr. Subhash Kumar, Chairman, UERC; Mr. K.P. Singh, Member (Technical), UERC; Mr. S.K. Agarwal, Member-Finance, UPERC; Mr. Deepak Lad, Member- Technical, MERC.

- India was offered a slot for keynote presentation in the Technical Session on Transformers held on 26.8.2016 during CIGRE Session 2016. Mr. B.N. De Bhowmick, GM, POWERGRID made excellent presentation.

PARTICIPATION IN CIGRE ADMINISTRATIVE COUNCIL

- Mr. I.S. Jha, President, CIGRE-India who is member of CIGRE Administrative Council, the administrative body supervises the operation of CIGRE, attended its meeting at Paris.
- President CIGRE Paris while appreciating the excellent performance of CIGRE-India as National Committee, Invited India during the meeting to present the best practices adopted by CIGRE-India for the tangible achievements.

PARTICIPATION IN CIGRE AORC (ASIA OCEANA REGIONAL COUNCIL) MEETING AT PARIS

- CIGRE-AORC (Asia Oceans Regional Council) is a forum for sharing experience and knowledge regarding pertinent technical issues particularly those affecting power systems in the Asia-Oceana Region.

Mr. P.P. Wahi, Director, CIGRE-India making presentation to invite CIGRE SC A2; SC B2 and SC D1 to India in the year 2019

Mr. P.P. Wahi, Director, CIGRE-India with Chairman SC B2 (Dr. Konstantin O Papailiou) during his presentation at Paris

- The countries from Asia Oceana Region, who are associated with the forum are : Australia; China; Cambodia; Gulf Cooperative Council; Hong Kong; India; Indonesia; Iran; Jordan; Japan; Korea; Malaysia; New Zealand; Taiwan; & Thailand.
- Mr. I.S. Jha, President, CIGRE-India attended the administrative meeting of CIGRE AORC held on 24.08.2016 at Paris during CIGRE session 2016.
- The activities report of various countries like Japan, Korea, New Zealand, Thailand, Indonesia, China and India was presented in the meeting.
- The Chairmanship of AORC has been offered to India during the meeting. Dr. Subir Sen, ED, POWERGRID took over as Chairman of CIGRE AORC and Mr. P.P. Wahi as Secretary CIGRE-AORC for two year during the meeting.

PARTICIPATION IN TECHNICAL SESSION/ POSTER SESSION

- During the technical session 18 technical papers (List at Annexure 2), accepted from India, and were presented. Authors of these papers were also given opportunity to participate in the poster session for detailed interaction with the participants on their papers.

PARTICIPATION IN THE EXHIBITION

- M/s Scope T&M and CTR from India participated in the exhibition and displayed their services to the industry.
- The participants availed the excellent opportunity to update their knowledge by visiting exhibition and interacting with the exhibitors about their innovations and latest developments.

PARTICIPATION IN CIGRE STUDY COMMITTEE MEETINGS

- CIGRE operate through 16 study Committees on various subjects comprising experts from about 24 different countries in each committee.
- It is a matter of pride that India is represented in all the sixteen study committees of CIGRE.
- The study committee meetings held during the session at Paris were attended by the members/ their representative from India **(Annexure 2)**
- The various CIGRE Study Committees were invited to hold their future meetings in India for the benefit of the professional in India.

Mr. P.P. Wahi, Director, CIGRE-India inviting CIGRE SC A2; SC B2 and SC D1 to India

- The CIGRE Study Committee A2 (transformers); SC B2 (overhead lines) and SC D1 on (Materials) have agreed to visit India to have their meeting and Joint colloquium in November 2019.
- CIGRE SC A1 (Rotating Machines) have also agreed to visit India in February 2019.
- CIGRE SC B1 (HV Cables) are visiting India in October 2017.
- CIGRE SC A3 (High Voltage equipment) SC B5 (Protection), SC C1 (Power System Planning) and SC C6 (Distributed Generation) have agreed to consider the request for holding their meeting in India in 2021.

This is going to benefit the professional from India in a big way.

DINNER HOSTED BY CIGRE-INDIA & ISGF AT PARIS ON 23RD AUGUST 2016

A dinner was hosted by CIGRE-India & ISGF, Sr. Dignitaries from India and office bearers of CIGRE i.e. President, Secretary General and Technical Committee members participated.

Annexure 1

102 PARTICIPANTS FROM INDIA TOOK PART IN CIGRE SESSION 2016 AT PARIS

1. **PFISTERER** : Mr. Deepal Shah, Country Delegate
2. **ABB**
   - Mr. Demudunaidu Obbalareddi
   - Mr. Sachin Srivastava
   - Mr. Rajiv Govil, Sales & Marketing
3. Adani Transmission Ltd
   - Mr. Bipin B Shah, Sr. VP
   - Mr. R.K. Singh, GM - Transmission
4. **Alstom T & D** : Mr. Purshottam Kalky, Sr. Manager-Engg.
5. **Apar Industries : Mr. S.K. Jana, GM- QA**
6. **BHEL**
   - Mr. Atul Sobti, CMD
   - Mr. Amitabh Mathur, Director (IS&P)
   - Mr. Jithin Sundar, ED (TBG)
7. **Cargill India Pvt Ltd**
   - Mr. Naveen Jain, Technical Sales
   - Mr. Rajaram Shinde, Techno-commercial
8. **CESC Limited** : Mr. S. Bhattacharya, GM-Construction
9. **CIGRE India**
   - Mr. N.N. Misra , Vice Chairman – Tech. & Former Director (Operations), NTPC
   - Mr. P.P. Wahi, Director (IT)
   - Mr. Vishan Dutt, Chief Manager
10. **Consultant & Former ED POWERGRID** : Mr. N.S. Sodha
11. **Consultant & former GM, POWERGRID** : Mr. Gopal Ji
12. **CTR Manufacturing Ind. Ltd.**
    - Mr. V.K. Wakchaure ,VP, Gr.III
    - Mr. R.V. Talegaonkar, President, Gr I
    - Mr. S.G. Jagdale, Sr GM
    - Mr. D.M. Jadhav, Div. Mgr - Export Division
13. **Electricity Regulatory Commission of**
    - Delhi - Mr. Krishna Saini, Chairman
    - H.P. – Mr. S.K.B.S. Negi, Chairman
    - Maharashtra - Mr. Deepak Lad, Member- Technical
    - U.P. - Mr. S.K. Agarwal, Member Finance
    - Uttarakhand - Mr. Subhash Kumar, Chairman
    - Uttarakhand – Mr. K.P. Singh, Member (Technical)
14. **ESSAR Steel India Ltd.** : Mr. Subir Kumar. GM
15. **ERDA**
    - Mr. Satish Chetwani, Head R&D
    - Mr. Vinod Kumar Gupta, Asst. Director & Head
16. **GE Energy Management** : Ms. Tanavi Shrivastava
17. **GE T&D India Ltd** : Mr. Santosh Annadurai
18. **GETCo. Ltd.**
    - Mr. M.K. Jani, Deputy Engineer, MD Office
    - Mr. Nilesh Sheth, Deputy Engineer (Engg)
19. **HPGCL**
    - Mr. Swaroop Singh Dalal, Director Technical
    - Mr. Vinit Mishra, Executive Engineer/400 kV Switchyard
20. **India Smart Grid Forum**
    - Ms. Reena Suri, GM-Business Services
    - Mr. Amol Sawant, Smart Grid Senior Specialist
    - Mr. Reji Kumar Pillai, President
21. **International Copper Association** : Mr. Ajit Advani, Advisor
22. **Kalkitech** : Mr. Prasanth Gopalakrishnan, CEO
23. **NDMC**
    - Mr. Surender Kumar Negi
    - Mr. Bhikhari Singh Bhati
    - Mr. Vijay Kumar Pandey
24. **NEEPCO** : Ms. Elizabeth Pyrbot, Manager, BD
25. **NHPC**
    - Mr. Arvind Bhat, GM, Design (E&M)
    - Mr. Himangshu Saha, CE, Design (E & M)
    - Mr. J. Choudhry, ED, O&M

- Mr. S.K. Agrawal, Construction & O&M, Commercial
- Mr. Mohammed Abdul Gafur

26. NTPC Limited

- Mr. Subhash Thakur, AGM (PE-Elect.) Engg.
- Mr. A.K. Gupta, ED, Engineering
- Mr. Bimlesh Singh, GM, OS
- Mr. D.K. Chaturvedi, AGM, (PE-Elect.) Engg.)
- Mr. M. Chivukula, AGM (Elect. Mtc.)

