

Regional Testing Laboratory, Kolkata

Regional Testing Laboratory Kolkata was set up in September 2006 with a view to cater to the testing, certification and evaluation needs of electrical power equipment manufacturing industries, utilities and consumer in the eastern region. It also acts as a liaison unit of CPRI with various clients in the region and coordinates their test requirements which are beyond the scope of RTL, Kolkata but within capabilities of Bangalore and other units of CPRI. The major power utilities catered to by RTL in the region are PGCIL, DVC, NTPC, NHPC and state electricity boards of Bihar, Jharkhand, Orissa, Sikkim and West Bengal. Thus, the objective of CPRI Laboratory in Kolkata is to cater to the need of electric power utilities in the eastern region. A large number of power utilities are already in operation in the region. There are 49 power generating stations, 31 and 72 sub-stations of 400 kV and 220 kV capacities respectively in the region. CPRI is having ambitious plan to fulfill the need of test facilities in the region. The laboratory is going to take up expansion in its facilities to accommodate complete oil testing including testing of new oils, condition monitoring of substation equipment and studies on distribution transformers.

1.0 INTRODUCTION

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CPRI LABORATORY IN KOLKATA

various clients in the region and coordinates their test requirements which are beyond the scope of RTL, Kolkata, but within capabilities of Bangalore and other units of CPRI. The major power utilities in the region are PGCIL, DVC, NTPC, NHPC and state electricity boards of Bihar, Jharkhand, Orissa, Sikkim and West Bengal with a generation capacity of about 23119 MW, which is 14% of total electric power generated in India. Large number of power transformers with a total capacity up to 132 kV level is 35465 MVA are installed in the region. This is the only region having connectivity to all the regions of the country i.e., North, West, South and North – East, besides international connectivity to Nepal and Bhutan. Another important feature of the region is that it caters to core sector load including Steel, Coal, Aluminium and traction. There are 49 power stations, 31 and 72 sub-stations of 400 kV and 220 kV capacities respectively [1].

The project to set up RTL Kolkata is funded by Ministry of Power, Govt. of India and is supported by West Bengal Electricity Distribution and Transmission Company Ltd. The laboratory is located at Salt Lake, a place where Electrical Power utilities like WBSEDCL, WBSETCL, WBPDC, DVC Head Quarters are located. Eastern region office of NHPC, PGCIL, BHEL, etc. are also located in same area. The advantage of geographical location has helped maintaining easy communication with these power utilities.

The Laboratory is equipped with facilities to carry out testing and certification of insulating oils of power transformers as per IS:1866-2000. The Dissolved Gas Analysis on power transformers, an important diagnostic tool is available at RTL, Kolkata for assessing the internal condition of the transformers. The laboratory has the test facilities like High Performance Liquid Chromatography (HPLC) to evaluate Furan Content which is an important Diagnostic tool for assessing the condition of solid insulation in power transformers.

Augmentation of test facilities at RTL Kolkata remains a priority in CPRI. Electrical testing

facilities like Insulation Resistance, Capacitance and Tan delta measurements for power transformers have already been augmented. Few more facilities are likely to be added soon.

Regional Information Centre of Central Board of Irrigation and Power, New Delhi is housed in RTL, Kolkata laboratory. The information centre was inaugurated during August 2007 by CBIP to cater to the utilities in the eastern zone. There are about 2000 publications on various subjects like transmission, distribution, thermal generation, hydroelectric generation, irrigation, dam management, etc.

2.0 MAJOR EQUIPMENT

The laboratory has got following equipment with high precision to carry out analysis of transformer oils.

- Break Down Voltage Tester
- Tan delta and Specific Resistance Bridge
- Tensiometer
- Gas Chromatograph
- Flash point Test Apparatus
- Moisture Analyzer
- Auto Titrator
- Fourier Transform Infrared Spectrophotometer
- High Performance Liquid Chromatograph

3.0 FACILITIES

The testing facilities created at RTL, Kolkata mainly to address the effective maintenance of power transformer. The laboratory in its beginning stage is focused on analysis of transformer oil. Transformer oils are subjected to electrical and mechanical stress while a transformer is in operation. In addition, there is contamination caused by chemical interactions with windings and other solid insulation, catalyzed by high operating temperature. As a result the original chemical properties of the transformer oil

changes gradually, rendering it ineffective for its intended properties after years of operation. Hence there is a need to test the oil periodically to ascertain its basic electrical properties for its suitability to use or necessary actions like filtration, regeneration etc. has to be performed [2]. These tests can be broadly categorized into three groups: (1) Dissolved Gas Analysis, (2) Analysis of furanic compounds, and (3) General electrical and physic-chemical tests. Furan and DGA tests are specifically not to determine any abnormalities in the internal windings of the transformer or the paper insulation of the transformer which can not be otherwise detected without a complete overhauling.