27. OPGCL

- Mr. Sanjay Mishra, DGM-Maintenance
- Mr. Sanjay Garhwal, Factory Manager

28. POSOCO

- Mr. Rajib Sutradhar, DGM
- Mr. K.V.S. Baba, ED
- Mr. A.P. Das, Manager
- Mr. Nitin Yadav, Sr. Engineer
- Mr. K.V.N. Pawan Kumar, Sr. Engineer
- Mr. Saugato Mondal, Manager

29. POWERGRID

- Mr. I.S. Jha, CMD
- Ms. Seema Gupta, COO, CTU Planning
- Mr. B N De Bhowmick, GM, T&D
- Mr. A. Choudhary, ED, NE Region Transmission System
- Mr. R.K. Chauhan, ED, HVDC
- Mr. Subir Sen, ED, Smart Grid

30. Powertech Global Pvt Ltd. : Mr. Piyush Saraf, MD

31. PTC India Limited : Mr. Ajit Kumar, Director (Comm. & Opns)

32. Ramelex Pvt Ltd. : Mr. Ram Jogdand, CMD

33. Savita Oil Tech. Ltd. : Mr. Narasimhan C. Srini, Head R&D

34. Scope T&M Pvt Ltd.

- Mr. Sanjay Kulkarni, CMD
- Mr. Yash Kulkarni
- Mr. Balasaheb Doiphode, CEO

35. SIEMENS Ltd : Mr. Subodh Suresh Kale, R&D

36. Sterlite Power Grid Ventures Ltd.

- Mr. Ajay Bhardwaj, President & Business Head
- Mr. Rajasekhar Chilukuri, Asset Management

37. Suzlon Power Infrastructure Ltd : Mr. Pulin Shah, MD

38. Tata Power Company Ltd.

- Mr. Narayan Sirdesai, Head - MO EHV Cable Group
- Mr. Mayuresh V. Deodhar, Maharashtra,
- Mr. Ramachandran Pillai, Chief, Corp. Operation (T&D)

39. Transformers & Rectifiers India Ltd : Mr. V. K. Lakhiani, Director, Technical

40. UPPCL : Mr. A. P. Mishra, Managing Director

41. Companion

- HPGCL - Mrs. Sarita Dalal
- NHPC - Mrs. Naumaan Ansari
- NDMC - Mrs. S.K. Negi
- HPERC - Mrs. Kavita Negi

Nominations withdrawn after registration due to their other important assignments

o POWERGRID
- Mr. R.P. Sasmal, Director (Operations)
- Mr. R. K. Tyagi, AGM
- Mr. M. S Rao, CDE, HVDC
- Mr. Kashish Bambani, Chief Manager SG

o Kanohar Electricals Ltd : Mr. M. Ramaswamy, COO, GIS

o Supreme & Co. Pvt. Ltd. : Mr. Harish Agarwal, CEO

o NEEPCO : Ms. Bonani Choudhury, DGM (O&M)

o POSOCO
- Mr. Akhil Singhal, Dy. Manager
- Mr. R. M. Krishnamoorthy, Chief Manager

o Electricity Regulatory Commission of Sikkim
- Mr. Nanda Ram Bhattarai, Chairperson
- Mr. Palchen Dorjee Chaktha, Director (Tariff & Technical)

Annexure 2

TECHNICAL PAPERS (18 NOS.) FROM INDIA PRESENTED DURING CIGRE SESSION 2016 AT PARIS

- NTPC - Ensuring High Quality Insulation System of Large Motors – Design & Testing Requiring - A.K. Gupta, D. K. Chaturvedi, P.K. Basu
- Alstom T&D - 3 Phase 420 kV Shunt Reactor manufacturing and quality sensitivity for vibration control – A case study - Vijayakumaran Moorkath, Tanvi Srivastava, Niladri Sekhar Mitra
- SCOPE T&M Pvt. Ltd. - Transformation in Lifetime Asset Management of EHV Circuit Breakers – A Case Study - Balasaheb Doiphode, Sanjay Kulkarni, Yash Kulkarni, N. S. Sodha (EX. ED, POWERGRID)
- The Tata Power Co. Ltd. - Monitoring and up-gradation of Underground Cable Network by various methods - NARAYAN SIRDESAI & DILIP M. MIRASHI (The Tata Power Co. Ltd); MAHENDRA KUMAR (Delhi Metro) and KIRIT RANA (CESC Ltd.)
- The Tata Power Co. Ltd. - Execution Of Transmission Projects With Innovative Methods For Augmentation Of EHV Network In Mega City of Mumbai – Challenges & Solutions - U K Maharaja, Vishwas Surange, P Murugan, Sandeep Deshmukh, P S Verma, M V Deodhar
- POWERGRID - Operational Experience In 1200kV (UHVAC) National Test Station, India – I. S. Jha, B. N. De. Bhowmick, S. B. R. Rao, Dhyeya. R. Shah, Rachit Srivastava, R. K. Singh (BHEL); Prof. S. V. Kulkarni, Santosh Kumar (IIT/M)
- POWERGRID - Commissioning Experience and Challenges of World's First 800 kV, 6000 MW NER – Agra Multi terminal HVDC System - Narendra Kumar, M.S. Rao, B.B.Mukherjee, Rakesh Kumar, M.M. Goswami, Oommen Chandy
- GETCO - Transmission Asset Management Through In - House Developed Software for Transmission System of Gujarat State - M. K. JANI
- POSOCO - Enhancing resilience of the North Indian Power System against pollution and foggy weather - An Experience - V.K. Agrawal, K.V.S. Baba, S.R. Narasimhan, R.K. Porwal, Nitin Yadav, Ankit Gupta, S.S. Goyal
- POSOCO-NLDC - Introduction of Sub-Hourly Market in Power Exchanges and Facilitating Large Scale Renewable Energy Integration in India - S.K. Soonee, V.K. Agrawal, S.S. Barpanda, S.C. Saxena, Kaushik Dey, K.V.N. Pawan Kumar
- ISGF - Leveraging Smart Grids Assets for Building Smart Cities at Marginal Cost - Reji Kumar Pillai, S. A. Khaparde
- ERDA - Thermoplastics for LV Switchgear Application - Beema Thangarajan R, Satish H Chetwani, Milind Oak
- POSOCO - Ensuring Uptime of WAMS Network with the Help of Common IT Tools – Case Studies - V. K. Agrawal, P. K. Agarwal, Harish Kumar Rathour, Puneet Maury
- POWERGRID - Communication Networks for Indian Smart Grids - N.S. Sodha, Former ED, POWERGRID
- POWERGRID - AC-DC Interaction Study For Upcoming ± 800 kV, 3000 MW Champa Kurukshetra HVDC Link - Mahesh Vardikar, Vishwajeet Singh, M.S. Rao, Vikas Bagadia, M M Goswami, Oommen Chandy.
- GETCO - Retrofitting And Modernization Of Conventional Substation To An IEC 61850 Based Automated Substation – A Case Study Of 400kV Amreli Substation - N. M. Sheth, S. K. Jadav, B. J. Patel
- Alstom Grid - Substation automation from conventional to full digital technologies – case studies and impact - Purshottam Kalky, Ritesh Bharat, Shantanu Dey, Saurabh Makwana.
- POWERGRID - Transmission System Planning under uncertainties including renewable penetration regime in Indian Context - I.S. Jha, Y. K. Sehgal, Subir Sen, Kashish Bhambani

CIGRE STUDY COMMITTEE MEETINGS DURING CIGRE SESSION 2016-PARTICIPATION OF CIGRE INDIA

- SC A1 on Rotating Electrical Machines – Meeting attended by Shri D.K. Chaturvedi, AGM, NTPC
- SC A2 on Transformers - Meeting attended by Me. Tanavi Shrivastava, Alstom
- SC A3 on High voltage Equipment – Meeting Attended by Shri N.N. Misra, Vice Chairman-Tech, CIGRE India
- SC B1 on HV Insulated cables – Meeting attended by Mr. Dipal Shah, Pfisterer
- SC B2 on Overhead Lines - Meeting attended by Mr. Gopal Ji, Former GM, POWERGRID
- SC B3 on Sub Station – Meeting attended by Mr. Abhay Choudhury, ED, POWERGRID
- SC B4 on HVDC – meeting attended by Mr. R.K. Vhauhan, ED, POWERGRID
- SC B5 on Power System Protection – meeting attended by Mr. Subhas Thakur, AGM, NTPC
- SC C1 on Power System Planning & Development - meeting attended by Ms. Seema Gupta, ED, POWERGRID
- SC C2 on Power System Operation & Control – meeting attended by Mr. K.V.S. baba, ED, POSOCO
- SC C4 on System technical Performance - meeting attended by Mr. N.M. Seth, GETCo
- SC C5 on Electricity markets & regulations - meeting attended by Mr. K.V. S. Baba, ED, POSOCO
- SC C6 on Distribution System & Dispersed Gen. - meeting attended by Dr. Subir Sen, ED, POWERGRID
- SC D1 on Material for Electro Technology – meeting attended by Mr. Jithin Sunder, ED, BHEL
- SC D2 on Information System & telecommunication - meeting attended by Mr. N.S. Sodha, Former ED, POWERGRID

BRIEF ABOUT CIGRE INDIA

CIGRE (India) the National Committee for CIGRE was set up as society in the year 1991

Governing Council of CIGRE India Office Bearers : The Committee has the following office bearers.