A MOMENT DURING INAUGURATION OF THE LABORATORY

The objective of RTL, Kolkata is to cater to the electric power utilities in the region. Over the period from its inception adequate response is being received from various utilities located in the region. The facilities available at RTL, Kolkata Laboratory are being utilized by the organizations like DVC, WBSETCL, WBPDC, WBSEDCL, DPL, CESC, OPTCL, Tata Power and other private utilities in the eastern region. Tests conducted on transformers oil samples over the period starting from its inauguration is given in Figure 1 and report issued is shown in Figure 2. The testing activities are spread over the region. In Figure 3 shown locations wise samples tested. RTL Kolkata is involved in testing at almost all substations of 132 kV and

above capacity and all the generating stations in West Bengal. Involvement with utilities located at other states is gradually improving.

Financial Express 27.9.06

Maintenance: WBSEB ropes in CPRI

Indronil Roychowdhury
Kolkata, Sept 26

The West Bengal State Electricity Board has roped in the Central Power Research Institute (CPRI), an autonomous body under the ministry of power, for proper maintenance of the power equipment, till recently a neglected affair in the SEB's scheme of things.

MK Ray, the member secretary told FE that the board, currently engaged in transmission and distribution, requires to make residual life assessment of its high voltage transformers. The facility it has been having so long with the only research and testing laboratory at Salt Lake was not enough to conduct such assessments.

The CPRI, offering expert consultancy in the areas of transmission and distribution, will start high voltage transformer oil testing and will also reclaim transformer oil, if required.

Every transformer is filled with a special type of oil, which acts as cooling and an insulating agent to prevent the transformer body from getting heated. This oil can decompose into various gases and its insulating capacity may get reduced resulting in a sudden burst followed by an interruption in power supply.

A timely check up, according to Ray, can prevent such transformer bursting as well as increase its efficiency effecting in lesser T&D loss.

Not only the transformers of the WBSEB, power intensive units, which has high voltage transformers, can be checked by the CPRI, Ray said.

The CPRI, with its headquarters in Bangalore and regional centres in Bhopal, Hyderabad, Tiruvandrum and Muradnagar, offers services in energy auditing, power system instrumentation, power system application conductor vibration and power system application in high power and extra high voltage and related fields.

It also conducts type tests, the test ensuring the standards set by the standard setting bodies, of power equipments like switchgear, fuse gears, transformers, cables, capacitors, insulating materials and systems, transmission line towers, liquid dielectrics, non-conventional energy devices and other electrical equipment.

Although, according to Ray, the CPRI, currently accommodated in the WBSEB's Salt Lake research centre, will conduct only dissolved gas analysis, condition monitoring of equipment with a mobile laboratory and transformer oil testing, later it will function as a full fledged laboratory once it sets up its own laboratory on a 20 acre plot in Rajarhat, it has already applied for.

The WBSEB spends Rs 3000 crore every year for system upgradation and buys a lot of power equipment tested in various CPRI centres. Once CPRI starts full fledged operations in Kolkata, the utility will no more need to go to other states for quality certification of the equipment purchased. Besides CPRI will be a factor in drawing investments to the eastern region for power sector equipment manufacturing, Ray said.

At present, there are no electrical equipment manufacturers in the eastern region.

After completion of rural electrification by 2010 in West Bengal, the WBSEB's customer base will go up to 90 lakh from the present 58 lakh. The WBSEB is encouraging new consumers to purchase meters from the open market and make it CPRI certified, Ray said.

Indian Express (KOL) 27.9.06

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SEB ropes in CPRI for proper maintenance