President	:	I.S. Jha, CMD, POWERGRID
Vice President	:	K.K. Sharma, Director, NTPC
Vice President	:	Amitabh Mathur, Director, BHEL
Chairman – Technical	:	R.P. Sasmal, Director, POWERGRID
Vice Chairman – Technical	:	N.N. Misra, Former Director, NTPC
Secretary & Treasure	:	V.K. Kanjlia, Secretary, CBIP
Director In charge	:	P.P. Wahi, *Director, CBIP*

- CIGRE-AORC (Asia Oceans Regional Council) is a forum for sharing experience and knowledge regarding pertinent technical issues particularly those affecting power systems in the Asia-Oceana Region.
- The countries from Asia Oceana Region, who are associated with the forum are : Australia; China; Cambodia; Gulf Cooperative Council; Hong Kong; India; Indonesia; Iran; Jordan; Japan; Korea; Malaysia; New Zealand; Taiwan; and Thailand.
- Mr. I. S. Jha, President CIGRE India attended the administrative meeting of CIGRE AORC held on 24.08.2016 at Paris during CIGRE session 2016.
- The Chairmanship of AORC has been offered to India during the meeting. Dr. Subir Sen, ED, POWERGRID took over as Chairman of CIGRE AORC and Shri P.P. Wahi, Director CBIP as Secretary of CIGRE AORC for two year during the meeting.


Subir Sen


P.P. Wahi

Progress and achievements of CIGRE India

- Growth of Membership

Years	2011	2012	2013	2014	2015	2016
Membership	280	276	243	325	244	611

* Till December 2016

CIGRE DISTINGUISHED MEMBERS AWARDS

1996
- Shri Mata Prasad
- Shri K.S. Madhawan, GEC Alstom
- Shri P.M. Ahluwalia

1998
- Shri R.T. Chari, Tag Corporation

2000
- Shri P.Bose, EMC, Kolkata

2002
- Shri B.S. Palki, ABB
- Dr. T. Adhikari, BHEL

2004
- Shri Yogendra Prasad
- Shri Bhanu Bhushan, CERC

2012
- Shri N.N. Misra, Director (Operation), NTPC
- Shri R.P. Sasmal, Director (Opn.), POWERGRID
- Shri M. Vijayakumaran, Sr. Tech. Expert, Alsthom

2014
- Shri Y.K. Sehgal, ED, POWERGRID
- Shri A.K. Mishra, AGM, POWERGRID
- Shri B.B. Shah, VP, Kalpataru Power Transmission

2016
- Shri S.K. Soonee, POSOCO
- Shri S.K. Negi, GETCO
- Shri S.G. Patki, Tata Power

- **Papers accepted for 2012, 2014 and 2016 session** – Twelve, Seventeen and Eighteen respectively
- Participation in CIGRE session - More than 75 people are participating from India in CIGRE 2012 session and about 60 attended CIGRE session 2014. For Session 2016, more than 100.
- **Representation in CIGRE Study Committees** – all the sixteen committees
- **Representation in CIGRE Administrative Council for 2012-2014 & 2014-16** - Mr. R.N. Nayak and **2016-18** Mr. I.S. Jha

CIGRE Study Committee meeting recently held in India

S. N.	Study Committee	Status
1	CIGRE SC D2: Information & Telecommunication	Held in 2013 at Mysore
2	SC B4 on HVDC	Held in Sept. 2015 at Agra

CIGRE Study Committee meeting Planned in India

S. N.	Study Committee	Status
1	SC B1 on HV Insulated Cables	Planned in 9-13 Oct. 2017 at New Delhi
2	SC A2 (Transformers)/ D1 (Materials)/ B2 (overhead Lines)	Joint Meeting planned in Nov. 2019
3	SC A1 – Rotating Elect. Machines	planned in Feb. 2019
4	SC A3 – High Voltage Equipment SC C2 – System Operation	Invitation already sent
5	SC B3 – Substation SC C1 – Planning SC C4 - System technical Performance SC C6 – Distributed Generation	Invitation being Being sent

- **Publication of half yearly CIGRE India Journal**

  To increase the activities and membership CIGRE India has taken the initiative to publish its Journal initially with the frequency of six months.

  The CIGRE India journal contains details about the activities of the association, technical articles, and data and is circulated to its members within the country. The journal serves an excellent purpose of disseminating the technological, innovative developments etc. amongst the concerned organizations of the energy sector, which are taking place at the national and international level. The journal is available both in print and online versions.

CIGRE MEMBERS FROM INDIA IN 2016

Organizational Members

1 KEI Industries Ltd.
2 Power System Operation Corporation Ltd. (POSOCO), SRLDC
3 Reliance Infrastructure Ltd. Mumbai Transmission Business
4 NTPC Limited
5 Sterlite Power Grid Ventures Limited
6 Power Grid Corporation of India
7 Transformers & Rectifier (India) Ltd.
8 Power System Operation Corporation Ltd. (POSOCO), WRLDC
9 Central Power Research Institute
10 BHEL R&D
11 Power System Operation Corporation (NERLDC)
12 Savita Oil Technologies Ltd.
13 Skipper Limited
14 Central Electricity Authority (CEA)
15 HYOSUNG T&D India Pvt. Ltd.
16 Scope T&M Pvt Ltd
17 Toshiba Transmission & Distribution Systems (I) Pvt Ltd.
18 Ramelex Private Limited
19 Bharat Heavy Electricals Ltd. (BHEL)
20 Larsen & Toubro Limited- Construction
21 Universal Cables Limited
22 Supreme & Company Private Limited
23 The Tata Power Company Ltd.
24 Power System Operation Corporation Ltd,, ERLDC
25 CESC Limited
26 Adani Transmission Limited
27 NTPC Sail Power Company Pvt. Ltd.
28 Powergrid Corporation of India (ER-II)
29 Power System Operation Corporation Ltd (POSOCO)
30 Power Grid Corporation of India Ltd., Kurukshetra
31 The Motwane Manufacturing Co. Pvt Ltd
32 Maharashtra State Electricity Transmission Co. Ltd.
33 Tata Power Delhi Distribution Limited
34 Powergrid Corp. of India Ltd., NRTS-II
35 Power Grid Corp. of India Ltd (NER)
36 Siemens Limited, EM TS
37 Bharat Heavy Electricals Ltd, Bhopal
38 India Smart Grid Forum
39 NHPC Limited
40 NTPC - Dadri SSTP
41 Powergrid Corp. of India Ltd, SRTS-1
42 Powergrid Corp. of India Ltd, NRTS-3
43 Powergrid Corp. of India Ltd, SRTS-II
44 Powergrid Corporation of India Ltd, Odisha Project
45 Powergrid Corp. of India Ltd, WRTS-I
46 NTPC Limited, Faridabad
47 NTPC Limited, Singrauli STPS
48 NTPC Limited, Kahalgaon STPS
49 NTPC Limited, Rihand STPP
50 NTPC Limited, Vindhyachal STPS
51 Bharat Heavy Elect. Ltd, (HEEP) Hardwar
52 North Eastern Electric Power Corp. Ltd
53 NTPC Limited, Kayamkulam
54 NTPC Limited – Koldam
55 NTPC Limited, Simhadri STPP
56 NTPC Limited, Talcher-Kniha STPS
57 NTPC Limited, Bongaigaon TPP
58 NTPC Limited, Korba STPS
59 NTPC Limited, Jhanor-Gandhar GPP
60 NTPC Limited, Kawas GPP
61 NTPC Limited, BARH
62 NTPC Limited, Talcher TPS
63 NTPC Limited, Auraiya
64 NTPC Limited, Tanda
65 Power Grid Corp. of India Limited, WRTS-II
66 Powergrid Corp. of India Limited, ERTS-I
67 NTPC Limited, SIPAT STPS
68 NTPC Limited, Unchahar
69 NTPC Limited, Badarpur
70 NTPC Limited, Anta GPS
71 NTPC Limited, Mouda STPP
72 Bharat Heavy Electricals Limited
73 NTPC Limited, Ramagundam STPS

Institutional Members

1. Karnataka Electricity Regul. Commission
2. Maharashtra Electricity Regulatory Commission
3. Uttarakhand Electricity Regulatory Commission
4. Sikkim State Electricity Regulatory Commission
5. Electrical Research & Development Association
6. Delhi Electricity Regulatory Commission
7. Eastern Regional Power Committee
8. Jt. E R C for Manipur and Mizoram
9. Indian Institute of Technology Bombay
10. U.P. Electricity Regulatory Commission
11. Odisha Electricity Regulatory Commission

Individual Members

FAMILY NAME	FUNCTION	ORGANISATION
Mr. Vivek Thiruvenkatachari	Dept. Director	Tag Corporation
Mr. Arvind Gupta	AGM-OTS	Adani Power Limited
Mr. Satish Chetwani	Sr. Manager, Technology and Commircialization	Electrical Research and Development Association
Ms. Shefali Talati	Dy. Manager, Technology & Commercialization	Electrical Research and Development Association
Mr. Dipakrashmi Tripathi	Jt. President, Operation & Maintenance	Adani Transmission Limited
Mr. Sanjeev Bhatia	Technical Specialist, electrical	Bechtel (India) Pvt. Ltd.
Nayak Prakash	Managing Director	Pena Power Engg. & Automation (P) Ltd.
Bipin B Shah	SR. Vice President Engineering	Adani Transmission Ltd
Shah Sujalkumar B	Dy. General Manager - Engineering	Kalpataru Power Trans. Ltd.
Shah Dhwani S	Asst. Gen. Manager- Engineering	Kalpataru Power Trans. Ltd.
Makaram Narasimhan Ravinarayan	Managing Director	Taurus Powertronics Pvt. Ltd.
Patki Sanjay		
Sishtla V.N. Jithin Sundar	General Manager, (TES)	Bharat Heavy Electricals Ltd.
Bahirat Himanshu	Asst Professor, Dept of Electrical Engg.	Indian Institute of Technology, Bombay
Konkimalla Venkata Srinivasa Baba	Executive Director - NLDC	Power System Operation Corporation Ltd. (POSOCO)
Thakur Subhash	Addl. GM, Project Engg. (Electrical)	NTPC Limited
Gonda Jora	Associate Professor Dept. of Elect. & Electronics Engg.	National Institute of Technology, Karnataka, Surathkal
Rao I. R.	Faculty Member - Dept. of Elect. Engg.	National Inst. Of Technology Karnataka
Korde Aditya	Managing Director	Diagnostic Technologies India Pvt Ltd
Moorkath Vijayakumaran	Senior Expert - Engineering	ALSTOM T&D India Ltd
Sodha N.S	Former ED	Power Grid Corporation of India Ltd.
Ravindra Kumar Tyagi	Addl. General Manager	Power Grid Corporation of India Limited
Vikas Shahaji Jagadale	Jt. Managing Director	Shreem Electric Ltd.
S.R. Narasimhan	Addl. General Manager, NLDC	Power System Operation Corp. Limited
Parantap Krishna Raha	Head - Substation Engineering	Sterlite Power Grid Ventures Ltd.
Amit Kothari	Dy. General Manager (Grid Solution Engineering)	Alstom T&D India Limited
Udaya Kumar	Professor, Department of Electrical Engineering	Indian Institute of Science
Sameer Gaikwad	Regional Sales Manager	Doble Engineering Pvt. Ltd.
Seema Gupta	Chief Operating Officer(CTU-Planning & Cost Engineering)	Power Grid Corporation of India Limited

Krishnan S. Balasubramanian	Consultant	
Pradeep Kumar Gangadharan	Director	Protection Engg. & Researh Laboratories
Soonee Sushil Kumar	Chief Executive Officer	Power System Operation Corpn. Ltd.
Umesh Maharaja	Head-Transmission Projects (Retired)	Tata Power Company
Chendur Venkatarao Venkata Chalapathi	Dept. Principal Engg. (HV Cables)	Balfour Beatty Insfra. India Pvt Ltd.
Dhananjay Kumar Chaturvedi	Addl. General Manager	NTPC Limited
Ms. Anagha Dixit	General Manager TRE	EMCO Ltd.
Mrs. Mary Mody	General Manager-Engineer	EMCO Ltd
Mr. Rajendra Vinayak Saraf	Head Planning- PSCC	The Tata Power Co. Ltd.
Mr. Burjupati Nageshwar Rao	Joint Director (Power Cables Lab)	Central Power Research Institute
Mr. Venkaiah Chintham	Associate Prof.- Electrical Engineering	NIT
Mr.Purshottam Kalky	Senior Manager- Engineering	ALSTOM T & D India Limited
Mr. Alok Roy	Chief Executive Officer	Reliance Power Transmission Ltd
Mr. Naveen Nagpal	Dy. General Manager	Reliance Power Transmission Ltd.
Mr. Vikrant Joshi	General Manager- Technology Transformers	Crompton Greaves Ltd
Mr. Rajesh Kumar	Chief Manager- (Smart Grid)	Power Grid of Coporation India Ltd
Mr. Muralikrishna Kodakandla	DGM, WRLDC	Power System Operation Corporation
Mr. Chandan Kumar	Engineer,Market Operation (MO-III)	POSOCO, WRLDC
Mr. Prithwish Mukhopadhyay	General Manager- WRLDC	POSOCO, WRLDC
Mr. Muthuraj Ramaswamy	AGM, Global R&D Centre	Crompton Greaves Limited
Mr. Samir Chandra Saxena	Dy. General Manager	POSOCO, NLDC
Mr. Vivek Pandey	Chief Manager (System Operation)	POSOCO, WRLDC
Mr. Madhuryya Prosad Chakravorty	HOD,Electro-Mechanical(Design)	EIPL, Energy Infratech Pvt. Ltd.
Mr. Bapuji Palki	Grid Automation Products	ABB Limited
Mr. Anil Kumar Jha	SE (Elect) Electricity Deptt	Damodar Valley Corporation (DVC)
Mr. Habib Chowdhary	Executive Engineer	J&K Power Development Department
Mr. Savadamuthu Usa	Prof. Divison High Voltage Engg.	Anna University
Mr.Sukhbir Kapoor	Dy.General Manager	ALSTOM Grid
Dr. Aradhana Ray	Director Technical	Laxmi Associates
Mr. Rajesh Suri	Head - HVDC Competency Centre	Alstom T&D India Limited
Mr. Subhasis Jhampati	Engineer (System Design)	ALSTOM T&D India Ltd.
Mr. Firoz Ahmed	Manger, HVDC PEA India	ALSTOM T&D India Ltd.
Mr. Ajit Advani	Advisor on Sustainable Energy	International Copper Association
Mr. Gupta Sarveshkumar Virendrakumar	Manager (Projects)	KEC International Limited
Mr. Vineet Shawrav Tigga	Manager	Power Grid Corporation of India Limited
Vinod Kumar Agrawal	Executive Director	Regen Powertech Private Limited
Srimanta Kumar Jana	General Manager- (QA)	Apar Industries Ltd.
Mr. Vikas Jalan	Jt. Managing Director	Deccan Enterprises (Pvt.) Ltd.
Arun Kumar Mishra	General Manager Projects-2 SR-1	Power Grid Corporation of India Ltd

Arvind Kumar Sharma	Sr. Ex. Vice President	Reliance Infrastructure Ltd.
Arvind Shrowty	Head-EHV & Business Development	KEI Industries Ltd.
Mr. Satyajit Ganguly	Managing Director	ONGC Tripura Power Company Ltd.
Surinder Kumar Negi	Managing Director	Gujarat Energy Transmission Co. Ltd
Umeshbhai C. Patel	Chief Engineer (TR)	Gujarat Energy Transmission Co Ltd
Bhadresh B Chauhan	Chief Engineer (project)	Gujarat Energy Transmission Co. Ltd
Bhadreshkumar B. Mehta	Chief Engineer (SLDC)	Gujarat Energy Transmission Co Ltd
Manishkumar K. Jani	D.E. to M.D.	Gujarat Energy Transmission Co.Ltd
Jayesh M. Gandhi	Deputy Engineer (Testing)	Gujarat Energy Transmission Co. Ltd
Praful K. Varasada	Dy. Engineer (SMS)	Gujarat Energy Transmission Co Ltd
Yogesh Vishnu Joshi	Superintending Engineer (Engineering)	Gujarat Energy Transmission Co. Ltd.
Nilesh M. Sheth	Dy. Engineer (Engineering)	Gujarat Energy Transmission Co Ltd
Rameshchandra P. Satani	Dy. Engineer, (Engineering)	Gujarat Energy Transmission Co Ltd
Bankimkumar P. Soni	Executive Engineer (Engineering)	Gujarat Energy Transmission Co Ltd
Asha M. Agravatt	Deputy Engineer (Engineering)	Gujarat Energy Transmission Co. Ltd.
Mr. Pravinchandra Mehta	CEO	Persotech Solutions
Subrata Karmakar	Assistant Professor; Department of Electrical Engineering	National Institute of Techno., Rourkela
Ms. Angelica Pohshna	Sr. Manager (E/M)	NEEPCO
Mr. Hillol Biswas	Advisor, Transmission/ Power	WAPCOS Ltd.
Mr. Manoj Kumar Muthyala	Dy. Chief Engineer, Power Division	WAPCOS Limited
Mr. Raju DVSN	Senior General Manager, Power Division	WAPCOS Limited
Mr. Ramesh Bongu	Engineer (Electrical)	WAPCOS Limited
Ms. Pandharkar Anjani	Dy. Manager, R&D	Pune University
Mr. Shri Indu Bhushan Srivastava		Central Board of Irrigation & Power
Mr. Mata Prasad	Advisor/Consultant	
Mr. Ravi Kumar Puzhankara	Associate Consultant, Electrical	DNV-KEMA
Mr. Deepal Shah	Country Delegate - India	PFISTERER
Mr. Singaram Christian Johnson	Dean & Professor, Civil	Excel Engineering College Excel
Mr. Gopal Ji	Consultant	Angelique International Limited
Mr. Anil Kaplush	Consultant	Angelique International Limited
Ms. Boppudi Anantha Sarma	General Manager, Asset Management	Power Grid Corporation of India Ltd.
Mr. Sandeep Kulkarni	Sr. Manager, Design	Crompton Greaves Limited
Mr. V.K. Kanjlia	Secretary	Central Board of Irrigation & Power
Mr. Urmil Parikh	Smart Asset Management Specialist, PGHV- Services	ABB India Limited
Mr. Manoj Kumar Agrawal	Dy. General Manager, (SO-1)	Power System Operation Corporation, NRLDC
Mr. Rajiv Kumar Porwal	Dy. General Manager, (SO)	Power System Operation Corp., NRLDC
Mr. Narendra Nath Misra	Former Director (Operations)	NTPC Limited
Mr. Hrushaabh Prashaant Mishra	Chief Technical Officer	SyselecTechnologie Private Limited
Mr. Rahul Banerjee	Senior Business Developer	GDF Suez Energy Private Limited
Mr. Venkateswara Rao Edupuganti	Head Engineering Services T&D	KEC International Limited
Mr. Sunil Bhanot	GM- Engineering Services	KEC International Limited