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RESPONSE FROM MEDIA ON INAUGURATION OF THE LABORATORY

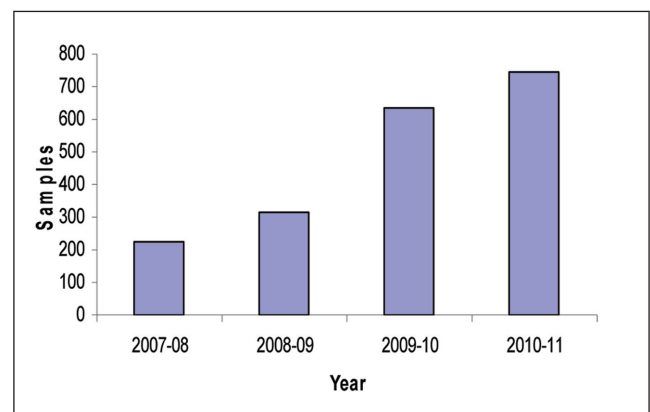


FIG. 1 NUMBER OF SAMPLES TESTED

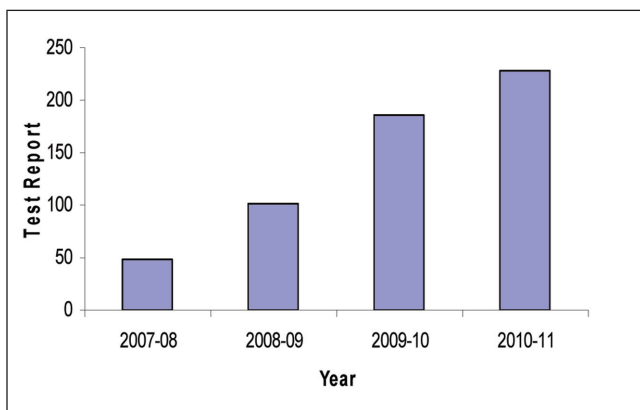


FIG. 2 NUMBER OF TEST REPORT ISSUED

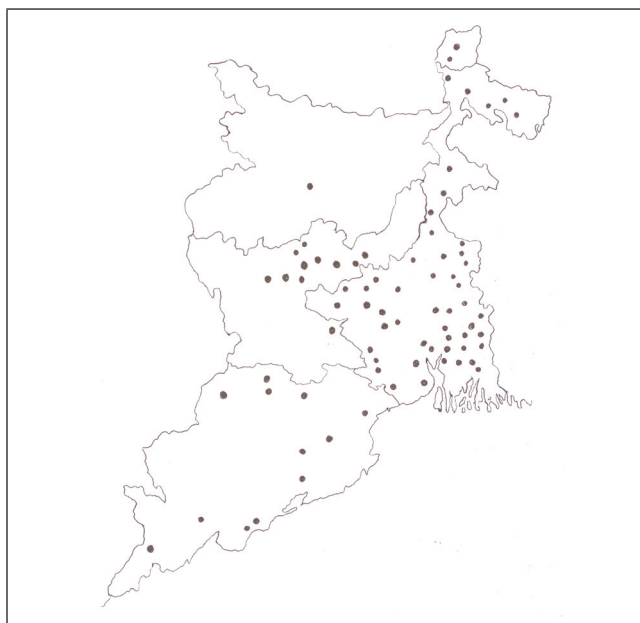


FIG. 3 LOCATIONS FROM WHERE SAMPLES ARE RECEIVED AT RTL

3.1 Dissolved Gas Analysis

Dissolved gas analysis (DGA) is widely used to detect incipient faults in transformers. Insulating oils under abnormal electrical or thermal stress breakdown to liberate small quantities of gases like hydrogen (H₂), methane (CH₄), ethane (C₂H₆), ethylene (C₂H₄), acetylene (C₂H₂), carbon dioxide (CO₂) and carbon monoxide (CO). Hydrogen (H₂), methane (CH₄) and ethane (C₂H₆) are favored at low-energy level, such as in corona partial discharges or at relatively low temperatures (<500°C), ethylene (C₂H₄) at intermediate temperatures, and acetylene (C₂H₂) at very high temperatures (>1000°C) such as in arcs [3]. Paper insulation is composed of

complex cellulosic molecules containing carbon, hydrogen and oxygen as major constituents. Thus at higher temperature, carbon monoxide and carbon dioxide are produced due to degradation of paper.

The distribution of these gases can be related to the type of electrical fault, and the rate of gas generation can indicate the severity of the fault. Hence, identity of the gases being generated by a particular transformer can be very useful in taking preventive maintenance program [4]. There are several techniques in detecting those fault gases and DGA was recognized as the most informative method. This method involves sampling of the oil to measure the concentration of the dissolved gases.



INAUGURATION OF REGIONAL INFORMATION CENTRE OF CBIP

DGA being an important diagnostic tool to assess internal condition of power transformers, RTL Kolkata has carried out the analysis of samples received from various locations in the region. A growing trend has been observed in utilizing DGA as shown in Figure 4. DGA results obtained from samples analyzed helped categorize transformers as healthy, having faults but can be in service with periodic monitoring and the one where immediate internal inspection needed. So far, about five cases were detected where immediate action needed. Periodic monitoring is being conducted on about 15 transformers for trend analysis of key gases. The transformers are from organizations like KTPS,

BTPS, WBSETCL, DVC, etc. A typical growth rate of various hydrocarbon gas concentrations is shown in Figure 5.