Mr. Daljit Singh Bijral	Addl. Vice President	Parbati Koldam Transmission Company Ltd.
Mr. Anil Rawal	Vice President	Parbati Koldam Transmission Company Ltd.
Mr. Sachin Srivastava	Associate Principal Engg. (Applications)	ABB Global Industries & Services Ltd.
Mr. Subhash Chandra Takalkar	Managing Director	Takalkar Power Engineers & Consultants Pvt Ltd
Mr. Rabindra Nath Nayak		Smartec
Mr. Ramesh Dattaraya Suryavanshi	Director	Alfa Consultants, Lokhandwala Compl.
Mr. Vijaykumar Wakchaure	Vice President (Group III)	CTR Manufacturing Industries Ltd.
Mr. Ravindra Vishnu Talegaonkar	Vice President (Group I)	CTR Manufacturing Industries Ltd.
Mr. Nene Milind	Sr. Vice President	Kalpataru Power Transmission Ltd.
Mr. Rajendra Prasad Sasmal	Director (Operation)	Power Grid Corporation of India Limited
Mr. Indu Shekhar Jha	Chairman & Managing Director	Power Grid Corporation of India Ltd
Mr. Sen Subir	Executive Director	Power Grid Corporation of India Limited
Mr. Sushil Chaudhari	Asst. General Manager –Technology	Raj Petro Specialities Pvt Ltd
Mr. Deepak Kumar Saxena	Sr. Vice President	Welspun Energy Ltd.
Mr. Barindra Narayan De Bhowmick	General Manager (T&D)	Power Grid Corporation of India Ltd
Mr. Tarun Kumar Garg	Engineering Head-Power Transformers	ABB India Limited
Mr. Abhay Kumar Agrawal	Head-Transformer Technology Center	ABB India Limited
Mr. Ajay Bhardwaj	President & Business Head	Sterlite Power Grid Ventures Limited
Mr. Susobhan Bhattacharya	General Manager (Construction)	CESC Limited
Ms. Bonani Choudhury	Dy. General Manager, (O&M)	North Eastern Electric Power Corporation
Mr. Swaroop Singh Dalal	Director Technical	Haryana Power Generation Corporation Ltd
Mr. Mayuresh V. Deodhar		Tata Power Company Ltd
Mr. Sanjay Garhwal	Factory Manager	Odisha Power Generation Corporation Ltd.
Mr. Prasanth Gopalakrishnan	CEO	Kalkitech
Mr. Rajiv Govil	Sales & Marketing	ABB India Limited
Mr. Naveen Jain	Technical Sales	Cargill India Pvt Ltd
Mr. Subir Kumar	General Manager	Essar Steel India Ltd.
Mr. Ramesh Manda Krishnamoorthy	Chief Manager	Power System Operation Corporation Ltd. (SRLDC)
Mr. Sanjay Mishra	Dy. General Manager (Maintenance)	Odisha Power Generation Corporation Ltd.
Ms. Elizabeth Pyrbot	Manager, Business Development &Coordination	North Eastern Electric Power Corporation
Mr. Pulin Shah		Suzlon Power Infrastructure Ltd.
Mr. Rajaram Shinde	Techno-commercial	Cargill India Pvt Ltd
Mr. Subodh Kumar Agrawal	Executive Director (Commercial)	NHPC Limited
Mr. Mohammed Abdul Gafur Ansari	Power Generation	NHPC Limited
Mr. Janardan Choudhry	Executive Director, O&M	NHPC LTD
Mr. Subodh Kale	Circuit Breaker, R&D	Siemens Ltd
Mr. Demudunaidu Obbalareddi	Senior Scientist-ABB Corporate Research Center	Abb Global Industries & Services Ltd.

Mr. Himangshu Saha	Chief Engineer, Design(E & M)	NHPC Limited
Ms. Anita Joshi	Sr. General Manager	Tata Consulting Engineers Ltd.
Mr. Nishat Wasim	Asst. General Manager	Angelique International Limited
Mr. Ritesh Bharat	Director- Applications and BD	GE Grid Automation
Mr. Monal Patel	Owner	Map Power LLP
Mr. Soubhik Auddy	Team Manager, PSG R&D	ABB Global Industries Services Ltd.

Young Members

NAME	DESIGNATION	ORGANISATION
Bharat Soni	Dept.:Engineering	Adani Transmission Limited
Prayas Gupta	Dept.: Operation & Maintenance	Adani Transmission Limited
Sarasij Das	Assistant Professor, Electrical Engineering Department	Indian Institue of Science
Y. Nagarjun	Asst. Engineer	Karnataka Power Corporation Ltd.
Bapat Atul	Director	Sukrut Electric Co. Pvt. Ltd.
Bapat Pradnya	HOD-Marketing	Sukrut Electric Co. Pvt. Ltd.
Radhey Shyam Meena	M.Tech. (Power System) Electrical Engg.	SBCET-Jaipur, Rajasthan Technical University, Kota
Mr. Aditya Dokania	Manager- Projects	Doksun Power Private Limited
Mr. Rachin Agarwal	Manager-Electrical Design Engineering	ALSTOM T&D India Limited
Mr. Rajat Misra	Engineer Systems.System Design	General Electric Grid Solution
Mr. Dinesh Babu Krishtappa Nagalingam	Power System	General Electric
Mr. Vipul Singh	Site Engineer	Larsen & Toubro
Mr. Yong Woo Lee		Hyosung T&D India Private Limited
Mr. Bharat Nandula	Technical Application Specialist	Qualitrol
Mr. Mohit Bhatnagar	Graduate Engineer Trainee	Bharat Aluminium Company Limited
Mr. Sivaji Burada	Engineer, Design & Power Transmission	Sterlite Power Transmission Limited
Mr. Ruhul Islam	Application Manager	ISA Advance Intruments Pvt. Ltd
Mr. Kunal Sharma	Director (Technical)	Green-Watt Techno Solution Pvt Ltd
Mr. Sudalai Shunmugam Sundaram	Sr. Research Fellow, HVD	Central Power Research Institute
Mr. Niraj Kulkarni	Partner	REVEN-TEC
Mr. Kondala Rao Bandaru	Sr. Technical Consultant, Power Consult	ABB India Limited
Mr. Nageswara Rao Akoju	Sr. Technical Consultant, Power Consulting	ABB India Limited
Ms. Anchal Mittal	Associate Director, Research	India Infrastructure Publishing Limited
Mr. Abhishek Reddy Sheri	Assistant Prof., Electrical Engg. Dept.	Mahatma Gandhi Institute of Technology

INTERNATIONAL COUNCIL ON LARGE ELECTRIC SYSTEMS
TO BE SENT TO NATIONAL COMMITTEE (i.e Central Board of Irrigation and Power)

MEMBERSHIP APPLICATION FORM – for the year 2017

Please fill in the column of the relevant MEMBER CATEGORY.

MEMBERSHIP RENEWAL ☐ **NEW MEMBERSHIP** ☐ **Membership Number** ☐

☐ ***INDIVIDUAL MEMBER I*** ☐ ***INDIVIDUAL MEMBER II*** *(Young Member under 35 years)*	***COLLECTIVE MEMBER I*** *Administrative bodies, scientific and technical organisations, research institutes, public or private Companies industrial and/or commercial.*	***COLLECTIVE MEMBER II*** *Universities, Educational Bodies only.*
Family Name .... *Forename* .... *Position, Dept.* .... *Company, Organisation* .... *Full Address* .... TEL .... Mobile no. .... FAX .... E-Mail............ *Year of Birth*	*NAME of COMPANY* .... *Person or Department to receive ELECTRA journal.* .... *Full Address* .... TEL .... Mobile no. .... FAX .... E-Mail............	*NAME of UNIVERSITY* .... *Person or Department to receive ELECTRA journal .* .... *Full Address* .... TEL .... Mobile no. .... FAX .... E-Mail............