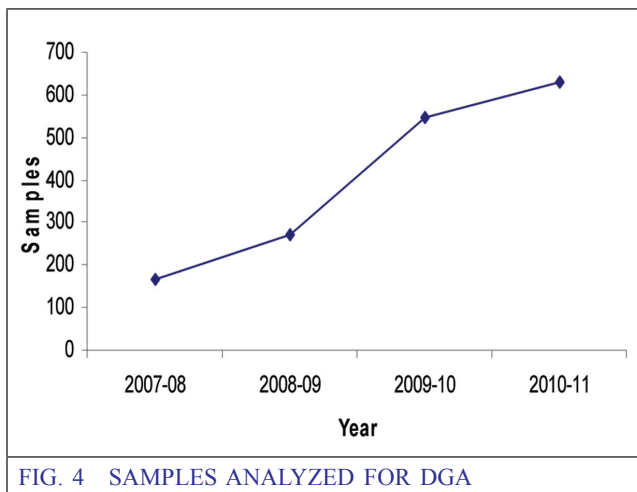


FIG. 4 SAMPLES ANALYZED FOR DGA

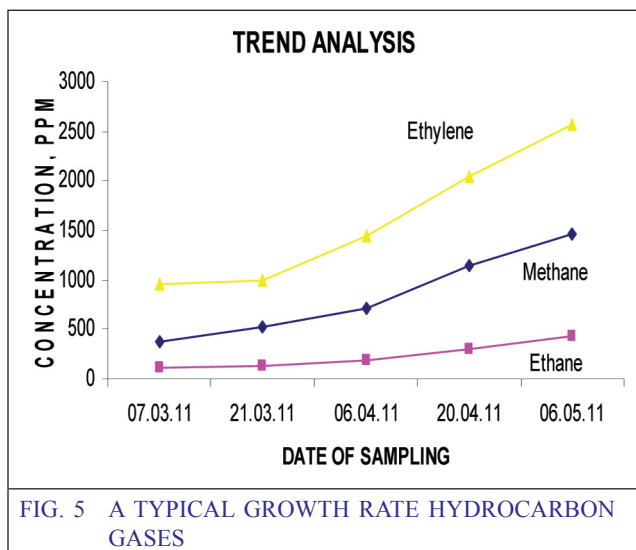


FIG. 5 A TYPICAL GROWTH RATE HYDROCARBON GASES

3.2 Analysis Of Solid Insulation

Transformer insulation consists of mineral oil, paper insulation and other cellulosic materials such as pressboard, woods, etc. The performance of the transformer depends to a large extent on the integrity of these materials. Because of this, great emphasis has been placed on estimating residual life of transformers by studying the degradation of Cellulosic paper insulation. The paper on degradation, produces various furanic compounds and hence the analysis of dissolved furanic compounds in any aged power transformer

oil by High Performance Liquid Chromatography technique can provide significant information on the extent of deterioration of the paper insulation. This helps in determining the life of insulation paper and subsequently the life of transformer [5]. So, analysis of furanic compounds in transformer oils has been initiated by RTL, Kolkata. More than 100 samples were collected from various power utilities in the region and the analysis was conducted utilizing the facility available at CPRI, Bangalore. The need for this facility has been well recognized and test facility to analyze furanic compounds is being augmented at CPRI, Kolkata Laboratory.

3.3 Condition Monitoring Assessment of Sub Stations

Condition monitoring of substation equipment was one of the major activities that CPRI was involved in the region. Field monitoring team of CPRI, Bangalore with mobile testing laboratory has performed detailed tests including C&Tan delta, RVM, SFRA, etc. on equipment at about 40 or more substations in West Bengal, Orissa and Jharkhand.

4.0 FUTURE PROSPECT

The objective of CPRI Laboratory in Kolkata is to cater to the need of electric power utilities in the eastern region. A large number of power utilities are already in operation in the region. There are 49 power generating stations, 31 and 72 sub-stations of 400 kV and 220 kV capacities respectively in the region. A substantial growth is also anticipated in near future especially during 12th five year plan. CPRI is having ambitious plan to fulfill the need of test facilities in the region. The laboratory is going to take up expansion in its facilities to accommodate complete oil testing including testing of new oils, condition monitoring of substation equipment and studies on distribution transformers.

ACKNOWLEDGMENT

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BIBLIOGRAPHY

- [1] Annual Report, 2009–2010, Eastern Regional Load Despatch Centre, 14, Golf Club Road, Kolkata-700 033.
- [2] S. Sridhar, V.V. Pattanshetti and P.K. Mait. “Insulating Fluids for Power Equipments”, *Seminar on Condition Monitoring of Power Transformers*, CPRI, Muradnagar, 1st and 2nd August, 2003.
- [3] SANGHI R. “*Chemistry behind the life of a transformer*”, Resonance Magazine, June 2003.
- [4] DiGiorgio, J.B. *Dissolved Gas Analysis of Mineral Oil Insulating Fluids*. DGA Expert System: A Leader in Quality, Value and Experience, No. 1, pp. 1–17, 2005.
- [5] P.K. Maiti and V.V. Pattanshetti, “Ageing of Insulating Paper in Power Transformers”, *Seminar on Condition Monitoring of Power Transformers*, CPRI, Muradnagar. 5th and 6th January, 2006.