Membership fee in India in Rs. is as below :

1	Collective I	Rs. 65,000/-
2	Collective II (Universities & Regulatory Commission)	Rs. 25,000/-
3	Individual	Rs. 7,500/-
4	Young - below 35 years of age	Rs. 3,750/-

Fee can be paid through cheque/ DD in favour of CIGRE India or through bank transfer

The details for bank transfer

Vender Name	The Committee for International Conference on Large High Voltage Electric Systems (CIGRE) India		
Bank Name & Branch	ICICI Bank Limited/ Malcha Marg Shopping Centre		
Branch Address	16/48, Malcha Marg Shopping Centre, Chankyapuri, New Delhi -110021. Ph.No.41680133-34-35		
IFSC code of branch	ICIC0000346	**MICR No.** : 110229052	**Account No.** : 034601001054
Type of account	Special Saving Account		**PAN No.** : AAAAZ0260A

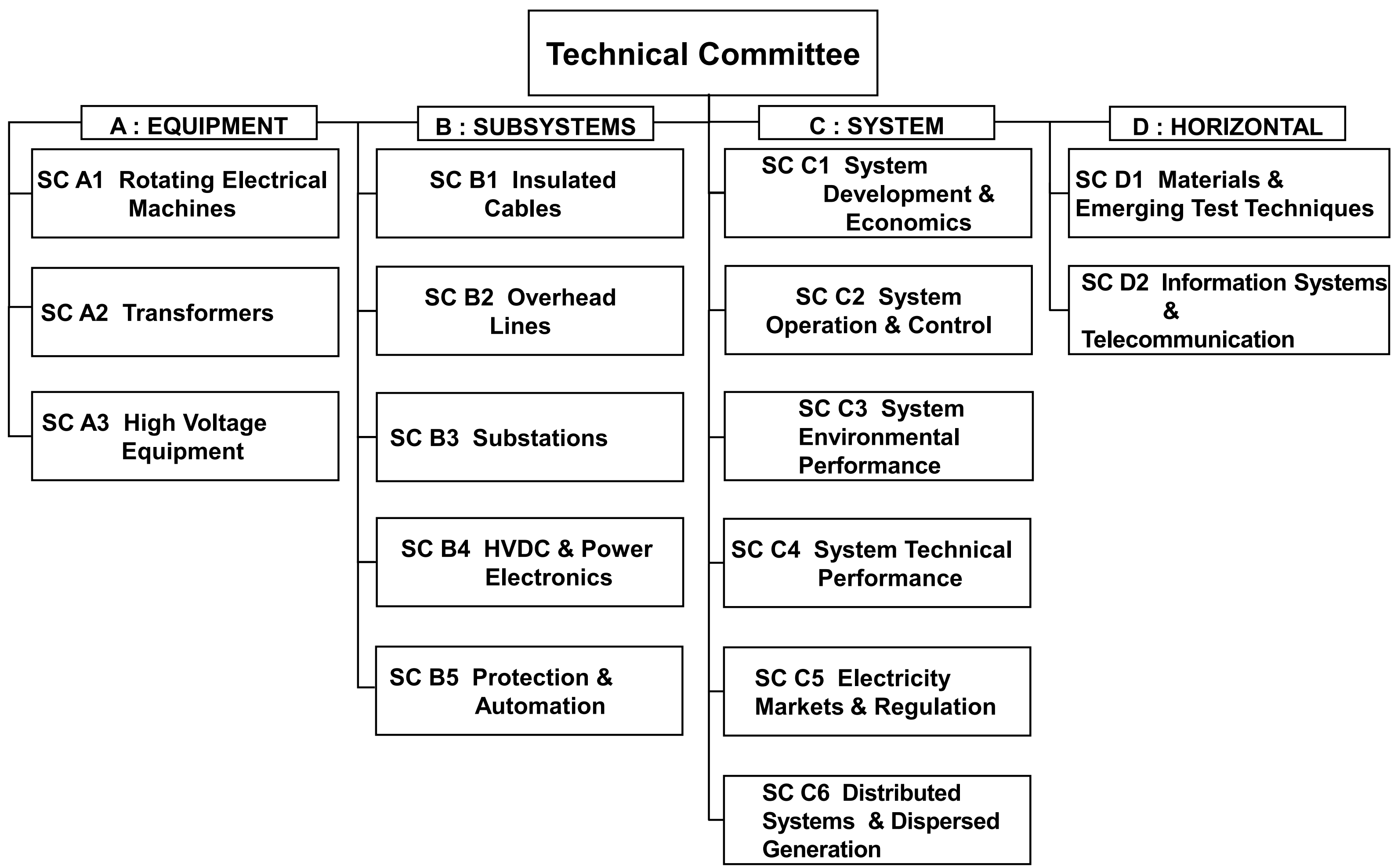
LIST OF PAPERS PRESENTED FROM INDIA IN CIGRE SESSION 2016 AT PARIS FROM 21-16 AUGUST 2016

S. No.	SC & PS	PAPER TITLED	AUTHOR (S)	ORGANISTION
01.	A1-PS1	Ensuring High Quality Insulation System of Large Motors – Design & Testing Requiring	A.K. Gupta, D.K. Chaturvedi, P.K. Basu	NTPC
02.	A2-PS2	3 Phase 420 kV Shunt Reactor manufacturing and quality sensitivity for vibration control – A case study	Vijayakumaran Moorkath, Tanvi Srivastava, Niladri Sekhar Mitra	Alstom T&D India Ltd.
03.	A3-PS2	Transformation in Lifetime Asset Management of EHV Circuit Breakers – A Case Study	Balasaheb Doiphode, Sanjay Kulkarni, Yash Kulkarni, N.S. Sodha – Ex. ED, POWERGRID	SCOPE T&M Pvt. Ltd.
04.	B1-PS1	Field Experience on newly installed cable system in large metro cities of India	Dilip M. Mirashi, Narayan Sirdesai Mahendra Kumar Kirit Rana	The Tata Power Co. Ltd. Delhi Metro CESC Ltd.
05.	B2-PS2	Execution of Transmission Projects With Innovative Methods for Augmentation of EHV Network In Mega City of Mumbai – Challenges & Solutions	U K Maharaja, Vishwas Surange, P Murugan, Sandeep Deshmukh, P.S. Verma, M V Deodhar	The Tata Power Co. Ltd.
06.	B3 -PS3	Operational Experience In 1200kV (UHVAC) National Test Station, India	I.S. Jha, B.N. De. Bhowmick, S.B. R. Rao, Dhyeya. R. Shah, Rachit Srivastava R.K. Singh Prof. S. V. Kulkarni, Santosh Kumar	POWERGRID BHEL IIT/ Mumbai
07.	B4-PS1	Commissioning Experience and Challenges of World's First 800 kV, 6000 MW NER – Agra Multi terminal HVDC System	Narendra Kumar, M.S. Rao B.B.Mukherjee, Rakesh Kumar, M.M. Goswami, Oommen Chandy	POWERGRID
08.	C1-PS1	Transmission Asset Management Through In-House Developed Software for Transmission System of Gujarat State	Manishkumar K. Jani	GETCO
9.	C3-PS3	Enhancing resilience of the North Indian Power System against pollution and foggy weather - An Experience	V.K. Agrawal, K.V.S. Baba, S.R. Narasimhan, R.K. Porwal, Nitin Yadav, Ankit Gupta, S.S. Goyal	POSOCO
10.	C5-PS2	Introduction of Sub-Hourly Market in Power Exchanges and Facilitating Large Scale Renewable Energy Integration in India	S.K. Soonee, V.K. Agrawal, S.S. Barpanda, S.C. Saxena, Kaushik Dey, K.V.N. Pawan Kumar	POSOCO-NLDC
11.	C6-PS2	Leveraging Smart Grids Assets for Building Smart Cities at Marginal Cost	Reji Kumar Pillai, S.A. Khaparde	ISGF
12.	D1 -PS2	Eco Friendly Thermoplastic Insulation for LV Switchgear Application	Beema Thangarajan R, Satish H Chetwani, Milind Oak	ERDA

13.	D2-PS1	Ensuring Uptime of WAMS Network with the Help of Common IT Tools – Case Studies	V. K. Agrawal, P. K. Agarwal, Harish Kumar Rathour, Puneet Maury	POSOCO
14.	D2-PS1	Communication Networks for Indian Smart Grids	N.S. Sodha	Former ED, POWERGRID
15.	B4-PS1	AC-DC Interaction Study For Upcoming ± 800 kV, 3000 MW Champa Kurukshetra HVDC Link	Mahesh Vardikar, Vishwajeet Singh, M.S. Rao, Vikas Bagadia M M Goswami, Oommen Chandy	POWERGRID
16.	B3-PS2	Retrofitting and Modernization of Conventional Substation To An IEC 61850 Based Automated Substation – A Case Study of 400 kV Amreli Substation	N. M. Sheth, S. K. Jadav, B. J. Patel	GETCO
17.	B3 -PS1	Substation Automation from Conventional to full Digital Technologies – Case Studies and Impact	Purshottam Kalky Ritesh Bharat Shantanu Dey Saurabh Makwana	(Alstom Grid, India) & (Alstom Grid, France)
18.	C1-PS3	Transmission System Planning under uncertainties including renewable penetration regime in Indian Context	S. Jha, Y. K. Sehgal, Subir Sen, Kashish Bhambani	POWERGRID

LIFE IS A COMBINATION OF SUCCESS AND FAILURE BOTH ARE NEEDED

CIGRE Technical Committee Subject



FIELDS OF ACTIVITY OF CIGRE STUDY COMMITTEES

Study Committees No.	Scope
A1	**Rotating Electrical Machines** : Economics, design, construction, test, behaviour and materials for turbine generators, hydro-generators, non conventional machines and large motors.
A2	**Transformers :** Design, construction, manufacture and operation for all kinds of power transformers including industrial,DC converters and phase-shift transformers and for all types of reactors and transformer components (bushing, tap-changer…)
A3	**High Voltage Equipment :** Theory, design, construction and operation for all devices for switching, interrupting and limiting currents, surges arresters, capacitors, busbars and equipment insulators and instrument transformers.
B1	**Insulated Cables :** Theory, design, applications, manufacture, installation, testing, operation, maintenance and diagnostic techniques for land and submarine AC and DC insulated cables systems.
B2	**Overhead Lines :** Design, study of electrical and mechanical characteristics and performance, route selection, construction, operation, service life, maintenance, refurbishment uprating and upgrading of overhead lines and their components including : conductors, earth wires, insulators, towers, foundation and earthing systems.
B3	**Substations :** Design, construction, maintenance and ongoing management of substations and electrical installations in power stations, excluding generators.
B4	**HVDC and Power Electronics :** Economics, application, planning aspects, design, protection, control, construction and testing of HVDC links and the associated equipment. Power Electronics for AC systems and Power Quality Improvement and Advanced Power Electronics.
B5	**Protection and Automation :** Principles, design, application and management of power system protection, substation control, automation, monitoring and recording – including associated internal and external communications, substation metering systems and interfacing for remote control and monitoring.
C1	**System Development and Economics :** Economics and system analysis methods for the development of power systems : methods and tools for static and dynamic analysis, planning issues and methods in various context, assets management strategies.
C2	**System Operation and Control :** Technical and human resource aspects of operation of power systems : methods and tools for frequency, voltage and equipment control, operational planning and real time security assessment, fault and restoration management, performance evaluation, control centre functionalities and operators training.
C3	**System Environmental Performance :** Identification and assessment of the impacts on environment of electric power systems and methods used for assessing and managing the environmental impact of system equipment.
C4	**System Technical Performance :** Methods and tools for power system analysis in the following fields: power quality performance, electromagnetic compatibility, lightning characteristics and system interaction, insulation coordination, analytical assessment of system security.
C5	**Electricity Markets and Regulation :** Analysis of different approaches in the organisation of the Electric Supply Industry : different market structures and products, related techniques and tools, regulations aspects.
C6	**Distribution Systems and Dispersed Generation :** Assessment of technical impact and requirements which new distribution features impose on the structure and operation of the system : widespread development of dispersed generation, application of energy storage devices, demand side management; rural electrification.
D1	**Materials and Emerging Test Techniques :** Monitoring and evaluation of new and existing materials for electrotechnology, diagnostic techniques and related knowledge rules, and emerging test techniques with expected impact in medium to long term.
D2	**Information Systems and Telecommunications :** Principles, economics, design, engineering, performance, operation and maintenance of telecommunication and information networks and services for Electric Power Industry; monitoring of related technologies.

HIGHLIGHTS OF POWER SECTOR IN INDIA

GROWTH OF INSTALLED CAPACITY

(Figures in MW)

	At the end of 11th Plan (March 2012)	As on 31.10.2016	Planned for 12th Plan	Planned for 13th Plan
THERMAL	131603.18	212468.90	72340.00	56400.00
HYDRO	38990.40	43112.43	10897.00	12000.00
NUCLEAR	4780.00	5780.00	5300.00	18000.00
RENEWABLE ENERGY SOURCES	24503.45	45916.95	30000.00	30500.00
TOTAL	**199877.03**	**307278.28**	**118537.00**	**116900.00**

Captive Generation - 40726 MW *Source : CEA*

ALL INDIA REGION WISE INSTALLED CAPACITY

As on 31-10-2016

(Figures in MW)

Region	Thermal	Hydro	Nuclear	RES	Total
Northern	52080.76	18376.78	1620	8976.44	81053.98
Western	83326.42	7447.50	1840	15818.49	108432.40
Southern	44359.00	11668.03	2320	20277.82	78624.85
Eastern	30592.87	4378.12	0	564.39	35535.38
N. Eastern	2069.80	1242.00	0	268.72	3580.52
Islands	40.05	0	0	11.10	51.15
All India	**212468.90**	**43112.43**	**5780**	**45916.95**	**307278.28**
Percentage	**69.10**	**14.0**	**1.90**	**15.0**	**100**

Source : CEA

SECTOR WISE INSTALLED CAPACITY AND GENERATION

As on 31-10-2016

Sector	Installed Capacity (MW)					Percentage Share	Generation (MU)
	Thermal	Nuclear	Hydro	RES	Total		During October 2016
STATE	71155.13	0.0	28341.00	1975.40	101471.53	33.0	99709.57*
PRIVATE	82562.94	0.0	3120.00	43941.55	129624.49	42.0	
CENTRAL	58750.83	5780.00	11651.43	0.00	76182.26	25.0	
TOTAL	**212468.90**	**5780.00**	**43112.43**	**45916.95**	**307278.28**	**100 .00**	

*Includes 943.59 MU Import from Bhutan. *Source : CEA*

GROWTH OF TRANSMISSION SECTOR

	Unit	At the end of 11th Plan (March 2012)	Addition During October, 2016	As on 31.10.2016	Expected addition during 12th Plan	Expected addition during 13th Plan
TRANSMISSION LINES						
+/- 800 kV HVDC	ckm	9432	2574	6080	109440	130000
+/- 500 kV HVDC	ckm		0	9432		
765 kV	ckm	5250	4029	25828		
400 kV	ckm	106819	6017	153147		
220 kV	ckm	135980	3778	161016		
Total Transmission Lines	**ckm**	**257481**	**16398**	**357949**	**109440**	**130000**
SUBSTATIONS						
+/- 800 kV HVDC	MVA	9750	1500	3000	270,000	300,000
+/- 500 kV HVDC	MVA		0	13500		
765 kV	MVA	25000	13500	154500		
400 kV	MVA	151027	15920	225387		
220 kV	MVA	223774	8140	301622		
TOTAL	**MVA**	**409551**	**39060**	**698009**	**270,000**	**300,000**

RURAL ELECTRIFICATION / PER CAPITA CONSUMPTION

(As on 31-10-2016)

Total no. of Villages	597464
No. of Villages Electrified	589585
% of Villages Electrified	98.68
No. of Pump-sets Energized	20558235
Per Capita Consumption during 2014-15	*1010 kWh

*Provisional

RE SECTOR IN INDIA: POTENTIAL AND ACHIEVEMENTS

(As on 30.9.2016)

GRID-INTERACTIVE POWER Sector	Potential (GW)	Achievement (MW)
Wind	103	28082.95
Solar Power (SPV)	749	8513.23
Small Hydro (up to 25 MW)	20	4323.35
Bagasse Cogeneration/ Biomass	25	4882.33
Waste to Power	2.7	115.08
Total (Approx)	**900**	**45916.64**
OFF GRID/CAPTIVE POWER		**1382.68**

Source : MNRE

TATA POWER, ICICI VENTURE TEAM UP, EYE POWER ASSETS

With the government relaxing rules following a surge in bad loans, funds have been attracted by the prospects of acquiring troubled assets at deep discounts.

Tata PowerBSE 1.12 %, which pioneered electricity generation in the country, and ICICI Venture, one of India's biggest domestic private equity fund, on Friday teamed up to take over stressed power assets in Asia's third largest economy. The Tata Power-ICICI Venture is the latest alliance in the stressed assets space after Piramal-Bain Capital Credit and Brookfield-SBI.

Tata Power holds a 26 per cent stake in the newly incorporated company, called Resurgent Power Ventures. While ICICI Venture will be responsible for organising equity and debt financing for the acquisitions, Tata Power will manage the operations of the coal-fired and hydro power plants.

Resurgent, constituted in Singapore, has got the backing of Canada's second largest pension fund, Caisse de depot et placement du Quebec, and of sovereign wealth funds—Kuwait Investment Authority and State General Reserve Fund of Oman. The power platform will initially raise $850 million with the three global funds putting in about $500 million. The capital can be upsized going forward, depending on market opportunities, the companies said in a joint statement.

Resurgent intends to acquire controlling stakes in conventional and non-conventional power projects that are either completed or nearing completion.

Tata Power has routed its equity in Resurgent through its wholly owned subsidiary Tata Power International, while ICICI Venture has structured its investment through parent ICICI Bank's Bahrain branch. The power sector, which is laden with high debt, has seen several developers putting their assets on the block.

Source : TNN, 10.9.2016

HIGHER POWER PURCHASE COSTS EATS INTO PROFITS AT CESC

CES Cregistered a marginal 1.6% growth in total comprehensive income under the new accounting standards –IndAs, for the first quarter of the current financial year against the previous corresponding period.

Comprehensive income is the sum of net income (net profit) and other items that must bypass the income statement because they have not been realized. According to the new accounting standard - IndAs, total comprehensive income is a better indication of the company's profits rather than net profit.

Nevertheless, CESC's net profit for the quarter under review was Rs 174 crore, against Rs 173 crore in the previous corresponding period.

Profit growth was marginal despite a 11% growth in total income from operations at Rs 1,912 crore due to increased outgo on account of a 25% rise in power purchase cost as well as rise in employee costs.

The company sold 2,700 million units of power during the quarter against 2,550 million units in the previous corresponding period - a near 6% growth in energy sales.

Source : ET Bureau, 14.9.2016

FRENCH POWER MAJOR EDF PLANS $2 BILLION GREEN BET ON INDIA

French state-run power major EDF will invest heavily in renewable energy in India, with projects worth $2 billion in the pipeline, and is bullish about the sector, where it sees electricity tariffs falling 30% in five years, EDF Energies CEO Antoine Cahuzac told ET.

India is among the few countries EDF has chosen for a significant expansion of its global portfolio of renewable energy because the country has a huge demand potential, power scarcity and "fantastic" quality of wind and solar radiation, Cahuzac said.

EDF is also interested in nuclear energy, for which it has initial agreements with Nuclear Power Corp, but regulatory issues are still under discussion, he said. EDF also has interest in hydropower generation in India and is looking at a few prospects, he said.

Source : ET Bureau, 20.9.2016

RAYS POWER INFRA LAUNCHES 100 MW SOLAR PROJECT IN UTTARAKHAND

Rays Power Infra, a solar energy company, will set up a 100 mw solar power plant in Uttarakhand. The Project's execution began in August, 2016, and is expected to be commissioned by February, 2017. It will be executed by Rays Power Infra on turnkey basis - from land acquisition to commissioning.

Pawan Sharma, director-projects, Rays Power Infra said, "After successfully commissioning a 55 MW Solar Power PV project in U.P., this 100 MW project in Uttarakhand will be our biggest project."

The 100 MW project is spread over a sprawling land area at Tehsil - Bhagwanpur in Roorkee District of Uttarakhand. It comes under Uttarakhand Renewable Energy Development Agency's (UREDA) competitive bidding for 2015-16.

Source : ET Bureau, 20.9.2016

STATES TO GET CENTRE'S FINANCIAL SUPPORT FOR FREE POWER SCHEME

The Centre will extend financial support to states to enable them to offer new electricity connections free of cost to everyone.

At present, electricity connections to only below poverty line (BPL) families are offered for free. A senior government official said the Union power ministry has proposed to extend the free connections scheme to all in line with the Centre's goal to achieve 24x7 power for all by March 2019.

Rural Electrification CorporationBSE 0.65 % (REC) is working on a scheme to provide long-term loans to states that agree to offer free new electricity connections. The scheme will be a key issue for discussion when Union power minister PiyushGoyal meets state power ministers during the two-day conference of power ministers starting October 7 in Gujarat. REC is working on a scheme for financing the power distribution companies so that they could release new electricity connections to households.

The scheme covers funding of expenses like laying of lines to give access to electricity, installation of meters and other accessories. As per the plan, the distribution companies will have to get new connection plans approved by REC, which will reimburse expenses incurred by power utilities in giving electricity access to households.

"It will be an optional scheme for the states. Some states may not see merit in providing free power connections to remote areas that are not connected to the electricity grid. We would encourage such states to at least offer electricity connections on easy monthly instalments of as low as Rs 100 per month for 4-5 years," the government official said.

We do need transparent budgetary subventions to better allocate resources for power. But in tandem, we need to generate the necessary political will to put paid to populism and gross open-ended giveaways and subsidies in power. In a highly capital-intensive sector, routine revenue leakage in power distribution, with the powers that be in effect providing patronage for plain theft of electricity, would verily short-circuit the system. It would guarantee poor quality of power, which, in turn, would stultify growth.

Source : ET Bureau, 19.9.2016

NEW TECHNOLOGY TO HELP THERMAL POWER GENERATION COMPANIES QUICKLY SWITCH SOURCE

A new technology will enable thermal power plants to start up in as little as an hour, a fraction of the 24 hours currently needed, allowing for greater integration of renewable energy sources in the national electricity production system, which now runs primarily on coal.

Thermal plants retrofitted with this equipment can start generation as soon as power from solar units starts to reduce with decreasing sunlight, replacing it with coal-fired electricity. It will balance power flow into the network and keep it stable. Such flexibility isn't possible now since thermal power plants need 24 hours to start and cannot replace a fall in solar generation at a short interval.

Last week, India Power Corporation Ltd (IPCL) and Germany-based Uniper floated an equal joint venture company, India Uniper Power Services, which will source this proprietary technology from Uniper and offer it to Indian plants. "It is being successfully used at Uniper power station at Ratcliffe in the UK. Ratcliffe daily uses start and stop cycles in response to renewable generation. It is commonly used across EU countries, both for coaland gas-fired plants," said HemantKanoria, Chairman of IPCL. "The technology is a complete approach involving upskilling of people, modification of procedures, training, modification of systems and rigorous risk assessment."

The government has set a 100 gigawatt capacity addition target for solar power, which cannot yet be gainfully used to supply electricity to towns and cities because such plants cannot operate continuously. If stored in batteries, solar power will increase costs manifold and make it uneconomical. The Central Electricity Authority and other government agencies have been looking for a solution and this new technology could help at marginal additional cost.

Analysts said if this technology is successfully installed in existing plants, electricity exchanges could offer power in the hour-ahead market, depending on the day's demand surges. Trades in Indian power exchanges are settled on a dayahead basis - buying and selling commitments are made a day earlier and power is supplied the next day. This cycle could be bought down to an hour.

"It will also allow idle plants to start generation as soon as they see a fall in supply or a rise in demand during a day. At present, a number of independent power producers are idling their plants due to lack of power demand. These plants generally start only after demand has been on the rise for a day or two. With this technology retrofitted, this cycle can shorten and it can help them get relatively better returns on their investment," said an analyst.

An official from NTPC said it needs to verify if this technology works with equipment provided by Bharat Heavy ElectricalsLtd., which has built a majority of its thermal power plants. Kanoria of IPCL said it can be retrofitted on all plants, both coal and gas based.

Source : ET Bureau, 13.9.2016

International Council on Large Electric Systems (CIGRE)

International Headquarters:

International Council on Large Electric Systems (CIGRE), 21 Rue d'Artois, 75008 Paris, France
Tel: **+33 1 53 89 12 90;** Fax: **+33 1 53 89 12 99**
Email of Secretary General: philippe.adam@cigre.org

Date of inception : CIGRE was founded in 1921 with its HQ at PARIS

Aims and Objectives:

CIGRE (International Council on Large Electric Systems) is one of the leading worldwide Organizations on Electric Power Systems, covering their technical, economic, environmental, organisational and regulatory aspects.

A permanent, non-governmental and non-profit International Association, based in France, CIGRE was founded in 1921 and aims to:

- Facilitate the exchange of information between engineering personnel and specialists in all countries and develop knowledge in power systems.
- Add value to the knowledge and information exchanged by synthesizing state-of-the-art world practices.
- Make managers, decision-makers and regulators aware of the synthesis of CIGRE's work, in the area of electric power.

More specifically, issues related to planning and operation of power systems, as well as design, construction, maintenance and disposal of HV equipment and plants are at the core of CIGRE's mission. Problems related to protection of power systems, telecontrol, telecommunication equipment and information systems are also part of CIGRE's area of concern.

Establishment of Indian Chapters:

CIGRE India was set up as society on 24.07.91 with CBIP as secretariat.

Membership:

(I) Collective Members (I) - (companies of industrial and commercial nature)

(II) Collective Members (II) - (Universities, Engineering Colleges,Technical Institutes and regulatory commission)

(III) Individual Members -

(In the engineering, teaching or research professions as well as of other professions involved in the industry (Lawyers, economists, regulators...)

(IV) Young Members (Below 35 Years of Age) -

(In the engineering, teaching or research professions as well as of other professions involved in the industry (Lawyers, economists, regulators...)

CIGRE - HQ

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		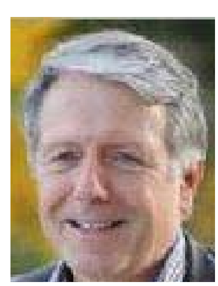	

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